

Appendix C – Ground Water Assessment

PROJECT

**GROUNDWATER ASSESSMENT
TWEED SAND PLANT EXPANSION
CUDGEN, NEW SOUTH WALES**

PREPARED FOR

HANSON CONSTRUCTION MATERIALS PTY LTD

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SYNOPSIS This report describes the methodology and results of a Groundwater Assessment undertaken for the proposed expansion of the Hanson Construction Material's Tweed Sand Plant located in Cudgen, New South Wales. This report was prepared to satisfy the relevant aspects of the Secretary's Environmental Assessment Requirements (SEAR) issued for the Project in December 2019.

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SUMMARY

Hanson Construction Materials Pty Ltd (Hanson) commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare a Groundwater Assessment (GWA) for the proposed expansion of its Tweed Sand Plant (TSP) operation located in Cudgen, New South Wales.

This report was prepared to satisfy the relevant aspects of the Secretary's Environmental Assessment Requirements (SEARs) issued for the Project in December 2019.

Groundwater quality

An ongoing program of groundwater quality compliance monitoring has been undertaken at the TSP site since 2001, resulting in a comprehensive data set for the site. Building on the existing water quality monitoring program, a further eight rounds of groundwater monitoring were conducted across the proposed expansion area between March and October 2020, to establish baseline conditions and determine similarities and differences between the expansion area and current TSP site.

For the baseline monitoring program, samples were recovered from 15 groundwater monitoring bores within the current operations area at TSP, in addition to 12 groundwater monitoring bores throughout the expansion footprint to determine the existing groundwater conditions at the site.

To provide context for the current water quality performance of the TSP site, surface water results were also compared with a selection of relevant guidelines including the:

- Tweed River Water Quality Objectives,
- ANZECC Water Quality Guidelines and
- NHRMC Recreation Water Quality Guidelines for primary contact recreation.

Results obtained for shallow groundwater within the existing and proposed site area demonstrate long-term median values generally comply with the Tweed River Water Quality Objectives, ANZECC Water Quality Guidelines and NHRMC Recreation Water Quality Guidelines for primary contact recreation. The exceptions to this are:

- Iron, which currently exceeds the performance criteria at a small number of monitoring locations; and
- Nutrients (total nitrogen, total phosphorous), with recorded exceedances of performance criteria within the expansion area groundwaters.

Results obtained for deep groundwater within the TSP site also demonstrate median values that generally comply with the Tweed River Water Quality Objectives, ANZECC Water Quality Guidelines and NHRMC Recreation Water Quality Guidelines for primary contact recreation, with the exceptions being:

- Ammonia, with recorded exceedances of performance criteria; and
- Nutrients (total nitrogen, total phosphorous), with recorded exceedances of performance criteria within the expansion area groundwaters.

Groundwater licencing requirements

The existing TSP and proposed expansion area are located within the Tweed Brunswick Coastal Sands (TBCS) of the Tweed Coastal Sands Groundwater Management Area (GMA). Environmental water is accessed via licensed entitlements through the North Coast Coastal Sands Groundwater Source Water Sharing Plan (WSP).

TSP currently holds an allocation of 109ML/yr in the TBCS source for groundwater interference/take commensurate with the scale of its existing operation. Expansion of the operation and the proposed increase in extraction rate will necessitate an application for an additional Water Access Licence and volumetric share within the TBCS of approximately 340 ML. As TSP currently holds an allocation of 109ML, a further 231 ML would need to be purchased and licenced for use should the expansion proposal be approved.

Groundwater modelling

Given the nature of the site soils and groundwater characteristics observed to date, the most likely potential impacts on groundwater as a result of the development are:

- Localised and minor changes to pre-development groundwater flow regimes in the vicinity of the lake that will be largely contained within the development footprint.
- Changes to groundwater elevation as a result of the proposed expansion. These are predominantly contained within the

development footprint, occurring within the northern and southern sections of the extraction footprint (Lot 51 on DP1166990 and Lot 1 on DP1250570 respectively) as follows;

- There is a maximum 0.5 m lowering of the water table in the northern portion of the expansion area. The impact is predominantly contained within the expansion footprint, however a decrease in groundwater elevation of up to 0.3 m is predicted within a small portion of the lands outside the northern perimeter of Lot 51 on DP1166990.
- In the southern extent of the site the steady-state model indicates a maximum 1.0 m lowering of the groundwater table predominantly within the expansion footprint. This impact reduces to a maximum of 0.5 m of drawdown outside of the site boundary to the west of Lot 1 on DP1250570.
- Groundwater level changes resulting from the development are not predicted to cause impacts within proximity to any of the known registered bores.
- Impacts to GDE's are predicted to be minimal. A drawdown of up to 0.5 m is predicted to occur within a small portion of the Low Potential GDE, which is mapped on the southern boundary of the expansion footprint west of Lot 1 on DP1250570. Ground-truthing of the presence and extent of this GDE and consideration of its sensitivity to groundwater drawdown of this magnitude is provided in the JWA Ecological Assessment Report 2021.
- The model predicts that the groundwater level throughout the expansion area and throughout the model domain will increase by a minimum of 0.1 m up to a maximum of 1.0 m. As anticipated by TSC's Climate Change Policy, the predicted sea-level rise will exacerbate tidal inundation and impede the site's drainage leading to increased water-logging of soils.

Groundwater management

Groundwater will be managed in accordance with the measures prescribed in the Soil and Water Management Plan (Gilbert & Sutherland, 2021). This management plan outlines monitoring regimes and mitigation measures for the management of impacts to surface and groundwaters.

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12035-001	Existing Tweed Sand Plant Operation
12035-002	Proposed Tweed Sand Plant Expansion
Z19163-104	Concept Development Phasing
12035-003	Monitoring Locations
12035-101	NSW Wetlands (OEH)
12035-102	Coastal Wetlands SEPP (Coastal Management) 2018
12035-103	Groundwater Dependant Ecosystems
12035-502 to 12035-509	Potentiometric surfaces
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1 Introduction

Hanson Construction Materials Pty Ltd (Hanson) Tweed Sand Plant (TSP) operation, located off Altona Road in Cudgen, New South Wales, has a total extraction footprint of approximately 46 hectares (ha). Sand extraction has been undertaken at this location since 1983 with Hanson assuming operation of the site in 2007.

TSP operates under Development Application (DA) DA 152-6-2006 issued on 31 July 2006, as modified on 20 August 2018 (Notice of Modification MOD 1). The current MOD 1 approval remains valid until 1 July 2036 and authorises TSP to produce and transport from the site up to 500,000 tonnes of quarry products per financial year. Drawing 12035_001 shows the location of the TSP site.

To meet ongoing demand for sand, Hanson is proposing to expand its existing operations into lands to the north and west of the TSP site. The footprint of the expansion area is approximately 190 ha, giving a total combined footprint of 236 ha for the existing and future extraction areas.

1.1 Expansion proposal

The TSP site is level to gently inclined, exhibits elevations of less than five metres Australian Height Datum (<5 mAHD) and has a current extraction footprint of approximately 46 ha. The proposed expansion would see TSP's operations extend into some 190 ha of lands to the north and west of the existing TSP site.

The total sand resource within the expansion area is estimated to be around 30 to 35 million tonnes, extending to approximately 20 metres below ground level (mbgl). Overburden is limited to topsoils of around one metre thickness, while minimal interburden is present throughout the resource. Drawing 12035_002 shows the footprint of the proposed expansion area and existing TSP site with respect to neighbouring operations and roadways.

Consistent with current TSP operations, sand would be extracted using a dredge and pumped to an onshore wash plant, where the target sands

are separated from the finer clay and silt materials ('the fines') through a hydrocyclone. The separated fines would then be returned to the lake under controlled conditions to minimise potential environmental impacts associated with these materials.

Sand extraction rates would be market driven, but capped at an annual maximum limit of 950,000 tonnes with a proposed project life of some 30 years. As extraction proceeds, the site office, washplant, stockpiling area and weighbridge would be moved from their current locations on the site's eastern perimeter to the northern end of Lot 2 DP1192506. Drawing Z19163-104 is a conceptual overview of the progression of sand extraction throughout the proposed expansion area.

The nature and scale of the expansion classifies the proposal as a State Significant Development (SSD). In November 2019, a Scoping Study was completed for the project and submitted to the NSW Department of Planning, Industry and Environment (DPIE) for its consideration and subsequent issue of site-specific Secretary's Environmental Assessment Requirements (SEARs). These SEARs were issued on 17 December 2019 and form the basis of the Tweed Sand Plant Expansion (SSD – 10398) Environmental Impact Study (EIS), of which this report is a part.

1.2 Scope of this report

Twelve groundwater monitoring bores have been assessed throughout the proposed expansion area, in addition to the extensive historical groundwater dataset for the existing TSP site. Monitoring bore locations throughout the proposed expansion area have been selected in order to best characterise groundwater conditions throughout the project area, as well as capture seasonal and environmental variation.

This report draws on the extensive historical dataset and water quality assessments conducted for the existing TSP operations area, which have characterised the water quality on site since 2001 along with the baseline groundwater monitoring program completed within the proposed expansion area in 2020 to respond to the SEARs relevant to the groundwater environment.

The groundwater investigation requirements detailed in the SEARS are reproduced below in Table 1.2.1. For ease of reference, this table also cites where each requirement is addressed in this report. Where SEARs requirements overlap between disciplines, a specific issue may be addressed under separate cover (as indicated in the table). As the issues which relate to surface and groundwater are highly interlinked, this report

should be read in conjunction with the Gilbert & Sutherland (2021) Surface Water Assessment, Tweed Sand Plant Expansion, Cudgen, New South Wales and the Burchills Engineering (2021), Flood and Stormwater Assessment.

In some instances, the SEARs were found not to be relevant to this Project. Where this occurs it has been noted in the Table.

Table 1.2.1 - SEARs relevant to this Groundwater Assessment

Department/Agency	Secretary's Environmental Assessment Requirements	Section
Planning Secretary's Environmental Assessment Requirements	Key Issues • Water – including: - a detailed site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply infrastructure and water storage structures; - identification of any licensing requirements or other approvals under the Water Act 1912 and/or Water Management Act 2000; - demonstration that water for the construction and operation of the development can be obtained from an appropriately authorised and reliable supply in accordance with the operating rules of any relevant Water Sharing Plan (WSP); - a description of the measures proposed to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo; - a detailed assessment of potential flooding impacts; - an assessment of the likely impacts on the quality and quantity of existing surface and ground water resources, including a detailed assessment of proposed water discharge quantities and quality against receiving water quality and flow objectives, and paying particular attention to potential flood-related nutrient transfers, including algal blooms; - an assessment of proposed interactions with groundwater, and the likely impacts of the development on aquifers, watercourses, riparian land, water-related infrastructure, and other water users; and - a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate and manage surface and groundwater impacts;	- Surface Water Assessment (G&S 2021) - Sections 3.2 4.4 and Appendix 8. - Section 4.4 and Appendix 8 - Section 4.4 - Flood and Stormwater Assessment (Burchills, 2021) - Section 5 and the Surface Water Assessment (G&S 2021) -This report - Soil and Water Management Plan (G&S 2021)
DPIE – Biodiversity and Conservation Division	Attachment A 9. The EIS must map the following features relevant to water and soils including:	

Department/Agency	Secretary's Environmental Assessment Requirements	Section
	a) Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map) b) Rivers, streams, wetlands, estuaries (as described in s4.2 of the Biodiversity Assessment Method) c) Wetlands as described in s4.2 of the Biodiversity Assessment Method d) Groundwater e) Groundwater dependant ecosystems f) Proposed intake and discharge locations	a) Acid sulfate soils assessment (G&S 2021)
	b) to f) Drawings 12035 101, 102 and 103, the Ecological Assessment (JWA 2021) and Flood and Stormwater Assessment (Burchills, 2021)	
	10. The EIS must describe background conditions for any water resource likely to be affected by the development, including: a) Existing surface and groundwater b) Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations c) Water Quality Objectives (as endorsed by the NSW Government) incl. groundwater as appropriate that represent the community's uses and values for the receiving waters d) Indicators and trigger values/criteria for the environmental values identified at c in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government. e) Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions	a) Sections 4 and 5 and the Surface Water Assessment (G&S 2021) b) Surface Water Assessment (G&S 2021) and Flood and Stormwater Assessment (Burchills, 2021) c) Section 5.4 d) Section 5.4 e) Section 1.5
	11. The EIS must assess the impacts of the development on water quality, including: a) The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the development protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the WQO over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction. b) Identification of proposed monitoring of water quality including how the waterbodies will be managed and water quality will be maintained post quarrying.	a) Section 5 the Surface water Assessment (G&S, 2021) and the Soil and Water Management Plan (G&S, 2021) b) Section 5 and the Soil and Water management Plan (G&S, 2021)

Department/Agency	Secretary's Environmental Assessment Requirements	Section
	c) Consistency with any relevant certified Coastal Management Program (or Coastal Zone Management Plan). 12. The EIS must assess the impact of the development on hydrology, including: a) Water balance including quantity quality and source. b) Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas. c) Effects to downstream water-dependant fauna and flora including groundwater dependant ecosystems. d) Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches). e) Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water. f) Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options. g) Identification of proposed monitoring of hydrological attributes.	c) NA a) Surface Water Assessment (G&S 2021) b) Surface Water Assessment (G&S 2021) and Flood and Stormwater Assessment (Burchills, 2021) c) Sections 4 and 6. The Surface Water Assessment (G&S, 2021) and the Ecological Assessment (JWA 2021) d) Surface Water Assessment (G&S, 2021) and the Ecological Assessment (JWA 2021) e) Section 4.4 f) Soil and Water Management Plan (G&S, 2021) and the Flood and Stormwater Assessment (Burchills, 2021) g) Soil and Water Management Plan (G&S, 2021)
DPIE – Biodiversity and Conservation Division	Attachment B – Water and Soils 1. The description of existing and proposed end use water quality/hydrology in the EIS must be based on suitable data (meaning data collection may be required) and must include:	

Department/Agency	Secretary's Environmental Assessment Requirements	Section
	a) Water chemistry b) A description of receiving water processes, circulation and mixing characteristics and hydrodynamic regimes c) Lake or estuary flushing characteristics d) Sensitive ecosystems or species conservation values e) Specific human uses and values (fishing, proximity to recreation areas) f) A description of any impacts from existing industry or activities on water quality g) A description of the condition of the local catchment e.g. erosion, soils, vegetation cover. h) An outline of baseline groundwater information, including, for example, depth to water table, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment. 3. The proposed monitoring of water quality must be undertaken in accordance with the Approved Methods for the Sampling and Analysis of Water Pollutant in NSW 2004.	a) Section 5 b) and c) Surface Water Assessment (G&S 2021) and the Flood and Stormwater Assessment (Burchills, 2021) d) Ecological Assessment (JWA 2021) e) Social Impact Assessment (2021) f) Section 5.3 and the Surface Water Assessment (G&S 2021) g) Section 2 h) Sections 4.3, Section 5 3. Section 3.3.
Dept. of Primary Industries (DPI)	Surface and groundwater protected; • Proposed development design, operation and by-product management should be undertaken to avoid nutrient and sediment build up and minimise erosion, off site surface water movement and groundwater accession. • The proposal should detail how design and operation will be undertaken for by-product management in accordance with best practice to prevent excess build-up of nutrients and salts in the soil profile and increase the risk of leaching. A monitoring program should be developed.	Soil and Water Management Plan (G&S 2021)
EPA	Attachment A B – The proposal: 2. Water • Provide details of the project that are essential for predicting and assessing impacts to waters including: a) The quantity and physio-chemical properties of all potential water pollutants and the risks they pose to the environment and human health, including the risks they pose to Water Quality Objectives in the ambient waters (technical criteria from the ANZECC guidelines for Fresh and Marine Water Quality, 2000) b) The management of discharges with potential for water impacts	a) Section 5 b) Soil and Water Management Plan (G&S 2021);

Department/Agency	Secretary's Environmental Assessment Requirements	Section
	c) Drainage works and associated infrastructure; land-forming and excavations; working capacity of structures; and water resource requirements of the proposal <u>E - The Environmental Issues</u> 4. Water Describe baseline conditions - Describe existing surface and groundwater quality – an assessment needs to be undertaken for any water resource likely to be affected by the proposal and for all conditions (e.g. a wet weather sampling program is needed if runoff events may cause impacts) - State the indicators and associated trigger values or criteria for the identified environmental values (ANZECC 2000 Guidelines for Fresh and Marine Water Quality). State any locally significant objectives, criteria or targets, which have been endorsed by the government - Where site specific studies are proposed to revise the trigger values supporting the ambient Water Quality and River Flow Objectives, and the results are to be used for regulatory purposes, then prior agreement from the EPA on the approach must be obtained. - Describe the state of the receiving waters and relate this to the relevant Water Quality and River Flow Objectives (i.e. which objectives are being achieved). Proponents are generally only expected to source available data and information. However, proponents of large or high risk developments may be required to collect some ambient water quality/river flow/groundwater data to enable a suitable level of impact assessment. Issues to include in the description of the receiving waters could include: a) Lake or estuary flushing characteristics b) Specific human uses c) Sensitive ecosystems or species conservation values d) A description of the condition of the local catchment e.g. erosion levels, soils, vegetation cover, etc e) An outline of baseline groundwater information, including, but not restricted to, depth to water table, flow direction and gradient, groundwater quality, reliance on groundwater by surrounding users and by the environment.	c) Section 4.4 and the Flood and Stormwater Assessment (Burchills, 2021) - Section 5 and the Surface Water Assessment (G&S, 2021) -Sections 5.3 and 5.4 Surface Water Assessment (G&S, 2021) - Section 5.4 and the Surface Water Assessment (G&S, 2021) a) Flood and Stormwater Assessment (Burchills 2021) and Surface Water Assessment (G&S 2021) b) Social Impact Assessment (2021) c) Ecological Assessment (JWA 2021) d) Section 2 e) Sections 4.3 and 5

Department/Agency	Secretary's Environmental Assessment Requirements	Section
	Assess impacts - Identify potential impacts on quality or quantity of groundwater describing their source Describe management and mitigation measures A soil and water management plan should be developed which outlines all management and mitigation measures relating to stormwater management and erosion control. The Soil and Water Management Plan should: - Describe groundwater impact mitigation measures including: - Site selection - Retention of native vegetation and revegetation - Artificial recharge - Providing surface storages with impervious linings - Monitoring program	- Sections 5, 6 and the Soil and Water Management Plan (G&S 2021) - Soil and Water management Plan (G&S 2021)
Tweed Shire Council	Impact on groundwater The proposal has the potential to result in detrimental impact on water quality discharged from the site, groundwater conditions and onsite dredge pond water management issues. Appropriate groundwater investigations should be undertaken, appropriate water quality parameters imposed and water and soil plans of management and monitoring should be developed.	- This Groundwater Assessment and the Soil and Water Management Plan (G&S 2021)
DPIE – Water and NRAR	- The identification of an adequate and secure water supply for the life of the project. This includes confirmation that water can be sourced from an appropriately authorised and reliable supply. This is also to include an assessment of the current market depth where water entitlement is required to be purchased. - A detailed and consolidated site water balance. - Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts. - Proposed surface and groundwater monitoring activities and methodologies. - Consideration of relevant legislation, policies and guidelines, including the NSW Aquifer Interference Policy (2012), the Guidelines for Controlled Activities on Waterfront Land (2018) and the relevant Water Sharing Plans (available at https://www.industry.nsw.gov.au/water).	-Section 4.3 - Surface Water Assessment (G&S 2021) - This report and the Surface Water Assessment Report (G&S 2021) - Soil and Water Management Plan (G&S 2021) - Sections 3.1.1 and 4.1

1.3 Objectives

To address the SEARs with respect to groundwater, Hanson commissioned Gilbert & Sutherland (G&S) to undertake a groundwater assessment within the proposed expansion area,

building on the robust historical dataset for the existing site. The investigation and analysis described in this report aims to adequately assess the groundwater characteristics within the network of monitoring bores throughout the existing and

proposed expansion area, quantify the water-related risks of the proposal and determine suitable management measures for the proposed expansion of TSP.

1.4 Relevant guidelines

Scoping, investigation and preparation of this SWA considered the following guidelines and documents:

- NSW Government Water Quality and River Flow Objectives (EPA)
- ANZECC (2000) Guidelines for Fresh and Marine Water Quality
- National Health and Medical Research Council, 2008, Guidelines for Managing Risks in Recreational Water.
- Approved Methods for the Sampling and Analysis of Water Pollutant in NSW 2004.
- NSW State Groundwater Policy Framework Document
- NSW State Groundwater Quality Protection Policy
- NSW State Groundwater Quantity Management Policy
- NSW Aquifer Interference Policy 2012
- Office of Water Guidelines for Controlled Activities (2012)
- Groundwater Monitoring and Modelling Plans – Information for prospective mining and petroleum exploration activities
- Australian Groundwater Modelling Guidelines 2012
- National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
- Guidelines for the Assessment and Management of Groundwater Contamination

1.5 Risk-based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning

This assessment and the associated management plan (Soil & Water Management Plan, G&S, 2020) have been prepared having considered the NSW Risk-based Framework for

Considering Waterway Health Outcomes in Strategic Land-use Planning, ensuring:

- Consideration of the Environmental Values of the Tweed Catchment;
- Identification of the environmental objectives of the Tweed River catchment when setting benchmarks for design and practice;
- Protection of environmentally significant areas;
- Development of management strategies which minimize impacts of the development to the environment and ensure the highest possible environmental outcomes.

2 Site description

2.1 Property description and zoning

The project site comprises eight allotments with a total site footprint of approximately 236 ha (including the existing TSP operation) as shown on Drawing 12035_002. Table 2.1.1 summarises the property description, lot size and land zoning under Tweed Shire Council's (TSC) Tweed Local Environmental Plan (LEP) 2014.

Table 2.1.1 Property description and land zoning*

Property description	Land zoning (LEP 2014)	Lot size (ha)
Lot 22 DP1082435	RU1 – Primary production	74.56
Lot 23 DP1077509	RU1 – Primary production	2.552
Lot 494 DP720450	RU1 – Primary production	0.1042
Lot 1 DP1250570	RU1 – Primary production RU2 – Rural landscape	90.00
Lot 2 DP1192506	RU1 – Primary production	11.12
Lot 3 DP1243752	RU1 – Primary production	1.612
Lot 51 DP1166990	RU1 – Primary production	55.13
Lot 50 DP1056966	RU1 – Primary production	1.094

*Source: NSW Planning Portal, 23 October 2020

2.2 Existing land uses

TSP is located within the Tweed Valley Floodplain and is surrounded by various land uses. Located immediately north of the site is TSC's wastewater treatment facility and open grazing lands. Further to the north lies the Pacific Motorway, the township of Chinderah and the Tweed River. To the north-east is Chinderah Golf Course and some residential properties fronting Tweed Coast Road.

Immediately to the east lies the Cudgen Lakes Sand Extraction. Further to the east is the townships of Cudgen and Kingscliff and the Pacific Ocean.

The Cudgen Plateau, located immediately south of the project site, is primarily used for agricultural purposes including cropping and orchards. The Cudgen residential area is located to the southeast and incorporates Cudgen Public School directly west of the residential area.

To the west of the site lies open grazing lands, the Australian Bay Lobster Producers Limited facilities and the Pacific Motorway.

2.3 Topography and local drainage

Local topographic mapping indicates that the elevation of the property is uniform, with an average relative level (RL) of 1.0 metres Australian Height Datum (mAHD). The site's slopes are described as level (<1%) to very gently inclined (1-3%).¹ The project site abuts the Cudgen Plateau to the south, where elevations rise steeply to approximately 38 mAHD.

The site is located within the Tweed Valley Floodplain. Most runoff from the site passively infiltrates through the highly permeable sandy soils. Any remaining runoff is currently diverted towards the on-site extraction areas, or conveyed to a network of agricultural drains.

During high intensity rainfall events, the site becomes inundated and peak discharges may potentially flow toward the agricultural drainage lines constructed along the northern and western property boundaries. These drains convey runoff from the surrounding agricultural properties through flood gates to the Tweed River.

2.4 Regional drainage

The project site is located within the lower reaches of the Tweed River Floodplain. The headwaters of the Tweed River begin near Kunghur, approximately 50 km southwest of

¹ McDonald R. C., Isbell R. F., Speight J. G., Walker J. & Hopkins M. S. Australian Soil and Land Survey Field Handbook. Second Edition 1990, Inkata Press Pty Ltd.

Chinderah and generally flow in a north-easterly direction. Numerous rivers, creeks and tributaries feed into the Tweed River, including the Oxley River approximately 5 km southwest of Murwillumbah, and the Rouse River west of Tumbulgum.

The Tweed River discharges into the Pacific Ocean at the Tweed River mouth, immediately east of Tweed Heads. The tidal influence of the Pacific Ocean extends just upstream of Murwillumbah (WBM, 2005).²

The floodplain is criss-crossed by a network of interconnecting agricultural drains and flood gates which convey water from the floodplain to the Tweed River. The main drain through the catchment ('the western drain', shown in blue on Figure 4.4) flows westwards from Tweed Coast Road parallel to Altona Drive. The drain then turns northwards adjacent to the TSP site before discharging into the Tweed River through culverts under the Pacific Highway and Chinderah Bay Drive. These culverts have flood gates installed on the River side, under Chinderah Bay Drive. Other minor drains run east-west and north-south across the floodplain and generally discharge into the western drain.

The floodplain is subject to inundation from both local catchment floods as well as Tweed River overbank floods.

2.5 Soil landscapes

Soil Landscapes within the project site are described in the DPIE's Soil Landscapes of Central and Eastern NSW dataset 2020.³

The expansion area is within the 'Tweed landscape' (9541tw). This landscape is described as an extensive marine plain of the lower Tweed catchment, consisting of deep Quaternary alluvium and estuarine sediments.

The marine plain has been created by the in-filling of a large estuary or embayment during the Pleistocene era. Marine clays and muds have dominated these fill materials. Since this period of aggradation, the Tweed River has been creating a covered plain consisting of terrestrial sediments.

The eastern extents of the TSP site are mapped as a 'Tweed landscape variant b' (9541twb) (DPIE, 2020).⁴ This landscape is described as consisting of deep Quaternary alluvium and estuarine sediments with landscape variant 'twb', described as Pleistocene sands overlain by alluvial soil material.

The project site lies within the Cudgen 1:25 000 Acid Sulfate Soil Planning Map (DLWC 1997). This mapping indicates that there is a high probability of ASS material being encountered within 1 m to 3 m of the ground surface.

2.6 Geology

A review of the 1:250,000 Geological Series SH56-3 (Tweed Heads) indicates that the site geology is comprised of Quaternary sedimentary deposits of river gravel, alluvium, sand and clay.

A hydrogeological investigation at the eastern neighbouring property described the regional bedrock as interbedded argillite and metagreywacke of the Neranleigh-Fernvale Beds of lower Palaeozoic age. The materials overlying this stratum were described as Quaternary organic clays, which were in turn overlain by Quaternary sands.⁵

The quaternary sands were described as poorly graded medium to fine grained quartzose sands with some coarse grains. These materials had a relatively uniform thickness of around 21 m across the site. The depositional environment for the Quaternary sands was identified as deltaic, with the presence of shell and organic fragments

² Flood Impact Assessment for the Proposed Sand Quarry Expansion at Crescent Street, Cudgen, WBM Oceanics Australia, 13 June 2005.

³ Department of Planning, Industry and Environment, 2020, Soil Landscapes of Central and Eastern NSW - v2.1, NSW Office of Environment and Heritage, Sydney.

⁴ Ibid, 2020.

⁵ Coffey Geosciences (1999). Cudgen Sand Extraction – Hydrogeological Assessment and Installation of Monitoring Bores.

throughout the sequence, indicative of alternating marine and terrestrial influence.⁶

2.7 Vegetation

The TSP site and proposed expansion area is characterised by open grazing lands which have been largely cleared of native vegetation. Within the TSP site an area of approximately 20 ha is currently cultivated under tea tree.

The agricultural drains that traverse the site contain some native vegetation, which is described in detail under separate cover.

⁶ Coffey and Partners (1985 - 1986). Geotechnical investigation for proposed extractive industry on Lot 2 DPG11021 and DP216705.

3 Methodology

This section describes the methodology employed by G&S in undertaking this Groundwater Assessment to satisfy the SEARs.

3.1 Desktop assessment

A desktop assessment was undertaken to investigate the groundwater matters relevant for the Project. The following subsections detail the scope of the desktop assessment.

3.1.1 Environmental planning instruments

This assessment has been prepared with reference to the relevant environmental planning instruments⁷ for NSW including:

- Tweed Local Environmental Plan (LEP) 2014.
- State Environmental Planning Policy (Mining, Petroleum and Extractive Industries) 2007.
- State Environmental Planning Policy (State and Regional Development) 2011.
- State Environmental Planning Policy (Infrastructure) 2007.

The relevance of the various LEP's and SEPPs to the proposed expansion is discussed by others under separate cover. Of particular relevance to this groundwater assessment is the NSW Aquifer Interference Policy⁸ which defines the processes for the licensing and assessment of aquifer interference activities in NSW, providing considerations and advice regarding activities with the potential to impact water-dependent assets.

This policy has been developed particularly to address extractive industry activities such as sand extraction. TSP have considered the requirements outlined in this policy, taking a risk-management approach to assess the resultant potential impacts of these works, in particular:

- Baseline groundwater conditions including groundwater depth, quality and flow;
- A strategy for complying with the rules of the North Coast Coastal Sands Water Sharing Plan;
- Potential impacts to water level, quality and drawdown on nearby water users;

- Potential impacts to water level, quality and drawdown on GDE;
- Potential for contamination to aquifers and connected river systems;
- Potential for enhanced hydraulic connectivity between aquifers.

The requirements of this Policy are addressed directly and indirectly throughout Section 4 of this report.

3.1.2 Online mapping and data

Various online resources and mapping tools were used to identify aquifers and groundwater dependant ecosystems within the site locale.

These sources included:

- NSW Environmental data;
- Environment Protection and Biodiversity Conservation (EPBC) Environmental Matters reporting tool;
- The Department of Agriculture, Water and the Environment's Protected Matters Search Tool;
- The Bureau of Meteorology 'Potential Groundwater Dependent Ecosystems Atlas'.

Relevant features from these sources were then compiled and a series of site specific Drawings created to depict water and groundwater features present in the site and surrounds.

3.1.3 Review of environmental values

Various sources were reviewed to determine the environmental values relevant to the TSP site and proposed expansion area. A description of these environmental values can be found in Section 4.2.

3.2 Groundwater licensing requirements

Licensing requirements, relevant Water Sharing Plans (WSP) and their operating rules were reviewed for their applicability to the Project and to determine the relevant licencing and approvals requirements. Section 4.3 and Appendix 8 describe the existing licenses held for the TSP and any requirements for amended or additional licenses for the proposed expansion.

⁷ NSW Legislation. <https://www.legislation.nsw.gov.au/>

⁸ NSW Aquifer Interference Policy. DPI – NSW Office of Water, September 2012.

3.3 Groundwater monitoring

3.3.1 TSP ongoing monitoring program

A program of groundwater quality compliance monitoring has been ongoing at the TSP site since 2001. This program includes sampling at fifteen groundwater monitoring locations within the site bounds for insitu analysis of pH, DO, temperature, turbidity, ORP and EC using calibrated field instruments. Samples are also collected from each location and delivered to a NATA accredited laboratory for analysis for concentrations of sodium (Na), potassium (K), magnesium (Mg), chloride (Cl), sulfate (SO₄), bicarbonate alkalinity (CaCO₃), dissolved iron (Fe), dissolved aluminium (Al), arsenic, ammonium (NH₄), faecal coliforms and enterococci.

Groundwater monitoring locations are shown on Drawing No. 12035-003. A description of each bore location and its approximate depth below Near Surface Level (NSL) is given below:

- MB1B – North west corner of the Phase 2 extraction area (12 m below NSL)
- MB2A – South west corner of the Phase 2 extraction area (total depth 20 m below NSL)
- MB2B – South west corner of the Phase 2 extraction area (total depth 5 m below NSL)
- MB3 – South west corner of the Phase 1 extraction area (total depth 7 m below NSL)
- MB4 – Mid way along the southern boundary of the Phase 1 extraction area (total depth 7 m below NSL)
- MB5A – North eastern corner of the Phase 1 extraction area, near wash plant (total depth 20 m below NSL)
- MB5B – North eastern corner of the Phase 1 extraction area along the eastern boundary of the site (total depth 5 m below NSL)
- MB7 – Midway along the eastern boundary of the site on the adjacent property (total depth 6 m below NSL)
- MB8A – South west corner of the site (bore depth 6 m below NSL)
- MB8B – South west corner of the site (bore depth 19 m below NSL)
- MB9A – Midway along western boundary of the site (bore depth 6 m below NSL)

- MB9B – (Now damaged and/or destroyed) – located midway along western boundary of the site (bore depth 19 m below NSL)
- MB10A – North west corner of the site (bore depth 6 m below NSL)
- MB10B – North west corner of the site (bore depth 19 m below NSL)
- MB11A – North east corner of the site (bore depth 6 m below NSL)
- MB11B – North east corner of the site (bore depth 19 m below NSL)
- MB12A – (Now damaged and/or destroyed) - previously located midway along Phase 1 excavation area western boundary (bore depth 6 m below NSL)
- MB12B – (Now damaged) - previously located midway along western boundary of Phase 1 excavation area (bore depth 19 m below NSL).

The results of ongoing monitoring at TSP are reported to the relevant local and state government authorities in a detailed Annual Review submitted in September each year.

3.3.2 Expansion area monitoring program

Building on the existing water quality monitoring program a further 8 rounds of groundwater monitoring was conducted across the TSP proposed expansion area between March and October 2020, to establish background conditions. Monitoring was undertaken for the same suite of parameters described above for the compliance monitoring program.

A total of six groundwater monitoring locations were selected for this monitoring program, at sites with adequate spatial distribution to provide an understanding of groundwater gradients, flow directions, recharge processes, water quality and levels within each hydrogeological unit within the project area. Two monitoring bores of different depths (shallow and deep aquifers) were installed at each location, resulting in a total of twelve bores throughout the expansion area. These monitoring locations are identified on Drawing 12035-003. Monitoring bores were surveyed on 29 September 2020 and are described in the following tables 3.3.2.1 and 3.3.2.2.

The piezometers were installed by Pacific Geotechnical in accordance with the Minimum Construction Requirements for Water Bores in Australia⁹. Well screens, risers and end caps were constructed using factory constructed class 18 high pressure polyvinyl chloride (PVC) and secured by thread joints. The inside diameter of each well was 50mm to allow for development and sample collection.

The well pack surrounding the well screens consisted of washed, inert, coarse river sand. Caps were vented to allow for proper pressure equalisation. A filter sock was placed over the screened section of the wells. A permanent mark was made at the top of the monument (TOM) to provide a datum for subsequent water level measurements.

Bentonite pellets were placed above the sand pack at a thickness of at least 200mm and hydrated for at least 3hrs and allowed to swell. Steel box monuments (100x100mm) and a grouting of cement (200mm) were installed to protect the PVC pipe. The well-head stickup (from NSL) was generally 750mm in length.

Drilling logs of soil strata were recorded during construction of all monitoring bores, to record bore depths, construction method, soil strata and aquifer characteristics on site. Borelogs for each location are contained in Appendix 2.

Table 3.3.2.1 Shallow groundwater monitoring bore survey and depth details

Borehole	Easting	Northing	Ground mAHD	Total depth (mbgl)
MB13B	552742.04	6873904.64	0.99	6
MB14B	552709.52	6872597.55	0.96	6
MB15B	551808.92	6873425.47	0.65	6
MB16B	552131.84	6874378.74	1.10	6
MB17B	552302.42	6874904.13	1.08	6
MB18B	552978.27	6874673.15	0.88	6

Table 3.3.2.2 Deep groundwater monitoring bore survey and depth details

Borehole	Easting	Northing	Ground mAHD	Total depth (mbgl)
MB13A	552740.07	6873905.19	1.10	20
MB14A	552711.53	6872597.36	1.04	20
MB15A	551808.90	6873422.44	0.64	20
MB16A	552130.24	6874378.67	1.11	20
MB17A	552301.08	6874902.89	1.17	20
MB18A	552979.83	6874672.57	0.88	21.5

3.3.3 Preparation of potentiometric surfaces

Groundwater flow directions and levels are assessed through the preparation of monthly potentiometric surface drawings (Appendix 4). These surfaces are prepared using groundwater levels data collected on a monthly basis by TSP staff for monitoring locations within the current operations area, and G&S staff throughout the expansion footprint. The data is converted to metres AHD and plotted to depict the groundwater contours across the site.

3.4 Water quality analysis

Water quality data obtained from the various monitoring programs described above was collated to form a comprehensive water quality data set for the TSP site and expansion area.

Analysis of the data set was then undertaken to characterise and describe the existing groundwater conditions of the Project area and inform the various modelling exercises described herein. The data was then compared to relevant water quality guidelines as described in the following sections.

3.4.1 ANZECC Guidelines

Establishing water quality guidelines inform the planning and management of water quality within site groundwaters, while setting the path to achieving strong local environmental outcomes in the future.

⁹ Minimum Construction Requirements for Water Bores in Australia, Edition 2 (2003). Land and Water Biodiversity Committee.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)¹⁰ (the 'ANZECC Guidelines') provide water quality objectives for natural and semi-natural water resources. The Guidelines are based on the principles of Ecologically Sustainable Development (ESD) and provide guidance for the protection of existing and future environmental values for relevant water bodies.

Groundwaters assessed as part of this investigation are influenced by the site's location, geology, and variety of nearby land-uses. The ANZECC 2000 Guidelines recommend establishing water quality criteria in the unique context of the site, taking into account the local environmental conditions. For sites that have been subject to historical disturbance and where existing site water quality does not meet the ANZECC Guideline values, the document provides a methodology for determining site-specific water quality criteria.

Table 3.4.1.1 provides a sub-set of available trigger values from the ANZECC Guideline relevant to the site's monitoring suite.

Table 3.4.1.1 ANZECC water quality trigger values for freshwater 95% species protection

Parameter	ANZECC Guideline water quality criteria
pH	6.5-8
Turbidity	<50 mg/L
Dissolved Oxygen	>6 mg/L
Chlorophyll-a	<5 µg/L
Total Nitrogen	<0.5 mg/L
Nitrite+Nitrate NOx	<0.02 mg/L
Nitrate	<0.7 mg/L
Total Phosphorus	<0.05 mg/L
Aluminium	<0.055 mg/L
Arsenic	<0.024 mg/L

3.4.2 Tweed River Water Quality Objectives

The Tweed River Water Quality Objectives¹¹ were developed for NSW rivers and estuaries to

provide guideline levels to assist water quality planning and management. The Tweed River water quality criteria comprise community-based environmental values and their associated national criteria drawn from the ANZECC Guidelines. For waterways affected by urban development, the criteria are aimed at the protection of aquatic ecosystems, maintaining visual amenity and supporting secondary and/or primary contact recreation.

The Tweed River water quality objectives select relevant water quality indicators and related numerical criteria (default trigger values) from the ANZECC Guidelines 2000, relevant to assessing and monitoring the health of aquatic ecosystems. These criteria, as they originated from the ANZECC Guideline water quality criteria, are applicable to both surface water and groundwater.

Tweed River Water Quality Objectives¹² represent the water quality criteria for surface waters for the Tweed River catchment. Key indicators and their associated criteria are reproduced in Table 3.4.2.1.

Table 3.4.2.1 Tweed River Water Quality Objectives for the Tweed River catchment (Aquatic ecosystems - Lakes & reservoirs)

Parameter	Interim criteria
pH	6.5-8.0
Dissolved oxygen	80 – 110% saturation
Turbidity	1-20 NTU
Chlorophyll-a	<5 µg/L
Total Nitrogen	<0.35 mg/L
Total Phosphorus	<0.01 mg/L

3.4.3 NHRMC Recreational water guidelines

The National Health and Medical Research Council, 2008, Guidelines for Managing Risks in Recreational Water (the 'NHRMC Guidelines') were developed to protect human health from threats posed by the recreational use of coastal, estuarine and fresh waters, such as natural and artificial hazards. These Guidelines bring together much of the international consensus on healthy

¹⁰ Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, 2000

¹¹ Published online at:
<https://www.environment.nsw.gov.au/ieo/Tweed/report-02.htm>

¹² Published online at:
<https://www.environment.nsw.gov.au/ieo/Tweed/report-02.htm>

recreational water use with the current understanding of Australian waters and provide guidance relevant to local conditions. The NHRMC Guidelines supersede previous recreational water quality guidance, such as the ANZECC & ARMCANZ (2000) guidelines and the NHMRC (1990) Australian Guidelines for Recreational Use of Water. The relevant values are summarised in Table 3.4.3.2 below.

Table 3.4.3.2 – NHRMC Recreational water quality guidelines

Indicator	Guideline value
Temperature	16 - 34°C
Microbial quality	Preventive risk management practices should be adopted to ensure that designated recreational waters are protected against direct contamination by fresh faecal material, particularly of human or domesticated animal origin.
Cyanobacteria	Fresh recreational water bodies should not contain: • >10 µg/L total microcystins; >50 000 cells/mL toxic <i>Microcystis aeruginosa</i>; or biovolume equivalent • >4 mm³/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume;
pH	6.5 – 8.5 (A wider pH range of 5–9 is acceptable for water with a very low buffering capacity.)
Dissolved Oxygen	>80% saturation

3.5 Determining site-specific water quality criteria

Surface and groundwater quality has been monitored at the site since 2001. Analysis of this data (as described in this report) indicated that in

some instances the existing site water quality does not meet the ANZECC or TSC water quality criteria.

The ANZECC Guidelines recommend that for some water quality indicators, site-specific water quality criteria be derived and used instead of regional default guideline values (DGVs). The general approach recommended for deriving guideline values is as follows;

1. Determine the existing ecosystem condition and required level of protection.
2. Define the baseline or 'reference' condition for the site ideally based on appropriate site-specific data.
3. Depending on existing ecosystem condition and required level of protection, define trigger values choosing either a conservative percentile value (e.g. 80th percentile value) to improve water quality, or a less conservative percentile (e.g. 90th percentile) to maintain water quality.

The ANZECC Guideline recommends that a reference condition be defined to provide an appropriate management target and meaningful comparison for use in monitoring and assessment.

The robust historic dataset available for the TSP site allows for valid calculation of site-specific trigger values in instances where existing water quality does not align with the DGVs.

Site-specific trigger values, calculated in accordance with the ANZECC methodology are described in Section 4.6.

3.6 Groundwater modelling

Groundwater modelling was undertaken using MODFLOW (McDonald and Harbaugh, 1988) the United States Geological Survey (USGS) three-dimensional finite-difference groundwater flow model.

MODFLOW is a modular groundwater resources package with components for predicting subsurface flow and simulating the effects of wells, rivers, drains, head-dependent boundaries, recharge and evapotranspiration. The data

requirements of the constructed model are described in the following sections. For the purposes of this assessment a steady-state groundwater model was developed.

3.6.1 Model domain

The model grid was orientated at azimuth 0° in a northern alignment, comprising 271 columns over 5420m by 216 rows over 4,320m with a total of 58,536 cells within the domain. In plan-view, the grids comprised uniform cells of 20m x 20m.

The active model grid domain encompassed the Quaternary sands bounded to the north by the Tweed River and the residual soils and rock of the lamington volcanics to the south.

The thickness of the cells was defined by the topography based on the digital terrain model (forming the top of the cells) whilst the on-site drilling program was used to define the thickness of the quaternary sands. To maintain simplicity in the model the quaternary clays underlying the sands were set at a basement of -30mAHD. Table 3.6.1.1 details the range of depths used in the model.

Table 3.6.1.1 – Depth of modelled stratigraphy

Depth	Stratigraphic Medium
6.5m AHD (top of layer) To -25m AHD (bottom of layer)	Quaternary Sands aeolian, alluvial and estuarine deposits (unconsolidated)
-3m AHD (top of layer) To -30.0m AHD (bottom of layer)	Quaternary clays Semi -consolidated alluvial deposits
85m AHD (top of layer) To -30.0m AHD (bottom of layer)	Lamington Volcanics

3.6.2 Topography

The surface grid was interpolated from 1m Lidar (Tweed Heads 2013-09-18 1 metre Digital Elevation Model) sourced from Spatial Services, a unit of the NSW Department Finance, Services and Innovation.

3.6.3 Stratigraphy

The model requires the input of stratigraphic (layer) data together with the hydrogeological properties of the layer(s). This information was obtained from the drilling program undertaken primarily for the acid sulfate soil investigation¹³ undertaken for the TSP expansion proposal.

To maintain simplicity within the steady-state model two layers were used to define the stratigraphy of interest being the quaternary sands overlying quaternary clays in the floodplain. A third formation was added for the ridges to the south which form the Cudgen Plateau comprised of soils and rocks of the lamington volcanics.

3.6.4 Boundary conditions

The Tweed River was used as a constant-head boundary and forms the northern extent of the model. The boundary was set at 0.1m AHD based on a review of tidal information.¹⁴ To the east of the site local drainage features were also defined as constant head boundaries of 0.1m AHD. A no-flow boundary was set at the catchment divide formed by the lamington volcanics to the south of the TSP site.

Drainage cells were used in the model to represent local drainage features in the form of agricultural drains. The elevation of the drains were set between 0.1 mAHD and 0.4 mAHD which represents the current drainage regime. To represent runoff within the model, drainage cells were draped across the remainder of the model domain at the elevation of the current ground surface (i.e. the topography). The exception is the dredge lakes in which drainage cells were set at 0.3 mAHD to approximate the long-term lake level as measured on site.

3.6.5 Recharge and evaporation

For this exercise, groundwater recharge was reduced to account for losses from evaporation.

Initially, groundwater recharge was derived for the quaternary sands using a chloride balance model known as Cook's Method as described in

¹³ Gilbert & Sutherland, 2020. Acid Sulfate Soil Assessment, Tweed Sand Plant Expansion, Cudgen, New South Wales.

¹⁴ NSW Government, Public Works Manly Hydraulics Laboratory, October 2012. OEH NSW Tidal Planes Analysis, 1990 – 2010 Harmonic Analysis, Report MHL2053.

Appendix 6. An initial recharge of 330 mm/year was applied which increased to 660 mm/year following calibration of the model to the measured groundwater conditions.

The lamington volcanics were assumed to have a recharge of 150 mm/year and the waterbodies (dredge lakes) assumed to have a recharge of 100 mm/year being the approximate difference between annual rainfall and evaporation).

3.6.6 Hydraulic characteristics

The aim of assigning aquifer parameters to the model is to ensure the simplest representation of the actual regime.

Table 3.6.6.1 shows the adopted porosity, specific yield and permeabilities.

Table 3.6.6.1 Porosity and yield ranges used for calibration and modelling

Sequence	Porosity	Specific yield	Permeability (m/d)
Quaternary sands	0.3	20%	Kx – 9 Ky – 9 Kz – 1
Quaternary clays	0.01	1%	Kx – 1×10^{-6} Ky – 1×10^{-6} Kz – 1×10^{-6}
Lamington Volcanics	0.01	5%	Kx – 1 Ky – 1 Kz – 0.1
Dredge lake	1.0	100%	Kx – 10,000 Ky – 10,000 Kz – 10,000

3.6.7 Calibration

The model was calibrated under steady-state conditions to obtain an approximation of the site's groundwater regime as defined by groundwater level monitoring conducted throughout the expansion area and TSP site from March to October 2020.

3.6.8 Sensitivity

To further assess and quantify the inherent uncertainty in the model calibration process, a sensitivity analysis was undertaken. The aquifer

parameters were assessed using the WINPEST software to rank in order of greatest effect on calibrated model outcome.

3.6.9 Prediction

Following calibration and sensitivity analyses, the model was adjusted to represent the final formation of the site following completion of sand extraction throughout the existing TSP site and the proposed expansion area as depicted in Drawing Z19163-104.

To represent creation of the dredge lakes, the permeability of the cells within the lake boundaries was increased to 10,000 m/day in all directions to represent removal of the sand resource and creation of a waterbody. The recharge over the surface of the waterbody was adjusted to 100mm to represent the average annual difference between rainfall and evaporation.

The calibrated steady-state model for the existing (pre-expansion) conditions at the site were then used as the baseline condition upon which predictions of the impacts of the development could then be made.

3.6.10 Assessment of climate change

The TSC Climate Change Management Policy, version 1.0 adopts a sea level rise of 0.4m by 2050 and 0.9m by 2100 and anticipates an increase in the frequency and depth of tidal inundation of low lying lands and poor drainage in low lying areas.

The proposed expansion area is a low-lying coastal floodplain and is currently subject to tidal inflows from the Tweed River in parts of the site. To assess the possible changes to groundwater level as a result of sea-level rise the relevant hydraulic boundary conditions of the pre and post-extraction groundwater models were adjusted to reflect increased water levels. Specifically, the Tweed River level was adjusted upward by 0.9m to a level of 1.0m AHD to represent the anticipated rise by 2100. A comparison was then made between the existing site and the post-extraction site to explore the combined impact of sea-level rise and the presence of the extraction lake.

3.6.11 Model limitations

The groundwater model described in this report is limited by the constraints of the MODFLOW model itself (which are well known in the industry) as well as by the quality and availability of input data.

The model for this groundwater assessment is sound in that it is accurate within the limitations of the data and assumptions used in developing it

4 Desktop assessment findings

The results and findings of the various groundwater assessments undertaken to address the relevant SEAR's for the proposed expansion of Hanson's TSP operation are described in the following sections.

4.1 Online mapping and data

The subject site is located within the Tweed Valley flood plain, with the Tweed River located approximately 3 kilometres west of The Site.¹⁵

NSW Environmental Data, the Bureau of Meteorology's Groundwater Dependant Ecosystems Atlas and an EPBC Environmental Matters report were utilised to investigate the presence and characteristics of wetlands and groundwater dependant ecosystems (GDE) located nearby the proposed expansion footprint. G&S drawings 12035-101 and 12035-102 show the site in its regional context, and proximities to significant environmental features.

Groundwater dependant ecosystems are ecosystems with species composition and ecological processes determined largely by the availability of groundwater. GDE can be classified into three types of ecosystems. These are:

- Aquatic: ecosystems that rely on the expression of groundwater at the surface
- Terrestrial: ecosystems that rely on the presence of subsurface groundwater
- Subterranean: caves and aquifer ecosystems

A desktop assessment using the Bureau of Meteorology 'Potential Groundwater Dependant Ecosystems Atlas' determined the presence of one 'High potential' terrestrial GDE within the proposed project area based on a regional study providing a detailed analysis undertaken by various state and regional agencies. This GDE is

located on the northern perimeter of the proposed expansion area, (see Drawing 12035-501).

This terrestrial GDE is recorded as a Paperbark GDE, within the Richmond River Region. Its geomorphology is identified as Coastal Lowlands on weak sedimentary rocks, with littoral and alluvial plains.

The GDE falls partly within the designated footprint of the ultimate dredge lake and the nominated haulage route for site vehicles. As such it is likely that part of this GDE will be removed within years 23 to 26 of the progression of the development. Further consideration of this GDE and the implications of its removal are discussed under separate cover in the ecological assessment undertaken for the expansion proposal.¹⁶

While no wetlands are present within the development footprint, coastal wetlands identified by Coastal Management SEPP 2018 are located to the east of the site and identified in drawing 12035-102. These Coastal Wetlands have been identified as plant communities dominated by any of the following vegetation types:¹⁷

- mangroves
- salt marshes
- melaleuca forests
- casuarina forests
- sedgelands
- brackish and freshwater swamps - wet meadows.

The Department of Agriculture, Water and Environment's Protected Matters Search Tool identified Nationally Important Wetlands of the Cudgen Nature Reserve approximately 5km south east of the proposed development site.

4.2 Environmental values

The NSW Water Quality and River Flow Objectives for the Tweed River catchment describe the regions environmental values to be considered when developing plans and actions with the potential to affect water quality.

¹⁵ Flood and Stormwater Assessment, Burchills Engineering, October 2020.

¹⁶ JWA Ecological Consultants 2021.

¹⁷ Wetlands: State Environmental Planning Policy (Coastal Management) 2018

The environmental values for the Tweed River catchment – Estuaries, as they relate to the Water Quality Objectives, are as follows:

- Aquatic ecosystems
- Visual amenity
- Secondary contact recreation
- Aquatic foods (cooked) and commercial shellfish production.

To ensure the environmental values of the region and community as endorsed by the NSW Government for the Tweed River Catchment are protected, critical water quality parameters for surface waters within the proposed development site have been identified and evaluated in the context of the Tweed River Water Quality Objectives and the ANZECC 2000 Guidelines for Fresh and Marine Water Quality. Meeting the water quality objectives relevant to the site provides the basis for the successful protection of the remaining environmental values.

4.3 Existing groundwater users

A search was conducted using the Bureau of Meteorology's Australian Groundwater Explorer¹⁸ to determine the presence of groundwater bores/ existing groundwater users in close proximity to the TSP site. Drawing 12035-501 shows the location of the various registered bores with respect to the site and the registered classification of each.

Bores located within the boundary of the existing TSP site are largely monitoring bores installed and monitored by TSP. There are no groundwater bores currently registered within the footprint of the expansion area.

To the north of the existing TSP operation there are three bores located within the footprint of the Kingscliff Wastewater Treatment Plant and these are registered for the purposes of dewatering and monitoring.

To the immediate east of the existing TSP operation there is one bore registered for

Commercial and Industrial use for the adjacent Cudgen Lakes Sand extraction.

There are two registered bores to the west of the proposed expansion area located on the western side of the M1. These are registered as monitoring and Irrigation bores.

4.4 Licensing requirements

TSP currently operates under the Environmental Protection License 11453, which authorises sand extraction activities at the subject site. The EPL contains provisions that govern:

- The scale and nature of activities that are permitted on the subject site.
- Discharges to air, water and application to land.
- Limit conditions for pollution of waters, load limits and concentration limits.
- Monitoring and recording conditions.
- Reporting conditions.

An amended EPL would be required for the expansion of the TSP operations and would be the subject of consultation with the NSW EPA.

4.4.1 Groundwater licenses

The existing Tweed Sand Plant and proposed expansion area is located within the Tweed Brunswick Coastal Sands (TBCS) of the Tweed Coastal Sands Groundwater Management Area (GMA). Environmental water is accessed via licensed entitlements through the North Coast Coastal Sands Groundwater Source Water Sharing Plan (WSP).

The TBCS groundwater source encompasses the far North Coast of NSW, from Tweed Heads to the north and Suffolk Park to the south.

Groundwater is accessed primarily for domestic use via spear pump extraction. The TSP site and proposed development footprint are located within an area with groundwaters considered to be of high environmental value.

¹⁸ Australian Groundwater Explorer, Australian Government Bureau of Meteorology. 2000.
<http://www.bom.gov.au/water/groundwater/explorer/>

There are a number of water licences for the current TSP site. Table 4.4.1 identifies all current licenses, their associated activity and allocation.

Table 4.4.1 Groundwater licence particulars

License number	Approved works
WAL 38106	Approval number: 30WA319538 Water supply works Excavation – Groundwater Lot 22//1082435
WAL 38097	Approval number: 30CA319526 Water supply works, water use Excavation – Groundwater Lot 22//1082435
30BL207198	Monitoring bores (MB8a, MB8b, MB9a, MB9b, MB10a, MB10b, MB11a, MB11b)
30BL179685	Monitoring bores

Each groundwater licence contains provisions that license appropriate use, monitoring and management of groundwater resources at the site. Additional groundwater monitoring bores have been constructed throughout the expansion site. Advice from the Natural Resource Access Regulator states that these bores do not require a licence.¹⁹

4.4.2 Additional volumetric requirement

The North Coast Coastal Sands Groundwater Source Water Sharing Plan (WSP) sets an upper extraction limit in the Tweed-Brunswick Coastal Sands (TBCS) source at 21,750 ML/year²⁰, and indicates that at the time of publication of the WSP, the total current water requirements for this source were 713 ML/yr.²¹

The WSP provides consideration of future water requirements including sand mining developments which are common within this GMA. It states:

Based on the potential for significant development in the future, it is recommended

that a significant allocation for future sand mining developments is required. The future dewatering requirements for sand mining have been estimated by DPI Water licensing and hydrology staff based on local knowledge of current and future potential for sand mining along the north coast.

The WSP details the estimated future water requirements for sand mining operations in this GMA to be in the order of 5,000ML/yr.²²

TSP currently holds an allocation of 109ML/yr in the TBCS source for groundwater interference/ take commensurate with the scale of its existing operation. Expansion of the operation and the proposed increase in extraction rate will necessitate an application for an additional volumetric share within the TBCS and an application for an additional Water Access Licence under the Water Management Act 2000.²³

The volumetric requirements for the proposed TSP expansion are quantified in Appendix 8. The calculations indicate that a total volume of approximately 340 ML would be required for the proposed expansion. As TSP currently holds an allocation of 109ML a further 231 ML would need to be purchased and licenced for use should the expansion proposal be approved. Detailed calculations are provided in Appendix 8.

¹⁹ Email received 8.39am Wednesday 25 November 2020, from Shavaun Tasker, Water Regulation Officer Licensing & Approvals – West Water Regulation Operations (Natural Resources Access Regulator, New South Wales Department of Industry and Environment) to Gilbert & Sutherland Managing Director/Principal Environmental Scientist & Engineer Erin Holton, advising (inter alia) ‘...For monitoring

bores less than 40m deep no licence is required to construct (exempt development)’.

²⁰ Table 7 of the WSP.

²¹ Table 8 of the WSP.

²² Table 9 of the WSP.

²³ Water Management Act, NSW Government. 2000.

5 Groundwater quality results and interpretation

5.1 Potentiometric surface assessment

Potentiometric surface profiles were prepared from the results of groundwater level monitoring conducted from May to October 2020 within the proposed TSP expansion area. The groundwater potentiometric surfaces were prepared using Golden Software's Surfer and are presented as contour plots in Appendix 4.

The contour plots of relative potentiometric level, represented in metres Australian Height Datum (mAHD), indicate a relatively flat groundwater gradient across the site with the general flow direction being away from the extraction lake in a west/north-westerly direction. Groundwaters in the northern paddock (Phase 11 extraction area) tend to flow to the east/south-east along a shallow hydraulic gradient culminating at the main agricultural drainage line in this area. This flow path was observed throughout the monitoring period, while groundwaters across the remaining lots (Phase 6 to 9 extraction areas) to the south and west of the extraction lake appeared to generally flow in a westerly direction and culminate in agricultural drainage lines adjacent the M1 motorway.

5.2 Piper and Durov diagrams

Piper and Durov Diagrams were created using the results obtained from all bores within the current and proposed site area to characterise the sources of dissolved chemical constituents in groundwaters across the site. Diagrams prepared for both shallow and deep bores are included in Appendix 3.

The Piper Diagram for shallow groundwater presents an array of both magnesium carbonate and sodium chloride water types. The majority of monitoring bores were characterised by dominant calcium cations, with several sample locations dominated by chloride anions and two locations representing mixed types with no dominant chemical indicators.

Groundwaters within five out of the six shallow monitoring bores located within the proposed expansion area were diagnosed as magnesium carbonate water types, along with three of the eight shallow bores located within the current TSP site. Groundwaters within the remaining TSP bores in addition to one in the expansion footprint presented as either mixed or sodium chloride water types.

In addition to cation/anion diagnostics, the Durov diagram allows for the comparison of pH and TDS indicators. Shallow groundwaters across all monitoring locations were shown to largely remain within a pH range of 6.0 – 8.5, with the exception of shallow groundwaters of MB7, a shared monitoring bore between TSP and adjoining land operated by Cudgen Lakes Sand Extraction Project.

The Piper diagram for deep groundwater shows very similar proportions of cations and anions between monitoring locations, with the majority falling within a sodium-chloride water type dominated by strong acids and alkalis, with the exception of MB5a which tends towards a mixed type. The majority of monitoring bores were characterised by dominant sodium and potassium cations, and chloride anions.

The Durov diagram for deep groundwater confirms the close cation-anion grouping across all monitoring bore locations throughout the existing and proposed TSP site, with groundwaters shown to range in pH from 6.5 to 8.2.

5.3 Groundwater monitoring results and interpretation

A comprehensive program of groundwater quality monitoring has been conducted at the site since 2001. This data set has been supplemented by an additional eight rounds of monitoring during 2020. This data provides an indication of long-term water quality trends at the site throughout its operations at the existing TSP site.

Tables 5.3.2 and 5.3.3 (end of Section 5.3) summarises the results of groundwater quality in the context of relevant water quality guidelines including:

- Tweed River Water Quality Objectives,

- ANZECC Water Quality Guidelines and
- NHRMC Recreation Water Quality Guidelines for primary contact recreation.

Appendix 3 provides long term graphs and results tables of all analytes monitored within the groundwater. They show water quality trends over time, during ongoing extraction at the site.

Appendix 5 provides the certificates of analysis for recent monitoring conducted in 2020.

The following sub-sections section review the results of recent and historical monitoring of groundwaters in the context of the relevant environmental performance criteria.

5.3.1 pH

The pH within shallow and deep groundwaters throughout the existing TSP site and expansion area remain largely compliant with the ANZECC guideline range of 6.5 to 8.5.

5.3.2 Salinity

Shallow groundwaters throughout the existing TSP site and expansion area show some spatial variation ranging from fresh to brackish (86 to 4,470 $\mu\text{S}/\text{cm}$).

Salinity within the deep groundwater network ranged from brackish to saline with medians ranging from 3100 to 32,250 $\mu\text{S}/\text{cm}$.

5.3.3 Metals

Aluminium results recorded in both shallow and deep groundwater at the site show both spatial and temporal variation. Aluminium concentrations are relatively low with the majority of results (particularly those recorded in recent monitoring) below the laboratory's limit of reporting.

Iron results show substantial variation both spatially and temporally. Iron results within the shallow groundwater network of the current TSP site were elevated (ranging from 0.01 to 98.3mg/L) in comparison to the shallow network within the proposed expansion area where results were predominantly below the laboratory's limit of reporting.

The spatial and temporal variation in Iron concentrations was also observed in the deep groundwater network. Median concentrations within the existing TSP site ranged from 0.04 to 2.70 mg/L whilst in the expansion area the results were predominantly below the laboratory's limit of reporting.

5.3.4 Nutrients

Total nitrogen (TN) and total phosphorus (TP) levels within shallow groundwater were elevated above the ANZECC and TSC guidelines. Total nitrogen ranged from 0.3 to 3.5mg/L compared to the guideline value of 0.035mg/L. Total phosphorus ranged from 0.11 to 1.06mg/L compared to the guideline value of 0.01mg/L.

Ammonia levels were also elevated above the ANZECC Guideline (0.9mg/L) in the deep groundwater ranging from 0.05 to 29.20 mg/L.

Nutrient levels were more concentrated in the deep groundwater environment with some spatial variation in concentrations evident in the data set. TN ranged from 0.8 to 26mg/L whilst TP ranged from 0.24 – 2.04 mg/L.

Ammonia levels were also elevated above the ANZECC Guideline (0.9mg/L) in the deep groundwater ranging from 0.03 to 40.7 mg/L.

Table 5.3.1 - Compliance status key for Tables 5.3.2 to 5.3.3

Colour code	Description
Compliant	Median results comply with the relevant performance criteria
Marginally non-compliant	Median results marginally exceed the relevant performance criteria
Non-compliant	Median results do not currently comply with the relevant performance criteria

Table 5.3.2 – **Shallow groundwater** quality comparison of data median with relevant standards

Parameter	Data range	Median	Tweed River WQO (aquatic ecosystems)	ANZECC Aquatic Ecosystems Guideline	NHRMC Guideline or ANZECC Primary Contact	Comment
pH	3.60 to 9.51 pH units	6.85 pH units	6.5 - 8.0 pH units	6.5 – 8.0 pH units	6.5 to 8.5 or 5.0 to 9.0 in waters with poor buffering capacity	
EC	86 to 11,480 $\mu\text{S}/\text{cm}$	1,067 $\mu\text{S}/\text{cm}$	125 – 2200 $\mu\text{S}/\text{cm}$	NA	NA	Due to the alluvial nature of the site, groundwaters experience saline influence from the Tweed River ANZECC provides a guideline for salinity (EC) of 20 – 30 $\mu\text{S}/\text{cm}$ for lakes and reservoirs, and states: <i>Conductivity in lakes and reservoirs is generally low, but will vary depending upon catchment geology. Values provided are typical of Tasmanian lakes and reservoirs</i>
Temperature	15.6 to 31.8°C	21.8°C	NA	NA	16 to 34°C	
DO	0.1 to 11.54 mg/L	2.71 mg/L	NA	NA	NA	DO targets not applicable to groundwater
Sodium (Na)	7 to 630 mg/L	53 mg/L	NA	NA	<300 mg/L	Due to the alluvial nature of the site, groundwaters experience saline influence from the Tweed River, resulting in chemical profiles representative of saline environments
Potassium (K)	0.5 to 45 mg/L	7 mg/L	NA	NA	NA	
Magnesium (Mg)	0.4 to 138 mg/L	19 mg/L	NA	NA	NA	
Chloride (Cl ⁻)	11 to 990 mg/L	75.5 mg/L	NA	NA	<400 mg/L	Due to the alluvial nature of the site, groundwaters experience saline influence from the Tweed River, resulting in chemical profiles representative of saline environments
Sulfate (SO ₄)	0.5 to 774 mg/L	94.5 mg/L	NA	NA	<400 mg/L	Due to the alluvial nature of the site, groundwaters experience saline influence from the Tweed River,

Parameter	Data range	Median	Tweed River WQO (aquatic ecosystems)	ANZECC Aquatic Ecosystems Guideline	NHRMC Guideline or ANZECC Primary Contact	Comment
						resulting in chemical profiles representative of saline environments
Bicarbonate (HCO ₃)	0.5 to 690 mg/L	192 mg/L	NA	NA	NA	
TN	0.3 – 3.5 mg/L	0.8 mg/L	0.035 mg/L	0.035 mg/L	NA	TN results are for newly constructed bores only (MB13 to MB18) as nutrients within old bores have not historically been reported
TP	0.11 – 1.06 mg/L	0.4 mg/L	0.01 mg/L	0.01 mg/L	NA	TP results are for newly constructed bores only (MB13 to MB18) as nutrients within old bores have not historically been reported
Iron (Fe)	0.01 to 98.3 mg/L	4.3 mg/L	NA	NA	<0.3 mg/L	
Aluminium (Al)	0.001 to 2.390 mg/L	0.01 mg/L	NA	0.05 mg/L	<0.2 mg/L	ANZECC trigger value for freshwater – 95% Level of protection
Arsenic (As)	0 to 0.088 mg/L	0.003 mg/L	NA	0.024 mg/L	<0.05 mg/L	ANZECC trigger value for freshwater – 95% Level of protection
Ammonia (NH ₃)	0.04 to 29.2 mg/L	0.66 mg/L	NA	<0.9 mg/L	NA	
Faecal coliforms	0.5 to 700,000 cfu/100mL	10 cfu/100mL	NA	NA	<150 cfu/100mL	ANZECC 2000 Guidelines recommend: Median over bathing season of < 150 faecal coliforms/100 mL, with 4 out of 5 samples < 600/ 100 mL (minimum of 5 samples taken at regular intervals not exceeding one month)
Enterococci	0.5 to 22,000 cfu/100mL	10 cfu/100mL	NA	NA	<35 cfu/100mL	Results obtained for enterococci are limited to the existing TSP site ANZECC 2000 Guidelines recommend Median over bathing season of < 35 enterococci/100 mL (maximum number in any one sample: 60-100 organisms/100 mL)

Table 5.3.3 – Deep groundwater quality comparison with relevant standards

Parameter	Data range	Median	Tweed River WQO (aquatic ecosystems)	ANZECC Aquatic Ecosystems Guideline	NHRMC Guideline or ANZECC Primary Contact	Comment
pH	3.33 to 8.86	7.23	6.5 - 8.0	6.5 – 8.0	6.5 to 8.5 or 5.0 to 9.0 in waters with poor buffering capacity	--
EC	237 to 45,600 $\mu\text{S/cm}$	15,850	125 – 2200 $\mu\text{S/cm}$	NA	NA	Due to the alluvial nature of the site, groundwaters experience saline influence from the Tweed River. ANZECC provides a guideline for salinity (EC) of 20 – 30 $\mu\text{S/cm}$ for lakes and reservoirs, and states: <i>Conductivity in lakes and reservoirs is generally low, but will vary depending upon catchment geology. Values provided are typical of Tasmanian lakes and reservoirs</i>
Temperature	16.4°C to 29.3°C	21.8°C	NA	NA	16 to 34°C	--
DO	0.05 to 10.53 mg/L	2.47 mg/L	NA	NA	NA	DO targets not applicable to groundwater
Sodium (Na)	8 to 8,170 mg/L	2,240 mg/L	NA	NA	NA	Due to the alluvial nature of the site, groundwaters experience saline influence from the Tweed River, resulting in chemical profiles representative of saline environments ANZECC guidelines available for recreational purposes can therefore not be appropriately applied to this water type
Potassium (K)	6 to 350 mg/L	117 mg/L	NA	NA	NA	--
Magnesium (Mg)	3 to 975 mg/L	457 mg/L	NA	NA	NA	--

Parameter	Data range	Median	Tweed River WQO (aquatic ecosystems)	ANZECC Aquatic Ecosystems Guideline	NHRMC Guideline or ANZECC Primary Contact	Comment
Chloride (Cl ⁻)	10 to 12,000 mg/L	4,435 mg/L	NA	NA	NA	Due to the alluvial nature of the site, groundwaters experience saline influence from the Tweed River, resulting in chemical profiles representative of saline environments ANZECC guidelines available for recreational purposes can therefore not be appropriately applied to this water type
Sulfate (SO ₄)	8 to 5,020 mg/L	983 mg/L	NA	NA	NA	Due to the alluvial nature of the site, groundwaters experience saline influence from the Tweed River, resulting in chemical profiles representative of saline environments ANZECC guidelines available for recreational purposes can therefore not be appropriately applied to this water type
Bicarbonate (HCO ₃)	1 to 5,000 mg/L	612 mg/L	NA	NA	NA	--
TN	0.8 – 26 mg/L	11.45 mg/L	0.035 mg/L	0.035 mg/L	NA	TN results are for newly constructed bores only (MB13 to MB18) as nutrients within old bores have not historically been reported
TP	0.24 – 2.04 mg/L	0.56 mg/L	0.01 mg/L	0.01 mg/L	NA	TP results are for newly constructed bores only (MB13 to MB18) as nutrients within old bores have not historically been reported
Iron (Fe)	0.01 to 39.6 mg/L	0.28 mg/L	NA	NA	<0.3 mg/L	--
Aluminium (Al)	0 to 0.92 mg/L	0.01 mg/L	NA	0.05 mg/L	<0.2 mg/L	ANZECC trigger value for freshwater – 95% Level of protection

Parameter	Data range	Median	Tweed River WQO (aquatic ecosystems)	ANZECC Aquatic Ecosystems Guideline	NHRMC Guideline or ANZECC Primary Contact	Comment
Arsenic (As)	0 to 0.12 mg/L	0.001 mg/L	NA	0.024 mg/L	<0.05 mg/L	ANZECC trigger value for freshwater – 95% Level of protection
Ammonia (NH ₃)	0.03 to 40.7 mg/L	4.38 mg/L	NA	<0.9 mg/L	NA	--
Faecal coliforms	0.5 to 430,000 cfu/ 100mL	10 cfu/ 100mL	NA	NA	<150 cfu/100mL	ANZECC 2000 Guidelines recommend: Median over bathing season of < 150 faecal coliforms per 100 mL, with 4 out of 5 samples < 600/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month)
Enterococci	0.5 to 28,000 cfu/ 100mL	10 cfu/ 100mL	NA	NA	<35 cfu/100mL	Results obtained for enterococci are limited to the existing TSP site. ANZECC 2000 Guidelines recommend: Median over bathing season of < 35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/100 mL)

5.4 Proposed water quality objectives

Groundwater quality measured across the TSP site and proposed expansion area has been compared against the Water Quality Objectives for the Tweed River, the ANZECC Guidelines for aquatic species protection and the NHRMC Guidelines.

In many instances the existing groundwater quality complies with the guidelines and in these instances it is proposed that the ANZECC Guideline value for freshwater 95% species protection would be adopted as the site's compliance criteria. In instances where the existing water quality does not meet the generic guidelines, site specific water quality criteria are proposed.

5.4.1 Required level of protection

The ANZECC Guidelines recognise three categories of ecosystem condition, with a level of protection ascribed to each:

1. High conservation/ecological value systems
2. Slightly to moderately disturbed systems
3. Highly disturbed systems.

Based on the guidance provided in Section 3.1.1 of the ANZECC Guidelines, the ecosystem condition that best describes the receiving environment of the Tweed River is '*slightly to moderately disturbed*' condition. This is defined by the Guideline as:

'Ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by

Table 5.4.1. Proposed water quality objectives – Shallow groundwater

Pollutant	Unit of measure	Water quality objective	Derivation
pH	pH units	6.5 - 8.5	ANZECC
Dissolved Iron	mg/L	<17.3	80 th percentile of site data
Dissolved Aluminium	mg/L	<0.055	ANZECC
Arsenic	mg/L	<0.024	ANZECC
Total Nitrogen	mg/L	<1.8	80 th percentile of site data
Total Phosphorus	mg/L	<0.58	80 th percentile of site data

Table 5.4.2. Proposed water quality objectives – Deep groundwater

Pollutant	Unit of measure	Water quality objective	Derivation
pH	pH units	6.5 - 8.5	ANZECC
Dissolved Iron	mg/L	<1.9	80 th percentile of site data
Dissolved Aluminium	mg/L	<0.055	ANZECC
Arsenic	mg/L	<0.024	ANZECC
Total Nitrogen	mg/L	<19.48	80 th percentile of site data
Total Phosphorus	mg/L	<0.67	80 th percentile of site data

human activity. The biological communities remain in a healthy condition and ecosystem integrity is largely retained. Typically,

freshwater systems would have slightly to moderately cleared catchments and/or reasonably intact riparian vegetation; marine systems would largely intact habitats and associated biological communities. Slightly-moderately disturbed systems could include rural streams receiving runoff from land disturbed to carrying degrees by grazing or pastoralism, or marine ecosystems lying immediately adjacent to metropolitan areas.'

The majority of the TSP site and proposed expansion area have been subject to historic disturbance including previous clearing, agricultural use, and sugarcane cultivation. These areas are best described as '*highly disturbed systems*' which are described by the Guideline as:

'...measurably degraded ecosystems of lower ecological value. Examples of highly disturbed systems would be some shipping ports and

sections of harbours serving coastal cities, urban streams receiving road and stormwater runoff, or rural streams receiving runoff from intensive horticulture.'

For this type of ecosystem, the ANZECC Guidelines recommend that site-specific water quality criteria for physical and chemical stressors be derived and used instead of regional default guideline values (DGVs). The general approach recommended for deriving guideline values described in Section 3.5 of this report.

Depending on existing ecosystem condition and required level of protection, site specific trigger values are defined by choosing either a conservative percentile value (e.g. 80th percentile value) to improve water quality, or a less conservative percentile (e.g. 90th percentile) to maintain water quality.

In this instance the more conservative 80th percentile value has been adopted to determine the site-specific criteria with the aim of improving water quality over time.²⁴ Proposed water quality objectives are presented in Table 5.4.1 and 5.4.2.

²⁴ Page 3.1-22 ANZECC Guidelines 2000.

5.4.2 Interpreting results against water quality criteria

When interpreting compliance with the adopted water quality criteria, it is essential to acknowledge that the values of water quality indicators vary naturally and that not all of this variation is ecologically important.²⁵

It is important to note that when using the 80th percentiles to establish water quality criteria the probability of a single observation exceeding the 80th percentile is 20%. Thus, the probability of a Type 1 error (or the risk of triggering a false alarm) for this method of setting water quality criteria is 20%.

It is recommended that the recording of a single result that exceeds the criteria should not automatically be deemed as a 'non-compliance'. Rather, the water quality criteria are designed to be used as a tool to prompt additional investigations or observations of the parameter in question to ascertain whether an adverse trend may be emerging and if so, allow early detection of the cause of the trend. The findings of such site investigations should be used to determine whether a non-compliance has occurred.

²⁵ Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 1, 2000, Section 3.1, Page 21.

6 Groundwater modelling outcomes

The following sub-sections describe the findings of the steady-state groundwater model. Drawings depicting the results of modelling are contained in Appendix 7.

6.1 Steady-state calibration results

A summary of residuals analysis of the steady state calibrated model versus the measured (observed) groundwater levels from the site is provided in Table 6.1.1.

Table 6.1.1 Residuals analysis

Parameter	Results
Number of data points	25
Standard error of the estimate	0.02m
Root mean squared	0.113m
Maximum residual	0.24m (MB4A)
Minimum residual	0.01m (MB16A)
Normalised root mean squared	16.58%
Correlation coefficient	0.839

The results indicate that the model is well calibrated to site conditions and can be used to predict groundwater behaviour at the site within the known limitations of the model software and baseline data (as noted in Section 3.6.11).

6.2 Groundwater level changes

Drawing No. 12035-510 (Appendix 7) depicts the existing groundwater levels at the site as represented by the steady-state groundwater model. Within the footprint of the proposed TSP expansion are and the current TSP site groundwater levels range from approximately 0.0m AHD up to 1.0m AHD. To the south of the site, groundwater levels rise corresponding with the rise in elevation which represents the Cudgen Plateau.

Drawing No. 12035-511 (Appendix 7) shows the predicted groundwater levels at the completion of sand extraction at the site. In this post-extraction scenario the potentiometric surface across the extraction lake is predicted to be approximately 0.0 – 0.25m AHD. Groundwater levels external to

the site remain largely the same as the pre-extraction scenario ranging from 0m AHD to 1.0m AHD within the immediate vicinity of the site and increasing with elevation to the south of the site within the Cudgen Plateau.

Drawing 12035-512 is a comparison of the pre and post-extraction groundwater contours to allow an interrogation of the changes in groundwater level that are predicted to occur as a result of the development. The drawing indicates that changes to groundwater elevation are predominantly contained within the development footprint occurring within the northern and southern sections of the extraction area

There is a maximum 0.5m lowering of the water table in the northern portion of the expansion area. The impact is predominantly contained within the expansion footprint, however a decrease in groundwater elevation of up to 0.3m is predicted within a small portion of the lands outside the northern perimeter of Lot 51 on DP1166990.

In the southern extent of the site the steady-state model indicates a maximum 1.0m lowering of the groundwater table predominantly within the expansion footprint. This impact reduces to a maximum of 0.5m of drawdown outside of the site boundary to the west of Lot 1 on DP1250570.

These changes in groundwater elevation are brought about by the changes in topography caused by extraction of sand. Essentially, reducing the land elevation through extraction results in an associated lowering of the immediate groundwater table as it equilibrates with the surface water level of the extraction lake.

Areas within the model domain that are unshaded indicate negligible change in groundwater level (within ± 0.1 m of the pre-development model scenario).

6.3 Impacts on existing groundwater users

Section 4.3 and Drawing 12035-501 summarise the extent of existing registered groundwater use in close proximity of the site. There are no registered groundwater bores within the footprint

of the expansion area and those located within the footprint of the existing TSP operation were installed and are monitored by TSP management. Groundwater level changes resulting from the development are not predicted to cause impacts within proximity to any of the known registered bores.

6.4 Impacts on groundwater dependent ecosystems

Sensitive receptors with the potential to be affected by the proposed development include GDE's, wetlands and nearby registered groundwater users:

As discussed in Section 4.1 the Bureau of Meteorology Groundwater Dependant Ecosystems Atlas identifies a High Potential GDE within the north-eastern corner of Lot 51 on DP1166990 as shown on Drawing 12035-501. No change between the pre and post-extraction groundwater table is predicted to occur within this area of the site indicating that this GDE is unlikely to be impacted by changes in groundwater level resulting from the proposed development.

The BOM Ecosystem Atlas also identifies a Low Potential GDE (Drawing No. 12035-501) adjacent the southern boundary of the expansion footprint west of Lot 1 on DP1250570. Drawdown of up to 0.5m is predicted to occur within a small portion of this mapped GDE. Ground-truthing of the presence and extent of this GDE and consideration of its sensitivity to groundwater drawdown of this magnitude is provided in the JWA Ecological Assessment Report 2021.

6.5 Groundwater levels in response to sea level rise

The TSC Climate Change Management Policy, version 1.0 adopts a sea level rise of 0.4m by 2050 and 0.9m by 2100 and anticipates an increase in the frequency and depth of tidal inundation of low lying lands and poor drainage in low lying areas.

The proposed expansion area is a low-lying coastal floodplain and is currently subject to tidal inflows from the Tweed River in parts of the site.

To assess the possible changes to groundwater level as a result of sea-level rise the relevant hydraulic boundary conditions of the pre and post-extraction groundwater models were adjusted to reflect increased water levels. Specifically, the Tweed River level was adjusted upward by 0.9m to a level of 1.0m AHD to represent the anticipated rise by 2100. A comparison was then made between the existing site and the post-extraction site to explore the combined impact of sea-level rise and the presence of the extraction lake.

Drawing 12035-513 shows the outcomes of the sea-level rise modelling scenario. The model predicts that the groundwater level throughout the expansion area and throughout the model domain will increase by a minimum of 0.1m up to a maximum of 1.0m. As anticipated by TSC's Climate Change Policy, the predicted sea-level rise will exacerbate tidal inundation and impede the site's drainage leading to increased water-logging of soils.

7 Discussion and conclusions

7.1 Groundwater allocation and licencing

Licensing requirements, relevant Water Sharing Plans (WSP) and their operating rules were reviewed for their applicability to the Project and to determine the relevant licensing and approvals requirements.

TSP currently holds an allocation of 109ML/yr in the Tweed-Brunswick Coastal Sands (TBCS) source for groundwater interference/ take commensurate with the scale of its existing operation. Expansion of the operation and the proposed increase in extraction rate will necessitate an application for an additional volumetric share within the TBCS and an application for an additional Water Access Licence under the Water Management Act 2000.²⁶

The volumetric requirements for the proposed TSP expansion have been quantified with a total volume of approximately 340 ML required for the proposed expansion. As TSP currently holds an allocation of 109ML a further 231 ML would need to be purchased and licenced for use should the expansion proposal be approved.

7.2 Groundwater quality

In general, deep groundwater throughout the site (existing and proposed) was characterised by saline waters with sodium and chloride dominating the water's chemistry. The proportion of ions in the groundwater sampled indicates a saline influence likely to be associated with the Tweed River.

Shallow groundwater throughout the site showed fewer determinate indicators, with ionic balances displaying observable variation across monitoring locations. While the large proportion of bores (five out of six) within the expansion footprint appeared to be dominated by calcium ions, no definable relationships emerged between the location of

these bores, proximal to the extraction lake or significant environmental features, and their ionic characteristics.

An ongoing program of groundwater quality compliance monitoring has been undertaken at the TSP site since 2001, resulting in a comprehensive data set for the site. Building on the existing water quality monitoring program, a further eight rounds of groundwater monitoring were conducted across the proposed expansion area between March and October 2020, to establish baseline conditions and determine similarities and differences between the expansion area and current TSP site.

Results obtained for shallow groundwater within the existing and proposed site area demonstrate long-term median values generally comply with the Tweed River Water Quality Objectives, ANZECC Water Quality Guidelines and NHRMC Recreation Water Quality Guidelines for primary contact recreation. The exceptions to this are:

- Iron, which currently exceeds the performance criteria at number of monitoring locations; and
- Nutrients (total nitrogen, total phosphorous), with recorded exceedances of performance criteria.

Results obtained for deep groundwater within the TSP site also demonstrate median values that generally comply with the Tweed River Water Quality Objectives, ANZECC Water Quality Guidelines and NHRMC Recreation Water Quality Guidelines for primary contact recreation, with the exceptions being:

- Ammonia, with recorded exceedances of performance criteria; and
- Nutrients (total nitrogen, total phosphorous), with recorded exceedances of performance criteria within the expansion area groundwaters.

7.3 Groundwater level impacts

Given the nature of the site soils and groundwater characteristics observed to date, the most likely

²⁶ Water Management Act, NSW Government, 2000.

potential impacts on groundwater as a result of the development are:

- Localised and minor changes to pre-development groundwater flow regimes in the vicinity of the lake that will be largely contained within the development footprint.
- Changes to groundwater elevation as a result of the proposed expansion are predominantly contained within the development footprint occurring within the northern and southern sections of the extraction footprint (Lot 51 on DP1166990 and Lot 1 on DP1250570 respectively);
 - There is a maximum 0.5 m lowering of the water table in the northern portion of the expansion area. The impact is predominantly contained within the expansion footprint, however a decrease in groundwater elevation of up to 0.3 m is predicted within a small portion of the lands outside the northern perimeter of Lot 51 on DP1166990.
 - In the southern extent of the site the steady-state model indicates a maximum 1.0 m lowering of the groundwater table predominantly within the expansion footprint. This impact reduces to a maximum of 0.5 m of drawdown outside of the site boundary to the west of Lot 1 on DP1250570.
- Groundwater level changes resulting from the development are not predicted to cause impacts within proximity to any of the known registered bores.
- Impacts to GDE's are predicted to be minimal. A drawdown of up to 0.5 m is predicted to occur within a small portion of the Low Potential GDE which is mapped on the southern boundary of the expansion footprint west of Lot 1 on DP1250570. Ground-truthing of the presence and extent of this GDE and consideration of its sensitivity to groundwater drawdown of this magnitude is provided in the JWA Ecological Assessment Report 2021.
- The model predicts that the groundwater level throughout the expansion area and throughout the model domain will increase by a minimum of 0.1 m up to a maximum of 1.0 m. As anticipated by TSC's Climate Change Policy, the predicted sea-level rise will exacerbate tidal inundation and impede the site's drainage leading to increased water-logging of soils.

7.4 Groundwater management

Groundwater will be managed in accordance with the measures prescribed in the Soil and Water Management Plan (Gilbert & Sutherland, 2021). This management plan outlines monitoring regimes and mitigation measures for the management of impacts to surface and groundwaters.

8 Limitations of reporting

Gilbert & Sutherland Pty Ltd has made every effort to ensure that the information provided in this report is accurate. The interpretation of scientific data, however, involves professional judgment and as such is open to error.

In recognising the potential for errors in scientific interpretation, Gilbert & Sutherland Pty Ltd does not guarantee that the information is totally accurate or complete and clients are advised not to rely solely on this information when making commercial decisions. Any representation, statement, opinion or advice, expressed or

implied is made in good faith and on the basis that the authors, Gilbert & Sutherland Pty Ltd, their agents or employees are not liable (whether by reason of lack of care or otherwise) to any person for any damage or loss whatsoever which has occurred or may occur in relation to that person taking or not taking (as the case may be) action in respect of any representation, statement or advice referred to above.

Furthermore, this information should not be relied upon by any persons other than the client, for whom it has been compiled. This information reflects the specific brief and the budget of the client concerned, who enjoys an individual tolerance of risk.

9 Appendix 1 – Drawings




ORIENTATION

SCALE

50 100 150 200 250 300 metres

ROBINA

PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs www.access.gs

LEGEND

 Site Boundary

 Phase 4 Extraction Area (indicative only)

SOURCES

Image: Nearmap 2020. Image date: 14/09/2020

PROJECT

TWEED SAND
PLANT
EXPANSION

CLIENT

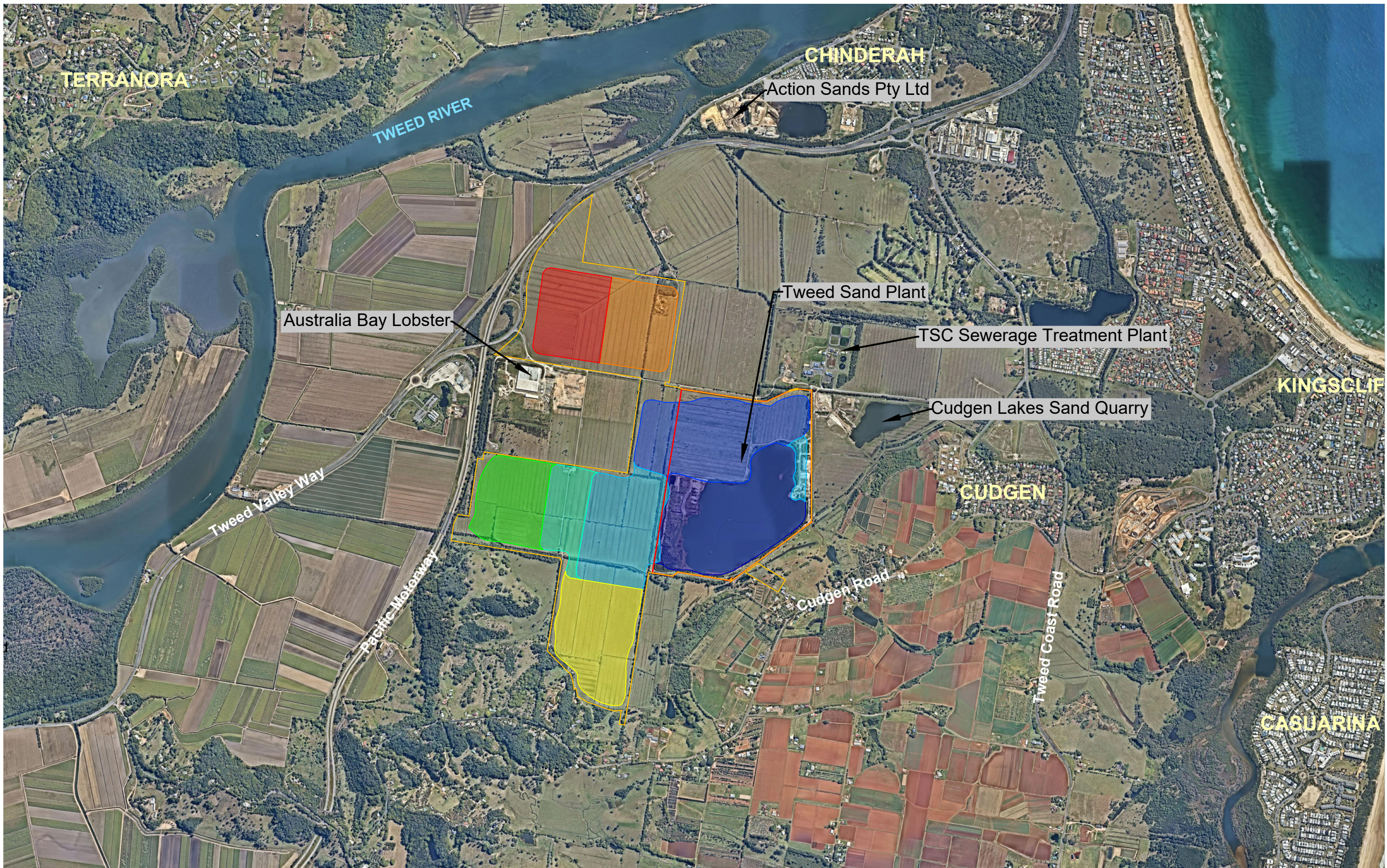
HANSON
CONSTRUCTION
MATERIALS

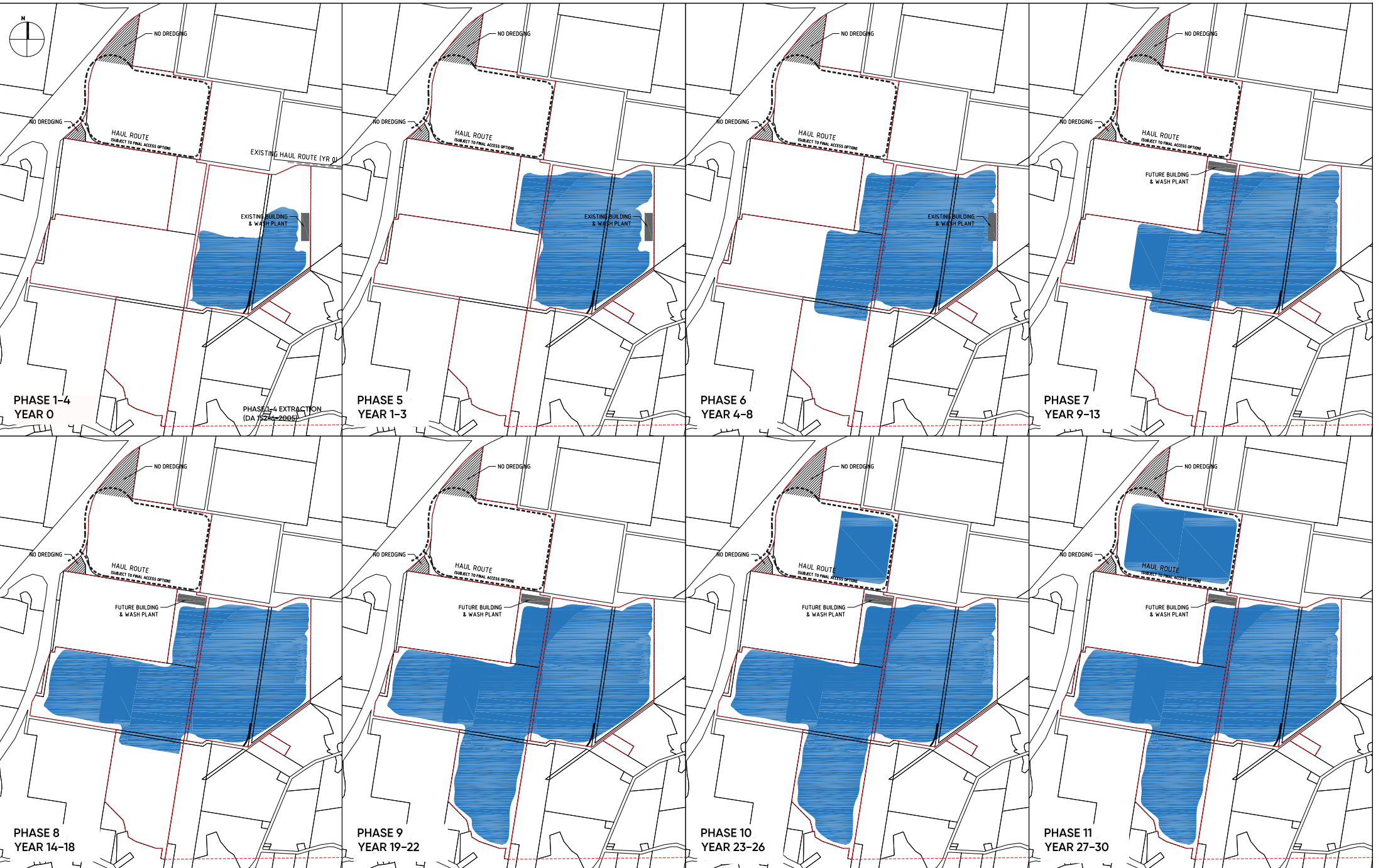
DRAWING

EXISTING TWEED SAND
PLANT OPERATION

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:6 250@A3	1/12/2020	AJF	ELH	12035	001	-







PROJECT TITLE

HANSON TWEED SAND PLANT

PHASE 5-11

DRAWING TITLE

CONCEPT DEVELOPMENT PHASING

REV	DESCRIPTION	DATE	DRAWN	DESIGN	CHECK	APPROVED
A	PHASING ARRANGEMENT CHANGES - REG. PLANNER	25.01.2021	ZP	LN	LN	LN

ISSUE:

PRELIMINARY

CLIENT:

HANSON CONSTRUCTION MATERIALS PTY LTD.

BASE PROVIDED BY:

SERMAPS DCDB

MANAGER:

LANCE NEWLEY

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GLADSTONE

2/172 Goodwood St, Gladstone, QLD 4680

PO Box 5332, Gladstone QLD 4680

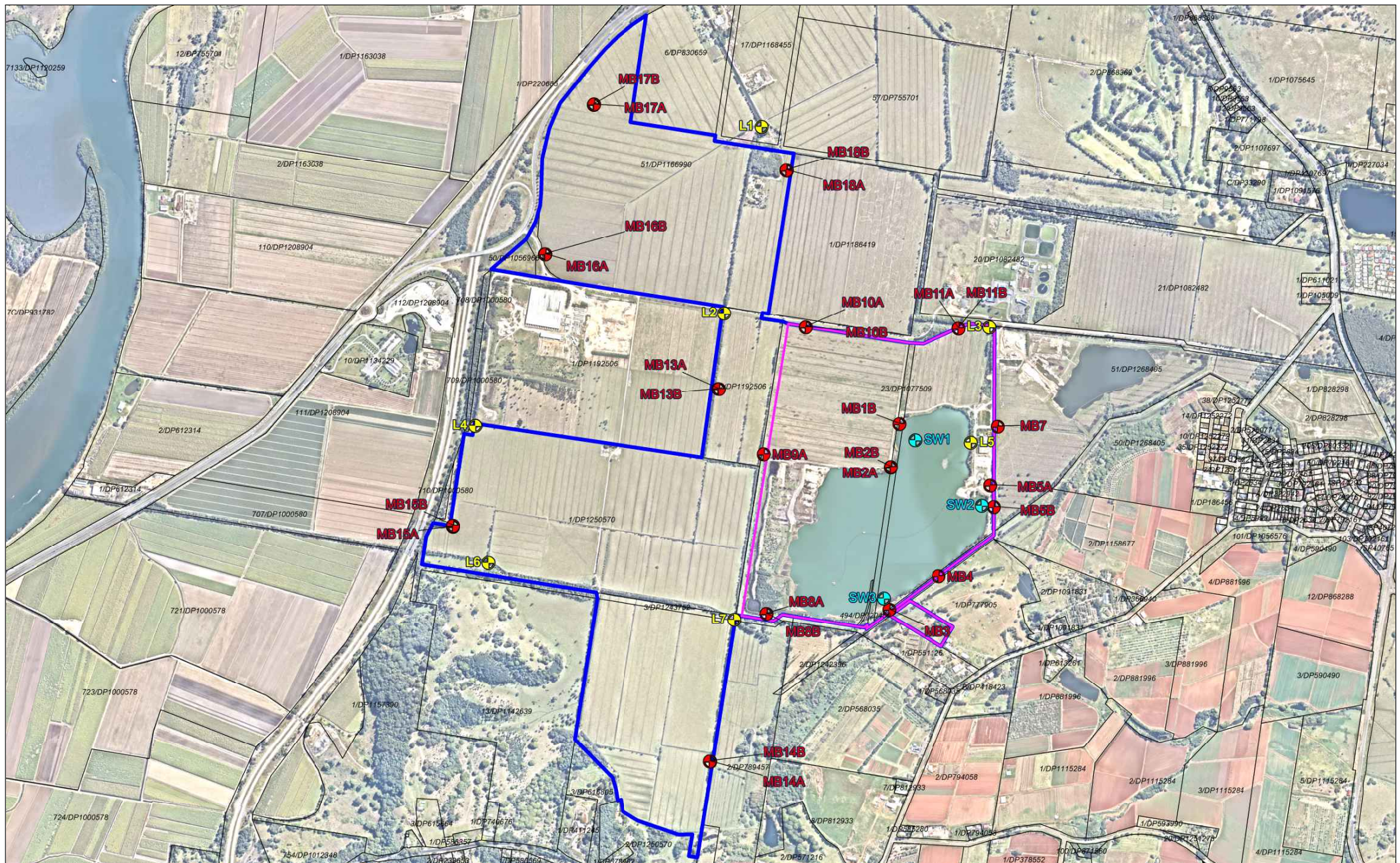
zonelandscapes.com.au | 07 55622303

JOB / DRAWING NO:

Z19163- 104

SHEET NO.

SHEET 01 OF 01



ORIENTATION



ROBINA
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07 5578 9944
www.access.gs

LEGEND

- Cadastral boundaries
- Site Boundary - Existing
- Site boundary - Expansion Area
- Groundwater monitoring bores
- Surface water monitoring locations
- Surface water loggers

SOURCES

Image: Nearmap image dated 14 September 2020.
Cadastral: NSW Six Maps, sourced 23/11/2020.

PROJECT

TWEED SAND
PLANT
EXPANSION

CLIENT

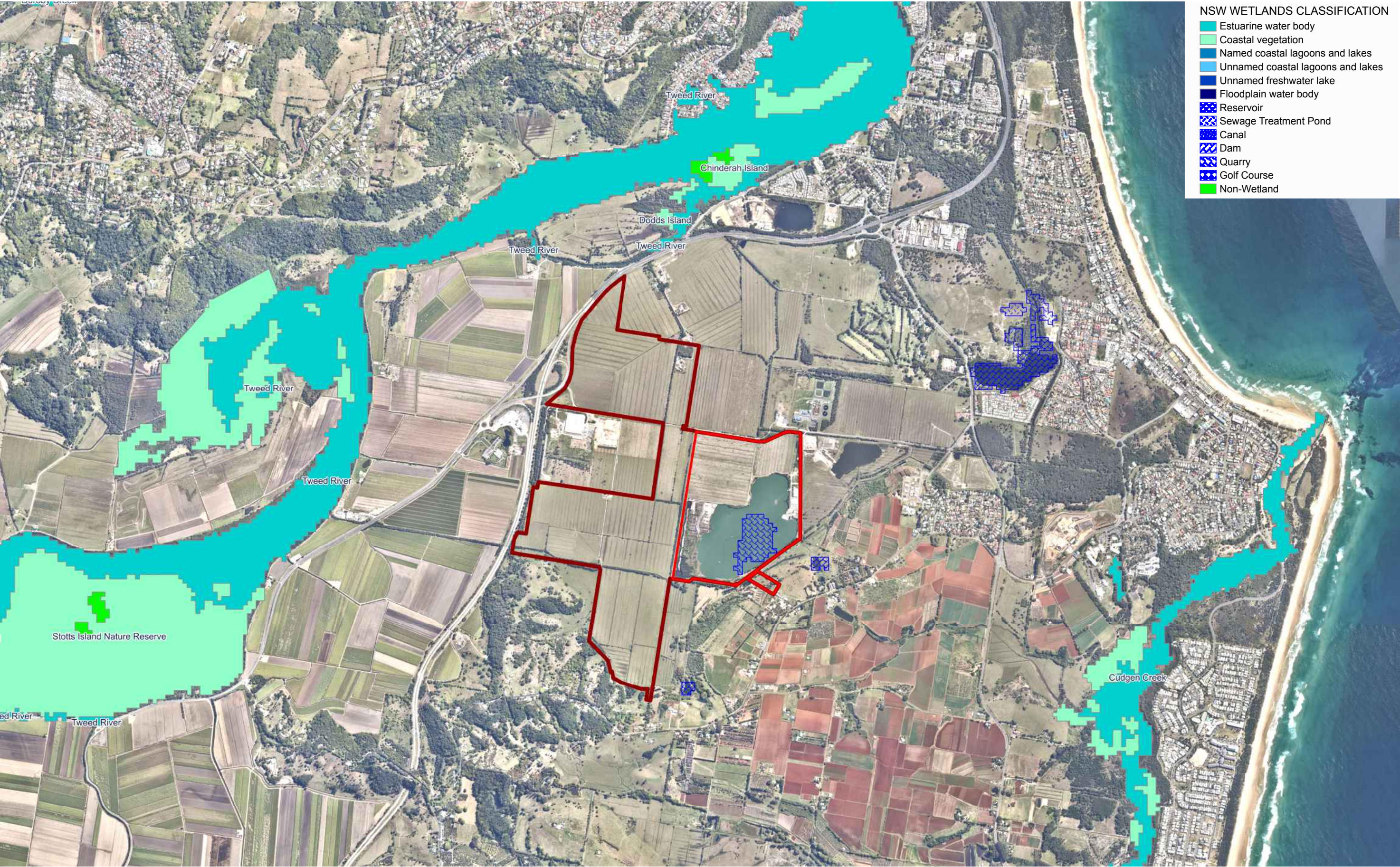
HANSON
CONSTRUCTION
MATERIALS

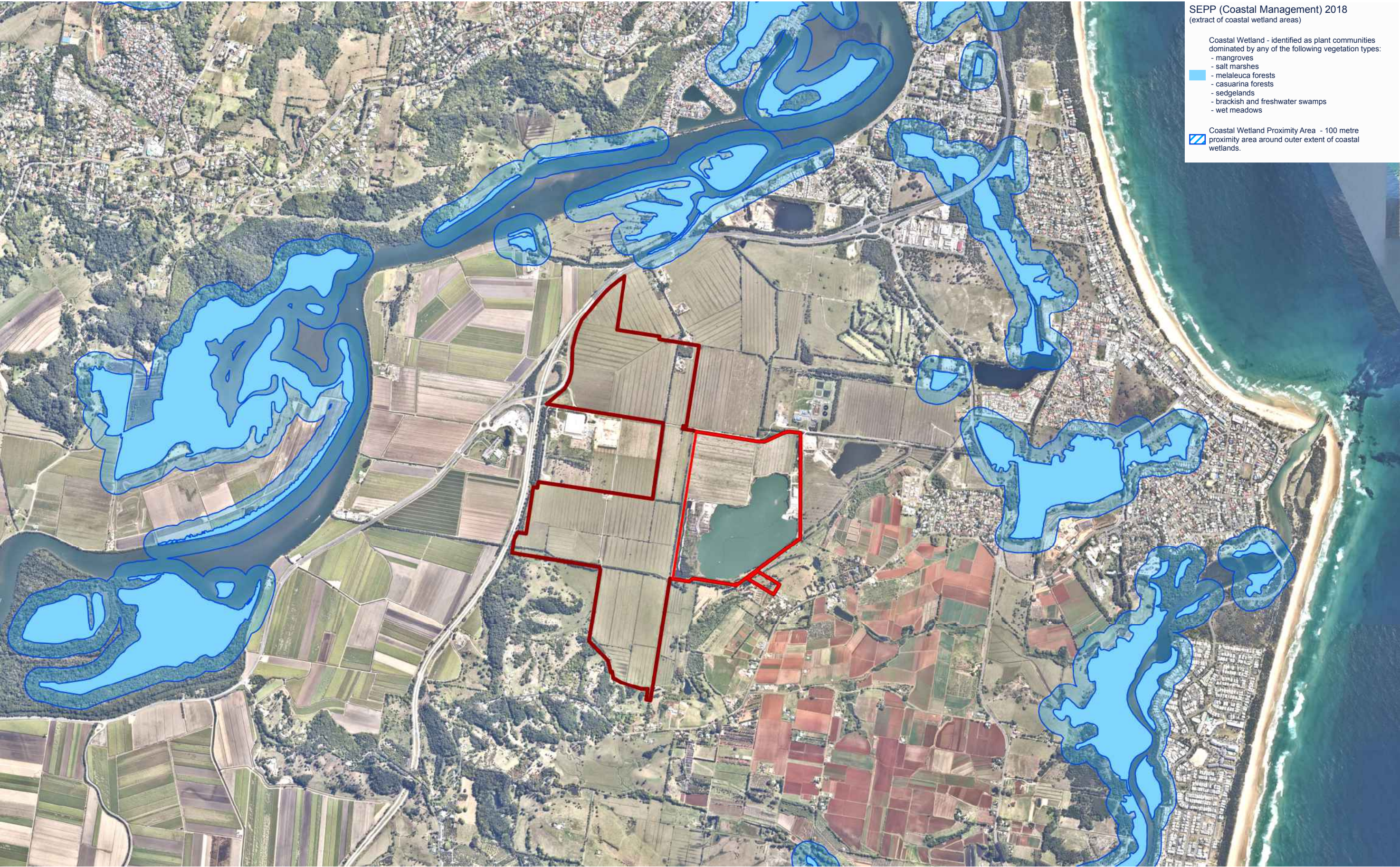
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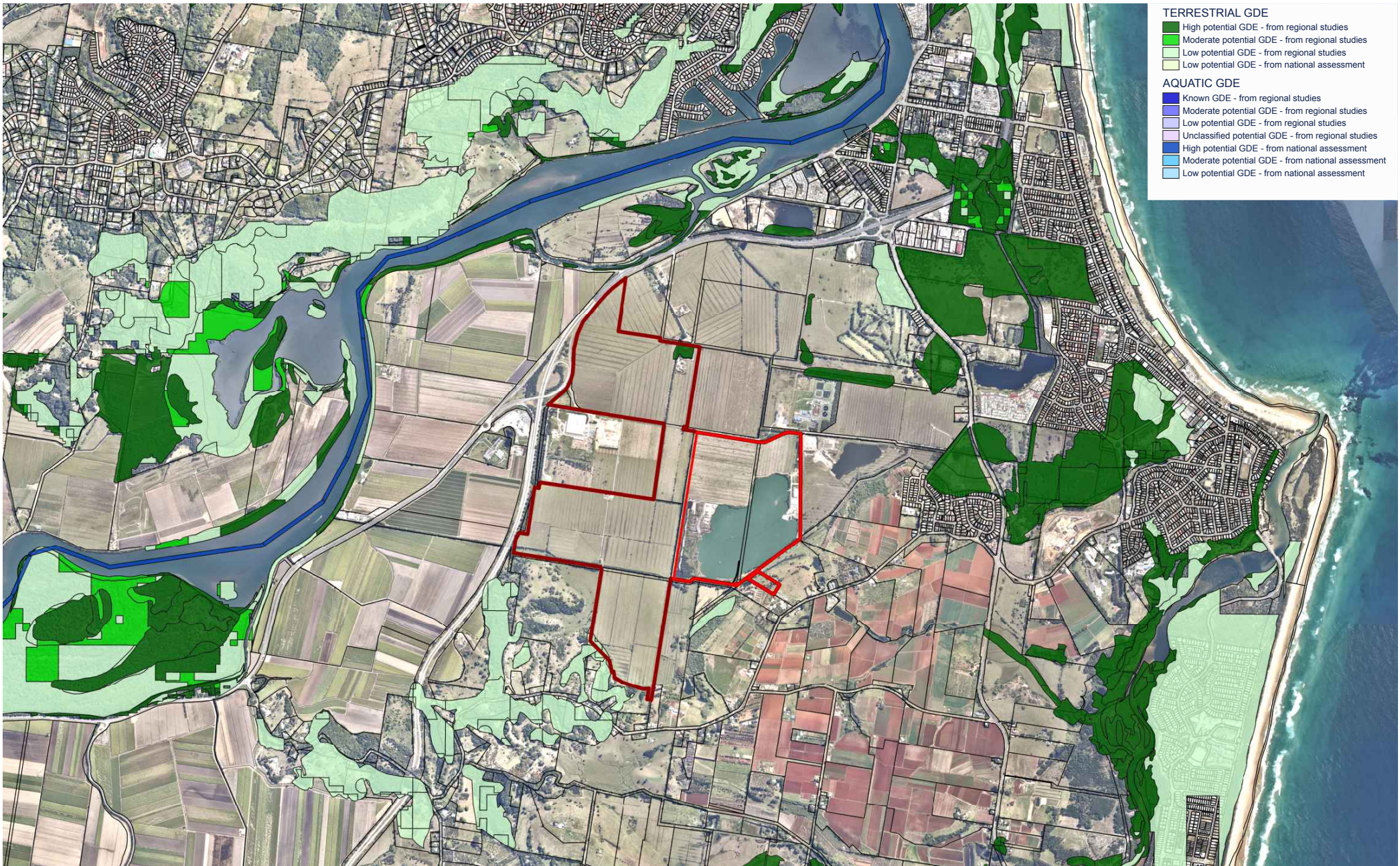
MONITORING
LOCATIONS

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:12 500@A3	19/01/2021	AJF	CMA	12035	003	

**+GILBERT
SUTHERLAND**







ORIENTATION

SCALE



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LEGEND

- Cadastral boundaries
- Site Boundary - Existing
- Site Boundary - Expansion Area

SOURCES

Image: Nearmap Image dated 14 September 2020.
Cadastral: NSW Six Maps, sourced 23 November 2020.
GDE: Groundwater Dependent Ecosystem Atlas, Bureau of Meteorology

PROJECT

**TWEED SAND
PLANT
EXPANSION**

SCALE
1:25 000@A3

DATE
19/01/2021

CLIENT

**HANSON
CONSTRUCTION
MATERIALS**

DRAWN
AJF

CHECKED
ELH

DRAWING

**GROUNDWATER
DEPENDENT
ECOSYSTEMS**

PROJECT
12035

DRAWING
103

REVISION
-

**+GILBERT
SUTHERLAND**

10 Appendix 2 – Borelogs

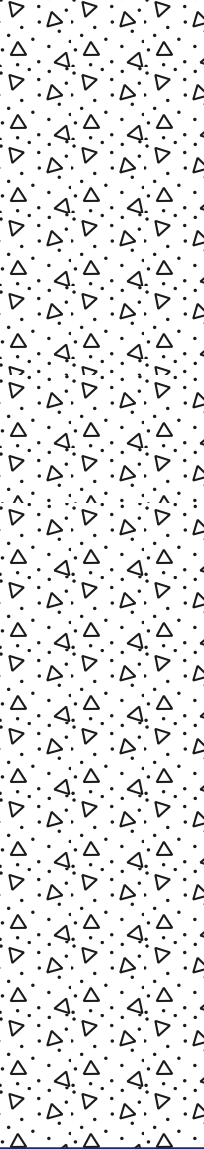
DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
0			Very dark brown (10YR 2/2) sandy clay loam ; no coarse fragments; moderately moist; massive structure; very weak consistence; no segregations; change to;	NATURAL
0.2				
0.4				
0.6			Grey (10YR 6/1) loamy sand ; no coarse fragments; moderately moist; massive structure; very weak consistence; no segregations; change to;	NATURAL
0.8				
1				
1.2	▼			
1.4				
1.6			Very dark greenish grey (10Y 3/1) clayey sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
1.8				
2			Dark greenish grey (10Y 4/1) loamy sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
2.2				
2.4				
2.6				
2.8				
3				
3.2				
3.4				
3.6				
3.8				
4			Olive grey (5Y 5/2) loamy sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
4.2				
4.4				

BOREHOLE

MB13a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	15-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552740.07
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6873905.19

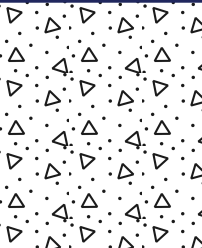


DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
4.6				
4.8				
5				
5.2				
5.4				
5.6				
5.8				
6			Olive grey (5Y 5/2) loamy sand ; very few, coarse gravelly, rounded calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
6.2				
6.4			Olive grey (5Y 5/2) loamy sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
6.6				
6.8				
7				
7.2				
7.4				
7.6				
7.8				
8				
8.2				
8.4				
8.6				
8.8				
9				

BOREHOLE
MB13a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	15-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552740.07
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6873905.19



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
9.2				
9.4				
9.6				
9.8				
10			Grey (5Y 6/1) fine sand ; very few, coarse gravelly, rounded calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
10.2				
10.4				
10.6				
10.8				
11				
11.2				
11.4				
11.6				
11.8				
12				
12.2				
12.4				
12.6				
12.8				
13				
13.2				
13.4				



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
13.6				
13.8				
14				
14.2				
14.4				
14.6				
14.8				
15				
15.2				
15.4				
15.6				
15.8				
16				
16.2				
16.4				
16.6				
16.8				
17				
17.2				
17.4			Dark grey (10YR 4/1) clayey sand ; very few, coarse gravelly, rounded calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
17.6			Very dark greenish grey (10Y 3/1) silty medium clay ; very few, coarse gravelly, rounded calcareous sand fragments; moist; massive structure; firm consistence; no segregations; borehole terminated at 20mBGL.	NATURAL
17.8				
18				

BOREHOLE MB13a	CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	15-Apr-20
	PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552740.07
	LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6873905.19

+GILBERT
SUTHERLAND

DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
18.2				
18.4				
18.6				
18.8				
19				
19.2				
19.4				
19.6				
19.8				
20				
20.2				
20.4				
20.6				
20.8				
21				
21.2				
21.4				
21.6				
21.8				
22				
22.2				
22.4				

BOREHOLE

MB13a

CLIENT HANSON CONSTRUCTION MATERIALS

PROJECT No. 12035

TOTAL DEPTH 20mBGL

DRILL DATE 15-Apr-20

PROJECT TWEED SAND PLANT EXPANSION

SURFACE RL Not surveyed

DRILLED BY PACIFIC GEOTECH

EASTING 552740.07

LOCATION CUDGEN, NSW

DRILL METHOD AUGER

LOGGED BY GLH

NORTHING 6873905.19

+GILBERT

SUTHERLAND

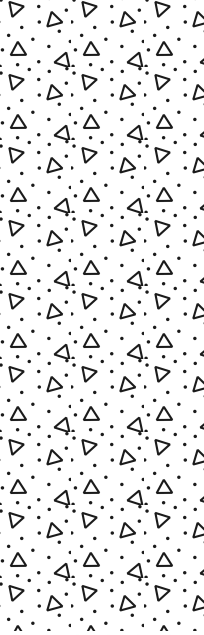
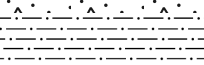
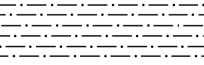
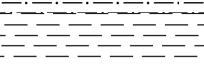
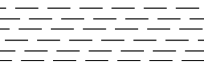
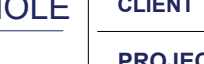
DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
0			Very dark grey (10YR 3/1) sandy loam ; no coarse fragments; moist; massive structure; weak consistence; no segregations; change to;	NATURAL
0.2			Reddish grey (5YR 5/2) sandy clay loam ; no coarse fragments; moist; massive structure; very weak consistence; no segregations; change to;	NATURAL
0.4				
0.6				
0.8	▼		Light brownish grey (10YR 6/2) loamy sand ; no coarse fragments; moist; massive structure; loose consistence; no segregations; change to;	NATURAL
1				
1.2				
1.4				
1.6				
1.8				
2			Grey (2.5Y 5/1) clayey sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
2.2				
2.4				
2.6				
2.8				
3				
3.2				
3.4				
3.6				
3.8				
4			Grey (2.5Y 5/1) loamy sand ; no coarse fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
4.2				
4.4				

BOREHOLE

MB14a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	16-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552711.53
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6872597.36



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
4.6				
4.8				
5				
5.2				
5.4				
5.6				
5.8				
6				
6.2				
6.4				
6.6				
6.8				
7				
7.2			Grey (2.5Y 5/1) clayey sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
7.4				
7.6			Very dark greenish grey (10Y 3/1) silty medium clay ; very few, medium gravelly, subangular calcareous sand fragments; moist; massive structure; firm consistence; no segregations; change to;	NATURAL
7.8				
8				
8.2				
8.4				
8.6				
8.8				
9				

BOREHOLE
MB14a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	16-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552711.53
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6872597.36



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
9.2				
9.4				
9.6				
9.8				
10				
10.2				
10.4				
10.6				
10.8				
11				
11.2				
11.4				
11.6				
11.8				
12				
12.2				
12.4				
12.6				
12.8				
13				
13.2				
13.4				

BOREHOLE

MB14a

CLIENT HANSON CONSTRUCTION MATERIALS

PROJECT No. 12035

TOTAL DEPTH 20mBGL

DRILL DATE 16-Apr-20

PROJECT TWEED SAND PLANT EXPANSION

SURFACE RL Not surveyed

DRILLED BY PACIFIC GEOTECH

EASTING 552711.53

LOCATION CUDGEN, NSW

DRILL METHOD AUGER

LOGGED BY GLH

NORTHING 6872597.36

+GILBERT

SUTHERLAND

DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
13.6				
13.8				
14				
14.2				
14.4				
14.6				
14.8				
15				
15.2				
15.4				
15.6				
15.8				
16				
16.2				
16.4				
16.6				
16.8				
17				
17.2				
17.4				
17.6				
17.8				
18				

BOREHOLE

MB14a

CLIENT HANSON CONSTRUCTION MATERIALS

PROJECT No. 12035

TOTAL DEPTH 20mBGL

DRILL DATE 16-Apr-20

PROJECT TWEED SAND PLANT EXPANSION

SURFACE RL Not surveyed

DRILLED BY PACIFIC GEOTECH

EASTING 552711.53

LOCATION CUDGEN, NSW

DRILL METHOD AUGER

LOGGED BY GLH

NORTHING 6872597.36

+GILBERT

SUTHERLAND

DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
18.2			Pale orange yellow (10YR 9/2) silty medium clay ; very few, medium gravelly, subangular calcareous sand fragments; moist; massive structure; very strong consistence; no segregations; borehole terminated at 20mBGL.	NATURAL
18.4				
18.6				
18.8				
19				
19.2				
19.4				
19.6				
19.8				
20				
20.2				
20.4				
20.6				
20.8				
21				
21.2				
21.4				
21.6				
21.8				
22				
22.2				
22.4				

BOREHOLE

MB14a

CLIENT HANSON CONSTRUCTION MATERIALS

PROJECT No. 12035

TOTAL DEPTH 20mBGL

DRILL DATE 16-Apr-20

PROJECT TWEED SAND PLANT EXPANSION

SURFACE RL Not surveyed

DRILLED BY PACIFIC GEOTECH

EASTING 552711.53

LOCATION CUDGEN, NSW

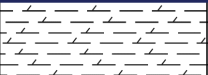
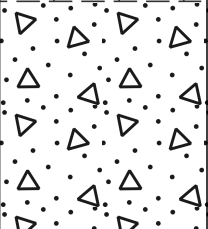
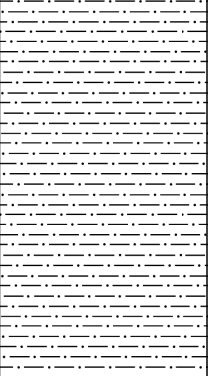
DRILL METHOD AUGER

LOGGED BY GLH

NORTHING 6872597.36

+GILBERT

SUTHERLAND

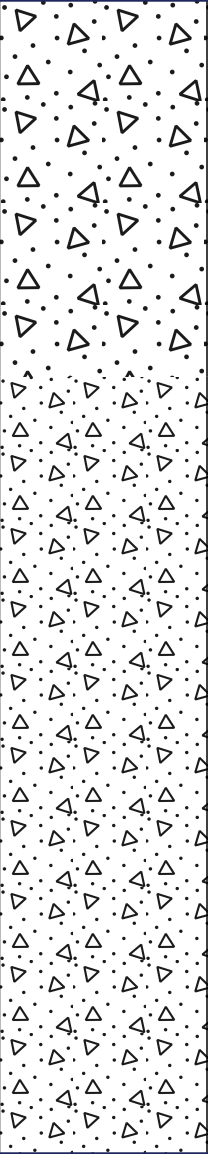
DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
0			Very dark greyish brown (10YR 3/2) silty clay loam ; no coarse fragments; moist; massive structure; weak consistence; no segregations; change to;	NATURAL
0.2				
0.4	▼		Greyish brown (10YR 5/2) sandy loam ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
0.6				
0.8				
1				
1.2			Greyish brown (10YR 5/2) sandy loam ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
1.4				
1.6				
1.8				
2				
2.2				
2.4				
2.6				
2.8				
3			Very dark grey (5Y 3/1) clayey sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
3.2				
3.4				
3.6				
3.8				
4				
4.2				
4.4				

BOREHOLE
MB15a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	17-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	551808.9
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6873422.44



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
4.6				
4.8				
5				
5.2				
5.4				
5.6				
5.8				
6				
6.2				
6.4				
6.6				
6.8			grey (5/N) sandy loam ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
7				
7.2				
7.4				
7.6				
7.8				
8				
8.2				
8.4				
8.6				
8.8				
9				
BOREHOLE MB15a CLIENT HANSON CONSTRUCTION MATERIALS PROJECT No. 12035 TOTAL DEPTH 20mBGL DRILL DATE 17-Apr-20 PROJECT TWEED SAND PLANT EXPANSION SURFACE RL Not surveyed DRILLED BY PACIFIC GEOTECH EASTING 551808.9 LOCATION CUDGEN, NSW DRILL METHOD AUGER LOGGED BY GLH NORTHING 6873422.44 +GILBERT SUTHERLAND				

DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
9.2				
9.4				
9.6				
9.8				
10				
10.2				
10.4				
10.6			Dark grey (5Y 4/1) loamy sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
10.8				
11				
11.2				
11.4				
11.6				
11.8				
12				
12.2				
12.4				
12.6				
12.8				
13				
13.2				
13.4				

BOREHOLE
MB15a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	17-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	551808.9
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6873422.44



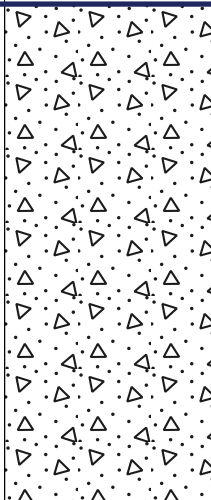
DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
13.6				
13.8				
14				
14.2				
14.4				
14.6				
14.8				
15			Very dark grey (5Y 3/1) sandy loam ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
15.2				
15.4				
15.6				
15.8				
16			Dark grey (5Y 4/1) loamy sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
16.2				
16.4				
16.6				
16.8				
17				
17.2				
17.4				
17.6				
17.8				
18				

BOREHOLE

MB15a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	17-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	551808.9
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6873422.44



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
18.2 18.4 18.6 18.8 19 19.2 19.4 19.6 19.8 20 20.2 20.4 20.6 20.8 21 21.2 21.4 21.6 21.8 22 22.2 22.4			Dark grey (5Y 4/1) light loamy fine sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; borehole terminated at 20mBGL.	NATURAL

BOREHOLE

MB15a

CLIENT

 HANSON CONSTRUCTION MATERIALS

PROJECT No.

 12035

TOTAL DEPTH

 20mBGL

DRILL DATE

 17-Apr-20

PROJECT

 TWEED SAND PLANT EXPANSION

SURFACE RL

 Not surveyed

DRILLED BY

 PACIFIC GEOTECH

EASTING

 551808.9

LOCATION

 CUDGEN, NSW

DRILL METHOD

 AUGER

LOGGED BY

 GLH

NORTHING

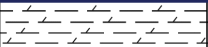
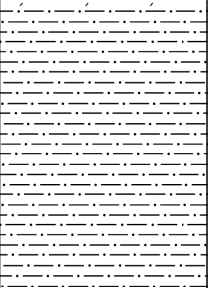
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+GILBERT

SUTHERLAND

+GILBERT

SUTHERLAND

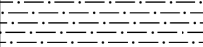
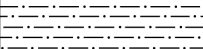
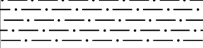
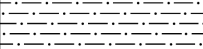
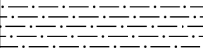
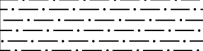
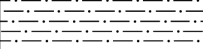
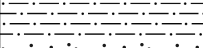
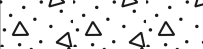
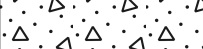
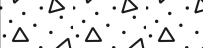
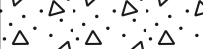
DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
0			Black (10YR 2/1) silty clay loam ; no coarse fragments; moist; massive structure; very weak consistence; no segregations; change to;	NATURAL
0.2			Greyish brown (2.5Y 5/2) clayey sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
0.4				
0.6				
0.8				
1				
1.2				
1.4			Dark grey (5Y 4/1) clayey sand ; no coarse fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
1.6				
1.8				
2				
2.2				
2.4				
2.6				
2.8				
3				
3.2				
3.4				
3.6				
3.8				
4				
4.2				
4.4				

BOREHOLE

MB16a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	20-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552130.24
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874378.67



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
4.6				
4.8				
5				
5.2				
5.4				
5.6				
5.8				
6			grey (5/N) loamy sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
6.2				
6.4				
6.6				
6.8				
7				
7.2				
7.4				
7.6				
7.8				
8				
8.2				
8.4				
8.6				
8.8				
9				

BOREHOLE

MB16a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	20-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552130.24
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874378.67

+GILBERT

SUTHERLAND

[illegible]

BOREHOLE

MB16a

CLIENT HANSON CONSTRUCTION MATERIALS

PROJECT No. 12035

TOTAL DEPTH 20mBGL

DRILL DATE 20-Apr-20

PROJECT TWEED SAND PLANT EXPANSION

SURFACE RL Not surveyed

DRILLED BY PACIFIC GEOTECH EASTING 552130.24

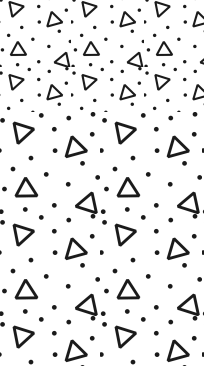
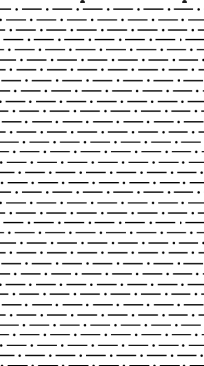
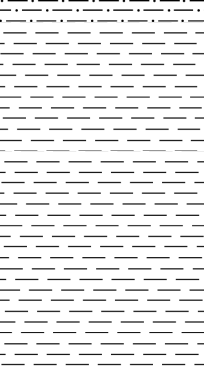
LOCATION CUDGEN, NSW

DRILL METHOD AUGER

LOGGED BY GLH

NORTHING 6874378.67

+ GILBERT SUTHERLAND

DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
13.6				
13.8				
14			Dark grey (5Y 4/1) sandy loam ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
14.2				
14.4				
14.6				
14.8				
15			Very dark grey (5Y 3/1) clayey sand ; no coarse fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
15.2				
15.4				
15.6				
15.8				
16				
16.2				
16.4				
16.6			Very dark greenish grey (10Y 3/1) silty medium clay ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
16.8				
17				
17.2			Very dark greenish grey (10Y 3/1) silty medium clay ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; borehole terminated at 20mBGL.	NATURAL
17.4				
17.6				
17.8				
18				

BOREHOLE

MB16a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	20-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552130.24
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874378.67



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
18.2				
18.4				
18.6				
18.8				
19				
19.2				
19.4				
19.6				
19.8				
20				
20.2				
20.4				
20.6				
20.8				
21				
21.2				
21.4				
21.6				
21.8				
22				
22.2				
22.4				

BOREHOLE

MB16a

CLIENT HANSON CONSTRUCTION MATERIALS

PROJECT No. 12035

TOTAL DEPTH 20mBGL

DRILL DATE 20-Apr-20

PROJECT TWEED SAND PLANT EXPANSION

SURFACE RL Not surveyed

DRILLED BY PACIFIC GEOTECH

EASTING 552130.24

LOCATION CUDGEN, NSW

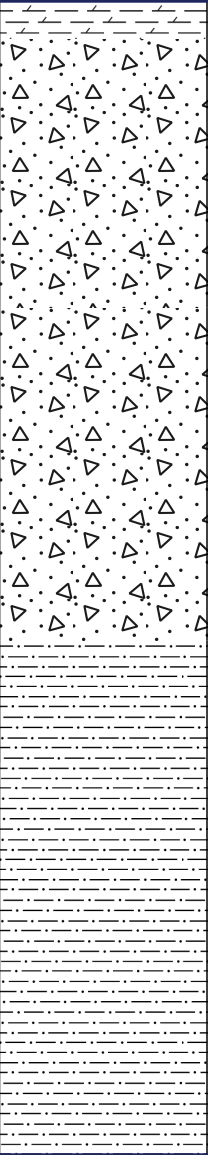
DRILL METHOD AUGER

LOGGED BY GLH

NORTHING 6874378.67

+GILBERT

SUTHERLAND

DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
0			Very dark grey (10YR 3/1) silty clay loam ; no coarse fragments; moist; massive structure; weak consistence; no segregations; change to;	NATURAL
0.2			Greyish brown (10YR 5/2) heavy loamy sand ; no coarse fragments; moist; massive structure; very weak consistence; no segregations; change to;	NATURAL
0.4				
0.6				
0.8				
1				
1.2			Grey (2.5Y 5/1) heavy loamy sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
1.4				
1.6				
1.8				
2				
2.2				
2.4				
2.6			Dark grey (5Y 4/1) clayey sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
2.8				
3				
3.2				
3.4				
3.6				
3.8				
4				
4.2				
4.4				

BOREHOLE
MB17a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	21-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552301.08
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874902.89



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
4.6				
4.8				
5				
5.2				
5.4				
5.6				
5.8				
6				
6.2				
6.4				
6.6				
6.8				
7				
7.2				
7.4				
7.6				
7.8				
8				
8.2			Grey (5Y 5/1) heavy loamy sand ; no coarse fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
8.4				
8.6				
8.8				
9				

BOREHOLE
MB17a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	21-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552301.08
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874902.89



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
9.2				
9.4				
9.6				
9.8				
10				
10.2				
10.4				
10.6				
10.8				
11				
11.2				
11.4				
11.6				
11.8				
12				
12.2				
12.4				
12.6				
12.8				
13				
13.2				
13.4				

BOREHOLE

MB17a

CLIENT HANSON CONSTRUCTION MATERIALS

PROJECT No. 12035

TOTAL DEPTH 20mBGL

DRILL DATE 21-Apr-20

PROJECT TWEED SAND PLANT EXPANSION

SURFACE RL Not surveyed

DRILLED BY PACIFIC GEOTECH EASTING 552301.08

LOCATION CUDGEN, NSW

DRILL METHOD AUGER

LOGGED BY GLH

NORTHING 6874902.89

+ GILBERT SUTHERLAND

DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
13.6				
13.8				
14				
14.2				
14.4				
14.6				
14.8				
15				
15.2				
15.4				
15.6				
15.8				
16			Grey (5Y 5/1) sandy loam ; no coarse fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
16.2				
16.4				
16.6				
16.8				
17			Very dark grey (5Y 3/1) clayey sand ; no coarse fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
17.2				
17.4				
17.6				
17.8				
18				

BOREHOLE
MB17a

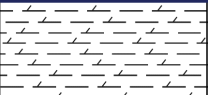
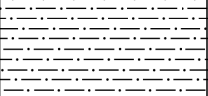
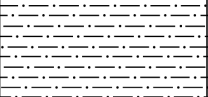
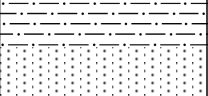
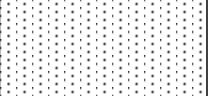
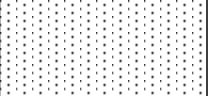
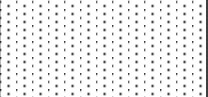
CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	21-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552301.08
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874902.89



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
18.2				
18.4				
18.6				
18.8				
19				
19.2				
19.4			Very dark greenish grey (10Y 3/1) silty medium clay ; no coarse fragments; wet; massive structure; loose consistence; no segregations; borehole terminated at 20mBGL.	NATURAL
19.6				
19.8				
20				
20.2				
20.4				
20.6				
20.8				
21				
21.2				
21.4				
21.6				
21.8				
22				
22.2				
22.4				

BOREHOLE MB17a	CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	20mBGL	DRILL DATE	21-Apr-20
	PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552301.08
	LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874902.89

+GILBERT
SUTHERLAND

DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
0			Black (10YR 2/1) silty clay loam ; no coarse fragments; moist; massive structure; weak consistence; no segregations; change to;	NATURAL
0.2				
0.4			Grey (10YR 5/1) loamy sand ; no coarse fragments; moist; massive structure; very weak consistence; no segregations; change to;	NATURAL
0.6				
0.8	▼			
1			Grey (7.5YR 5/1) loamy sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
1.2				
1.4			Very dark grey (5Y 3/1) clayey sand ; no coarse fragments; wet; massive structure; very weak consistence; no segregations; change to;	NATURAL
1.6				
1.8				
2				
2.2				
2.4				
2.6				
2.8				
3			Grey (5Y 5/1) sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
3.2				
3.4				
3.6				
3.8				
4				
4.2				
4.4				

BOREHOLE

MB18a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	21.5mBGL	DRILL DATE	22-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552979.83
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874672.57

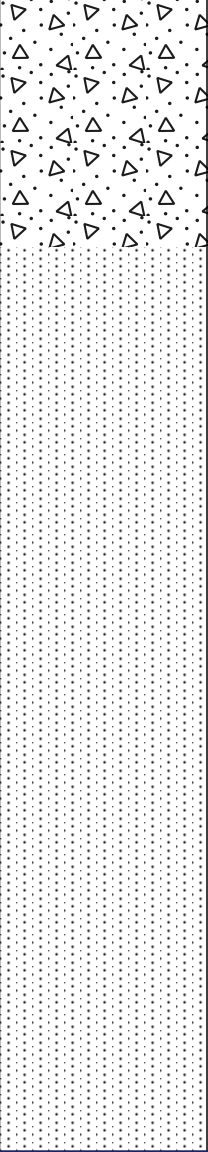


DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
4.6				
4.8				
5				
5.2				
5.4				
5.6				
5.8				
6			Dark grey (5Y 4/1) loamy sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
6.2				
6.4				
6.6				
6.8				
7				
7.2				
7.4				
7.6				
7.8				
8				
8.2				
8.4				
8.6				
8.8				
9				

BOREHOLE
MB18a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	21.5mBGL	DRILL DATE	22-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552979.83
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874672.57

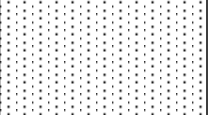


DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
9.2 9.4 9.6 9.8 10 10.2 10.4 10.6 10.8 11 11.2 11.4 11.6 11.8 12 12.2 12.4 12.6 12.8 13 13.2 13.4			Grey (5Y 5/1) sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL

BOREHOLE
MB18a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	21.5mBGL	DRILL DATE	22-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552979.83
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874672.57



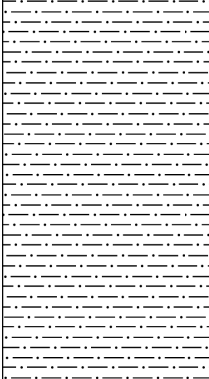
DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
13.6				
13.8				
14			Dark grey (5Y 4/1) loamy sand ; very few, medium gravelly, subangular calcareous sand fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
14.2				
14.4				
14.6			Dark grey (5Y 4/1) loamy sand ; no coarse fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
14.8				
15				
15.2				
15.4				
15.6				
15.8				
16				
16.2				
16.4				
16.6				
16.8				
17				
17.2				
17.4				
17.6				
17.8				
18				

BOREHOLE

MB18a

CLIENT	HANSON CONSTRUCTION MATERIALS	PROJECT No.	12035	TOTAL DEPTH	21.5mBGL	DRILL DATE	22-Apr-20
PROJECT	TWEED SAND PLANT EXPANSION	SURFACE RL	Not surveyed	DRILLED BY	PACIFIC GEOTECH	EASTING	552979.83
LOCATION	CUDGEN, NSW	DRILL METHOD	AUGER	LOGGED BY	GLH	NORTHING	6874672.57



DEPTH (mBGL)	GROUNDWATER	GRAPHIC LOG	SOIL DESCRIPTION	ORIGIN
18.2				
18.4				
18.6			Very dark grey (5Y 3/1) clayey sand ; no coarse fragments; wet; massive structure; loose consistence; no segregations; change to;	NATURAL
18.8				
19				
19.2				
19.4				
19.6				
19.8				
20				
20.2				
20.4				
20.6				
20.8				
21				
21.2				
21.4				
21.6				
21.8				
22				
22.2				
22.4				

BOREHOLE

MB18a

CLIENT

HANSON CONSTRUCTION MATERIALS

PROJECT

TWEED SAND PLANT EXPANSION

LOCATION

CUDGEN, NSW

PROJECT No.

12035

SURFACE RL

Not surveyed

DRILL METHOD

AUGER

TOTAL DEPTH

21.5mBGL

DRILLED BY

PACIFIC GEOTECH

LOGGED BY

GLH

DRILL DATE

22-Apr-20

EASTING

552979.83

NORTHING

6874672.57

+GILBERT

SUTHERLAND

11 Appendix 3 – Groundwater quality graphs, tables and plots

Figure A2.1 Shallow Groundwater | pH

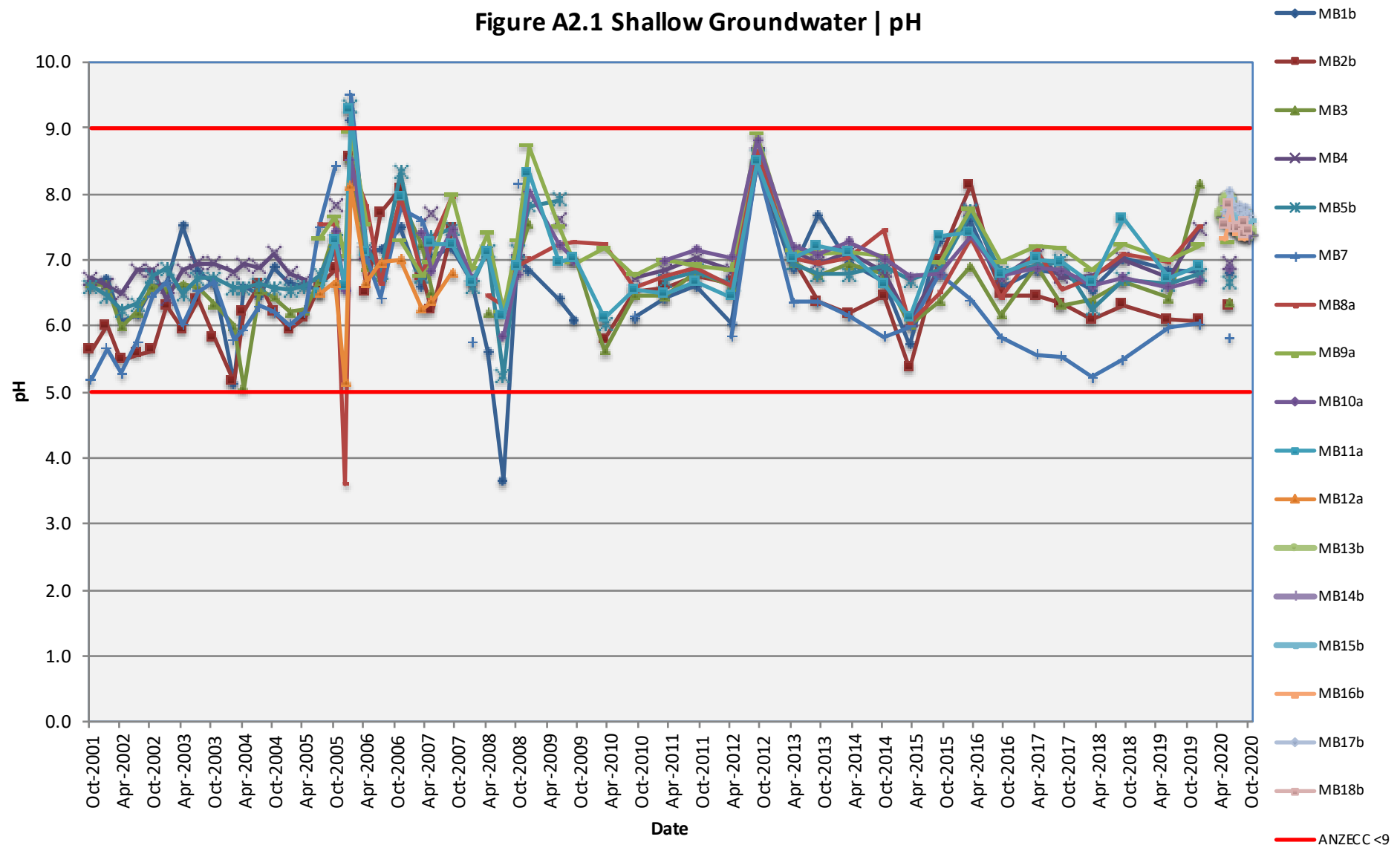


Figure A2.2 Deep Groundwater | pH

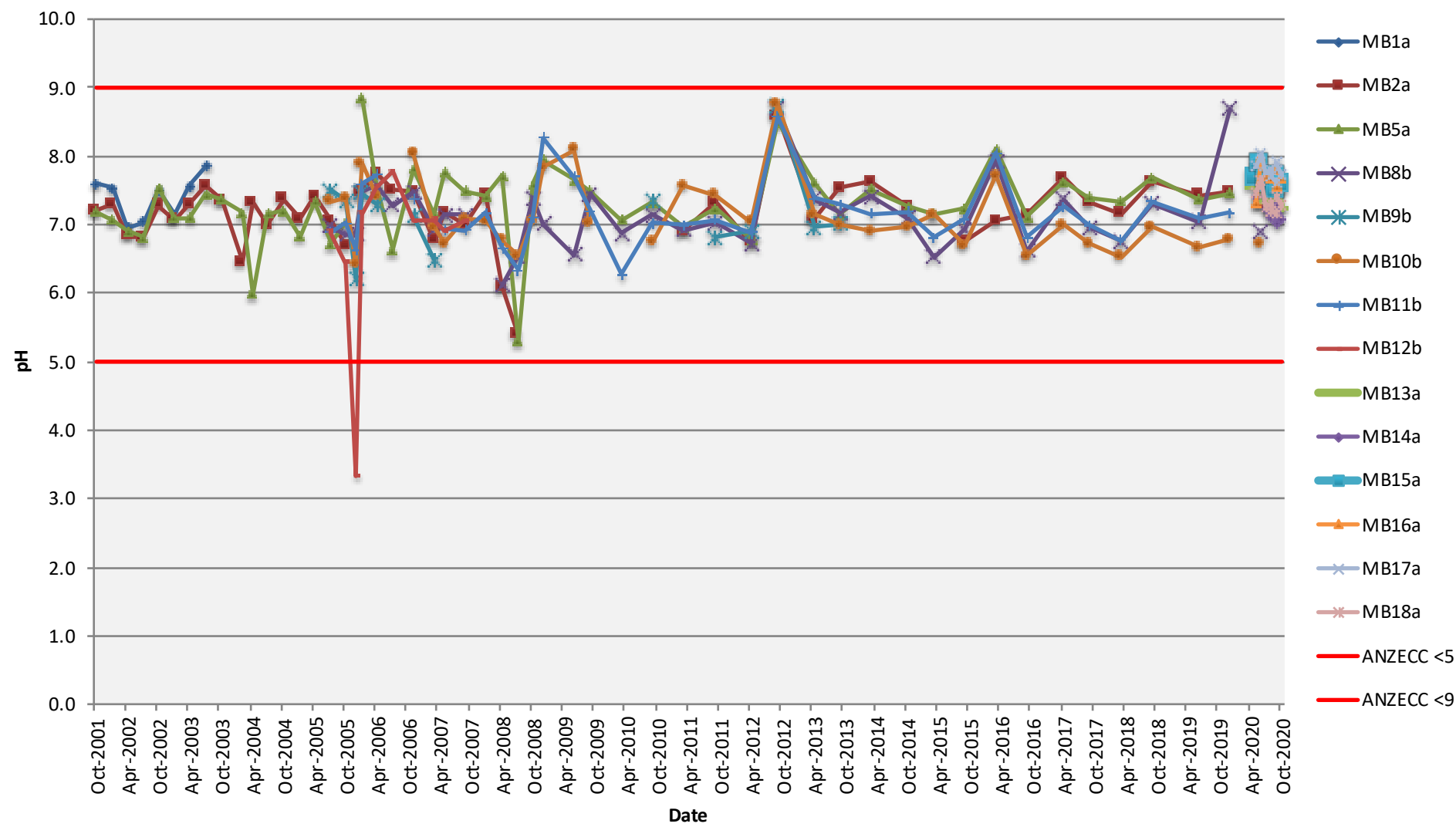


Figure A2.3 Shallow Groundwater | Electrical Conductivity

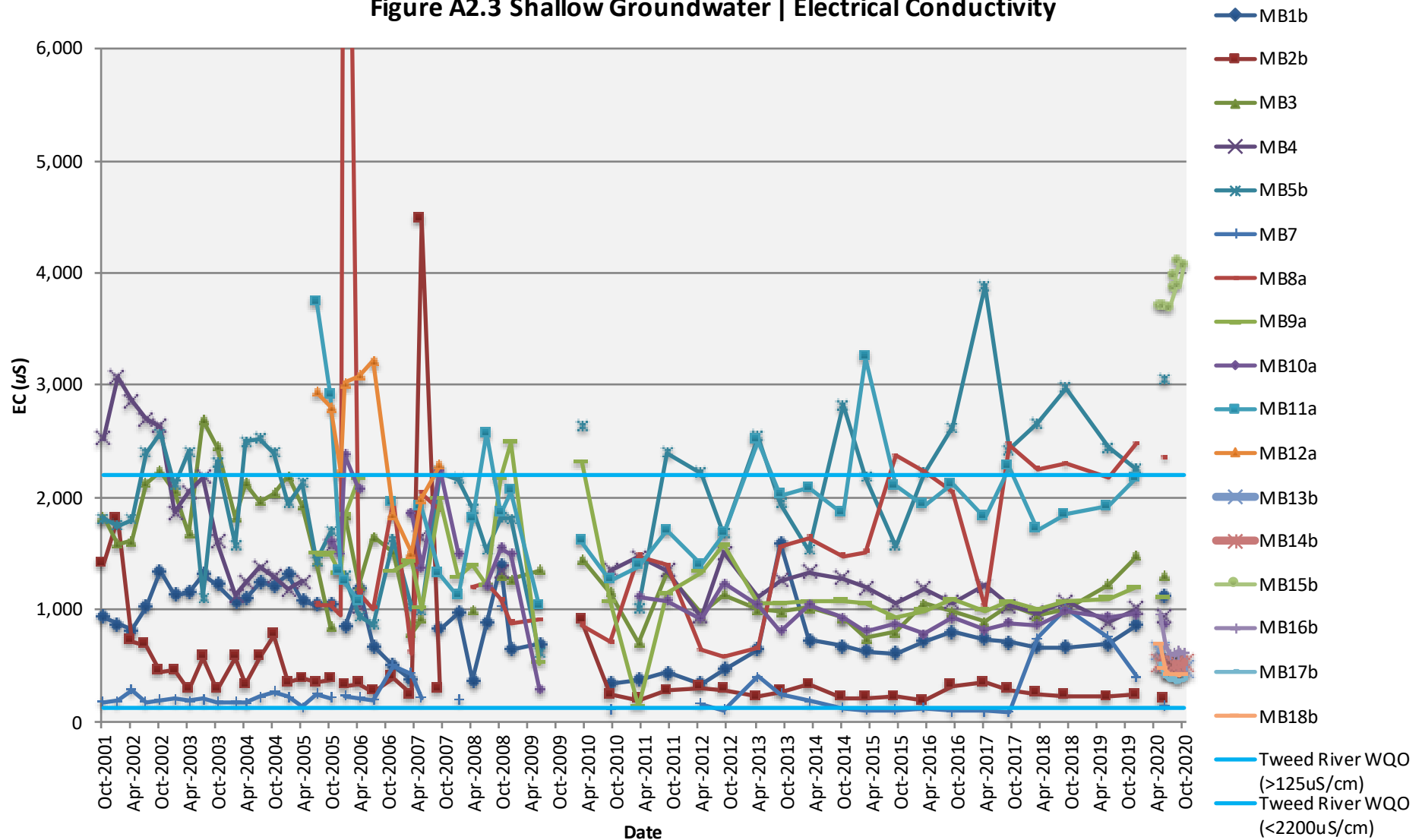


Figure A2.4 Deep Groundwater | Electrical Conductivity

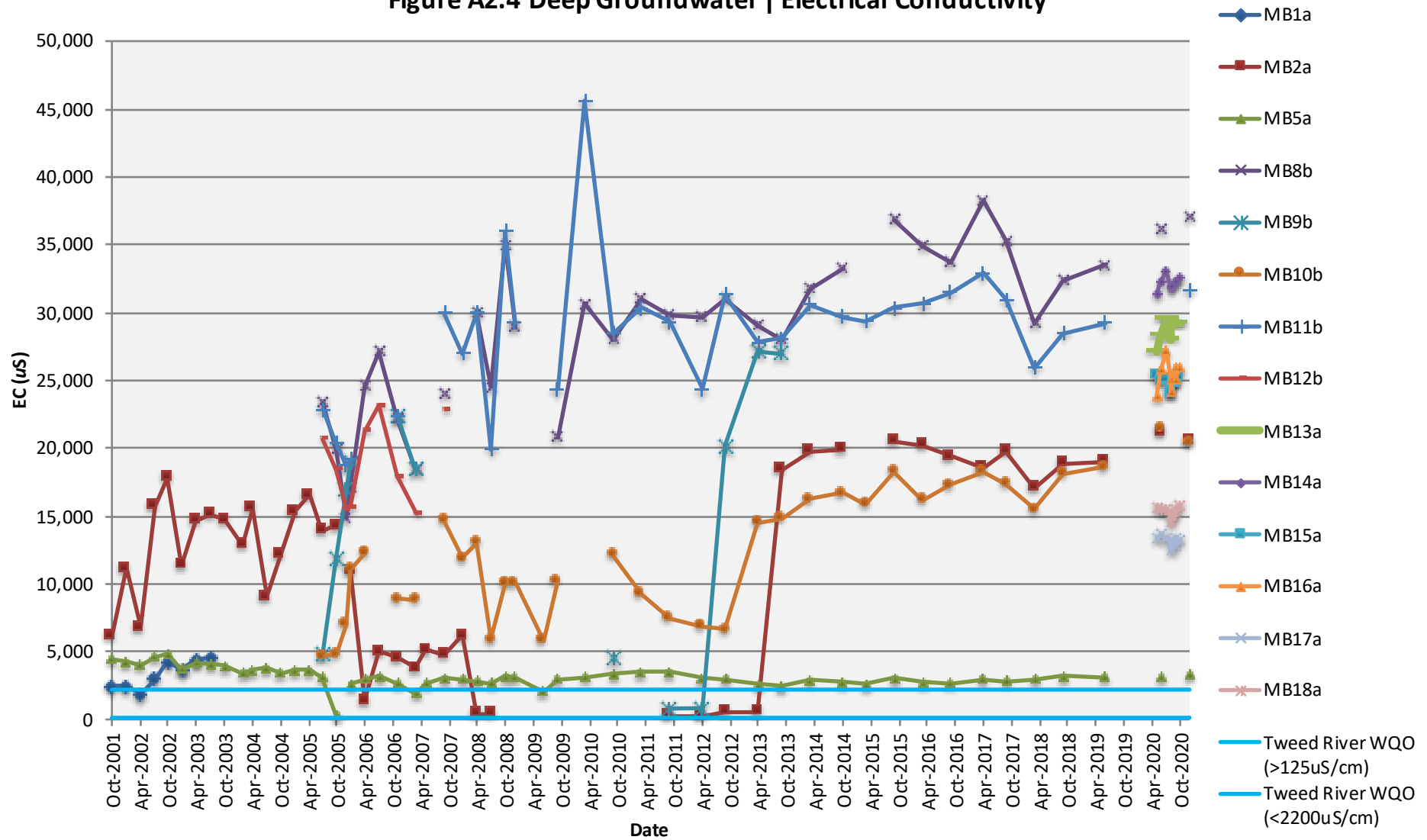


Figure A2.5 Shallow Groundwater | Dissolved Oxygen

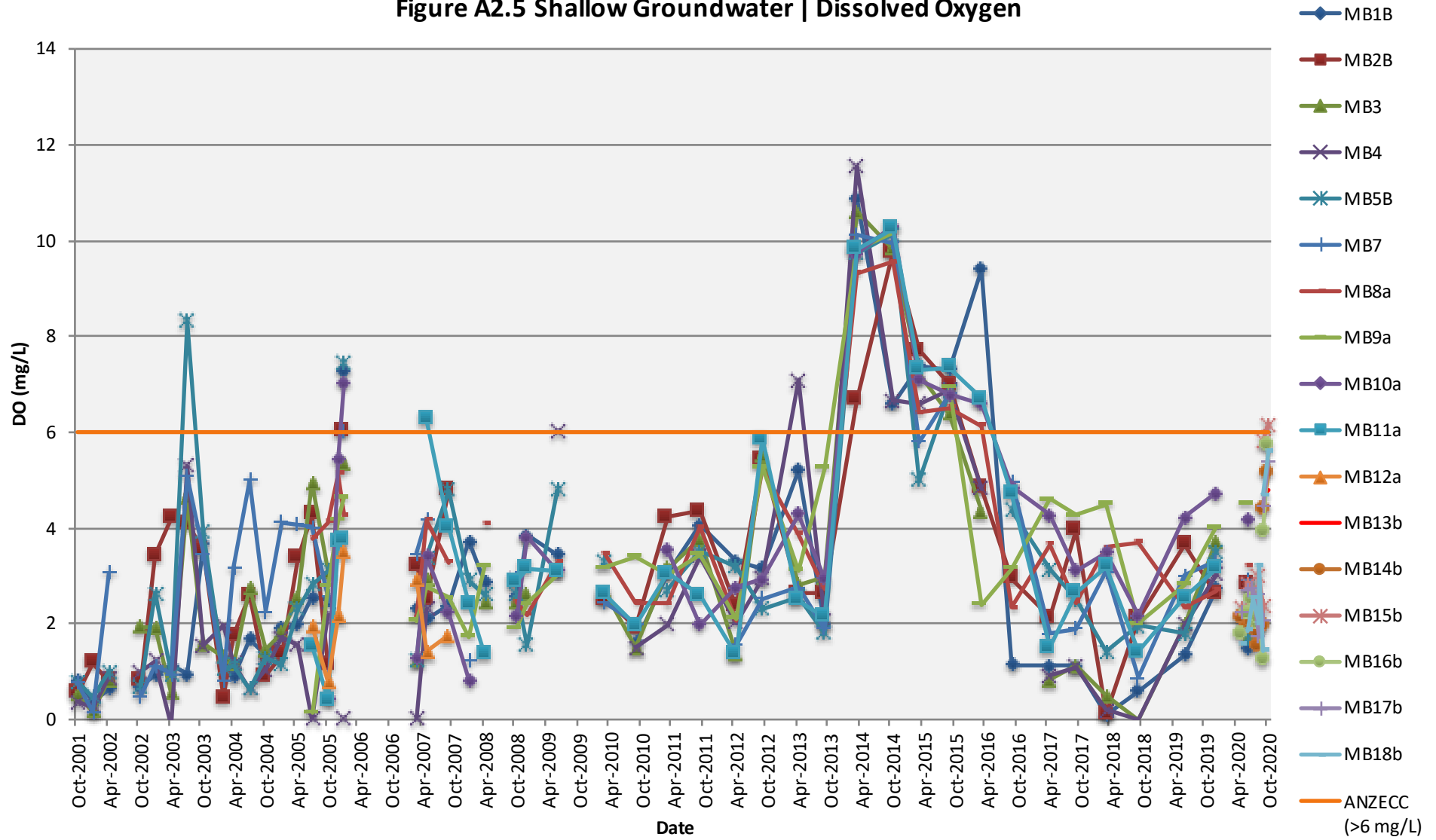


Figure A2.6 Deep Groundwater | Dissolved Oxygen

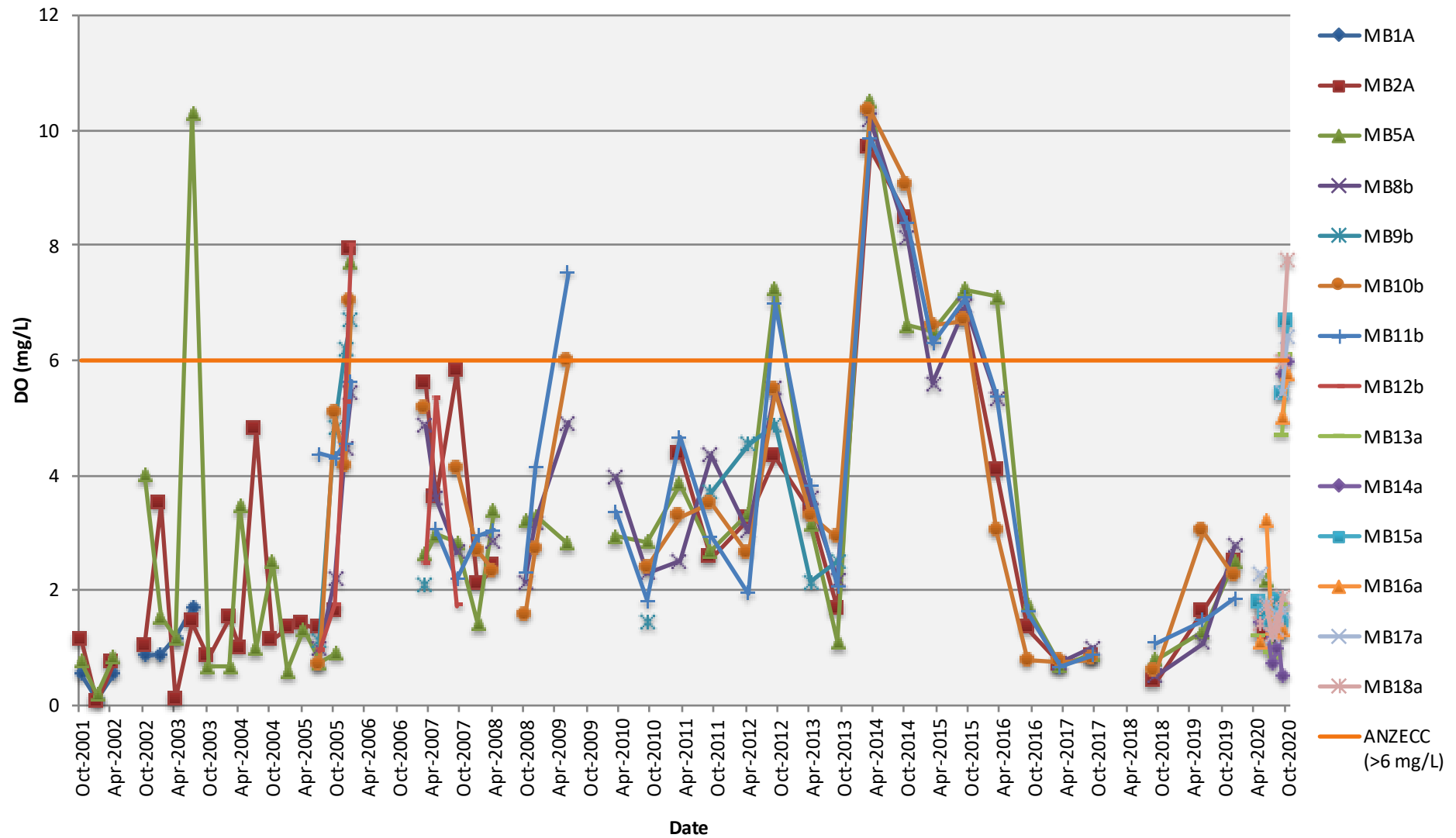


Figure A2.7 Shallow Groundwater | Sodium

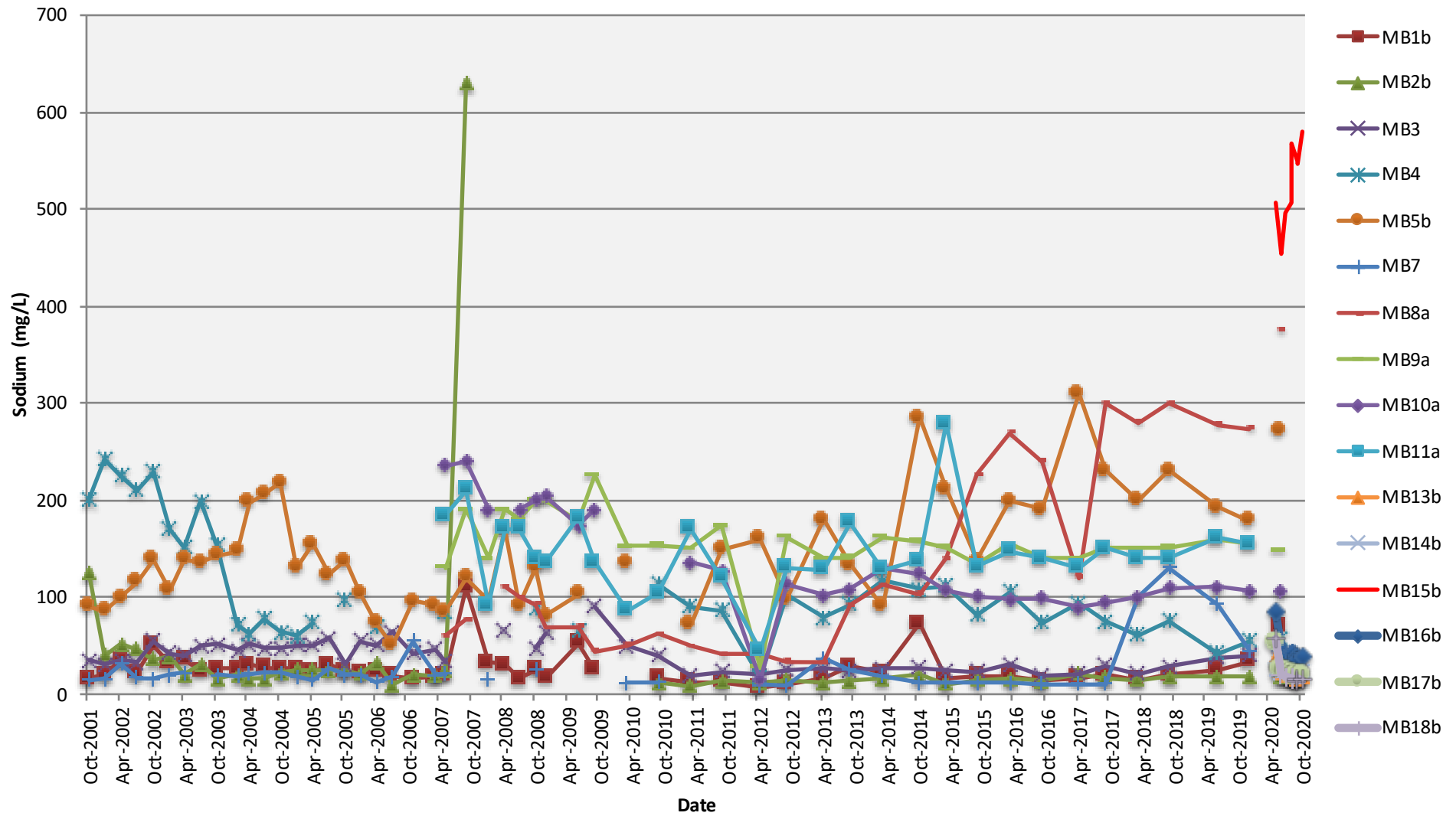


Figure A2.8 Deep Groundwater | Sodium

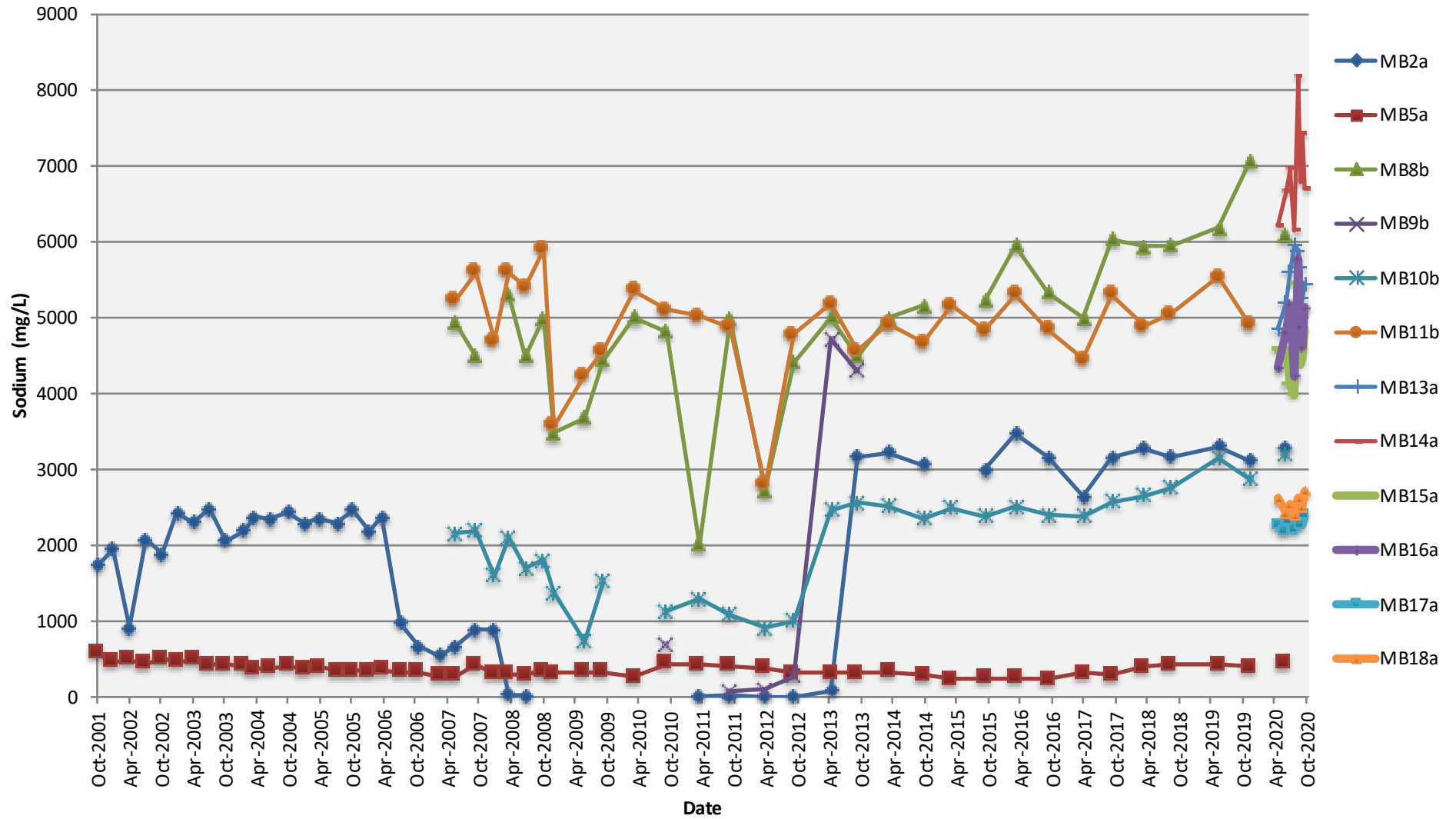


Figure A2.9 Shallow Groundwater | Potassium

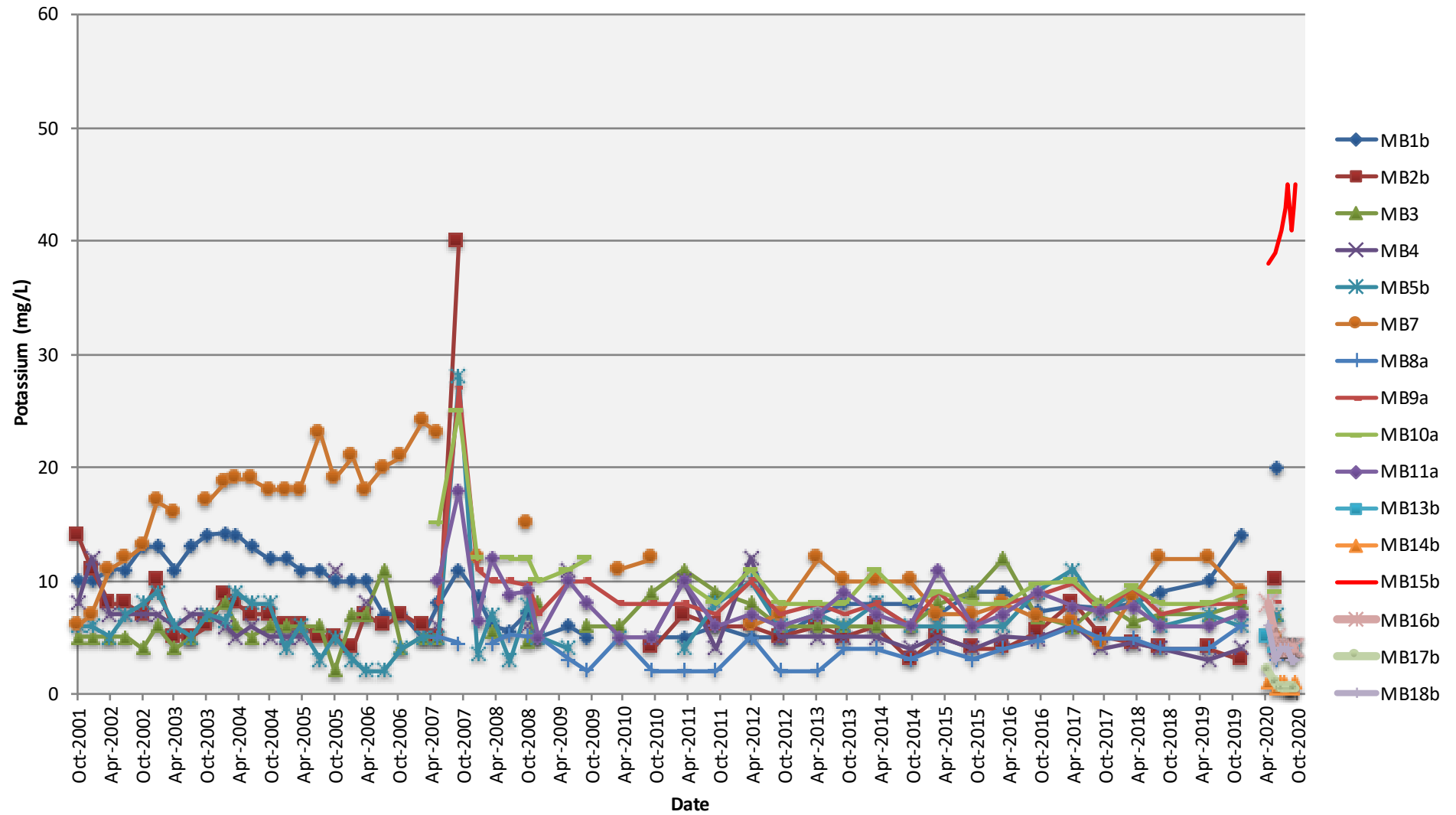


Figure A2.10 Deep Groundwater | Potassium

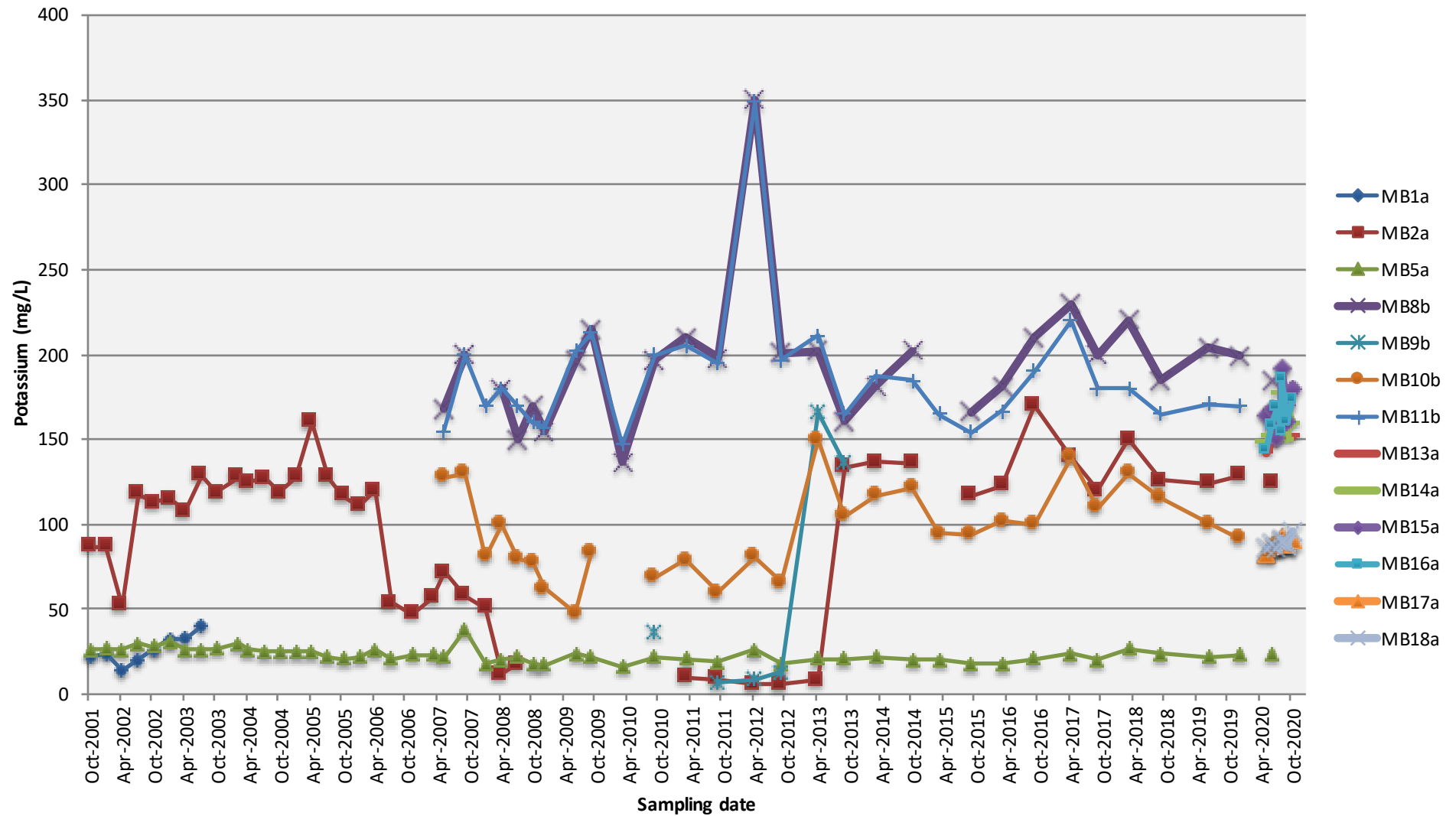


Figure A2.11 Shallow Groundwater | Magnesium

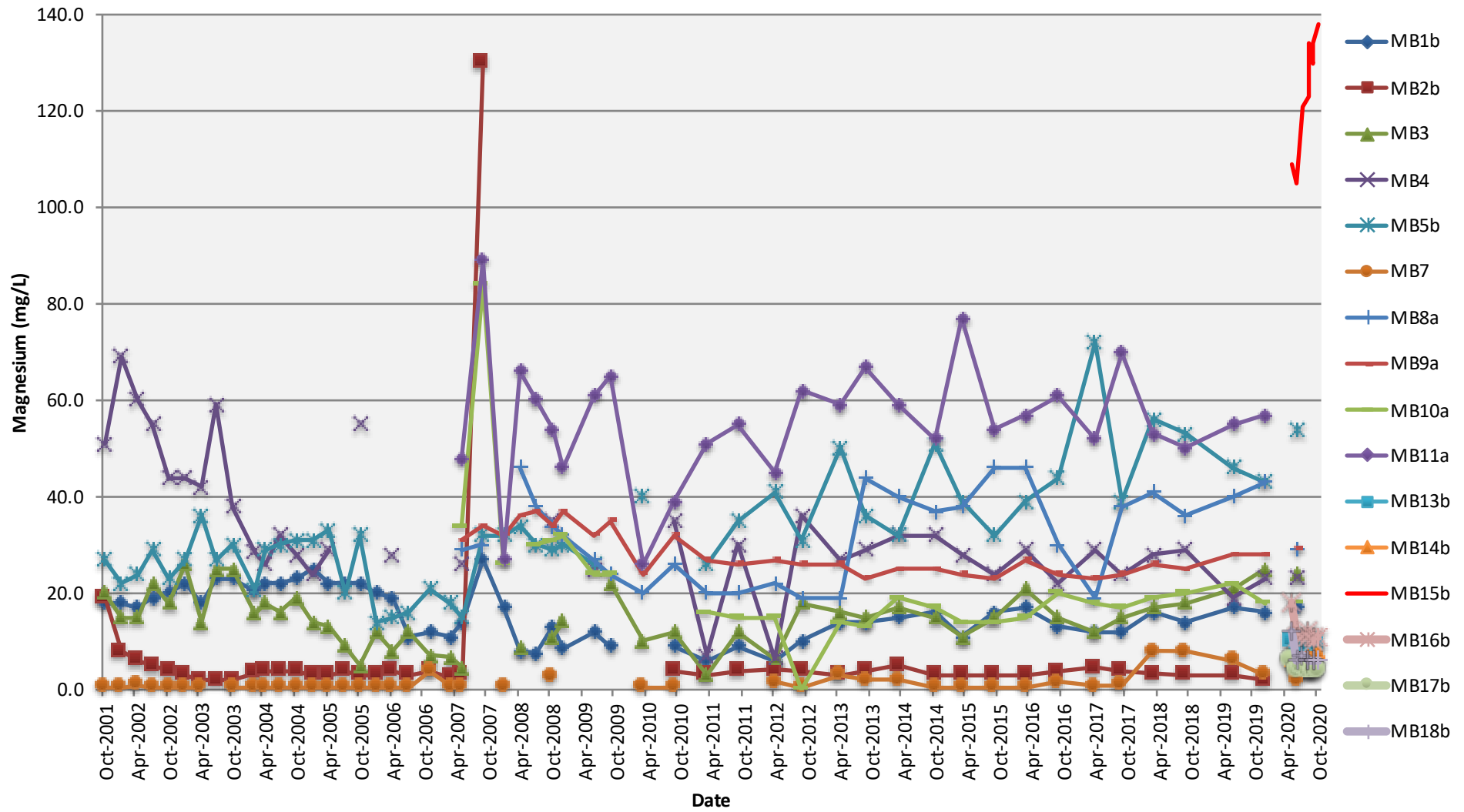


Figure A2.12 Deep Groundwater | Magnesium

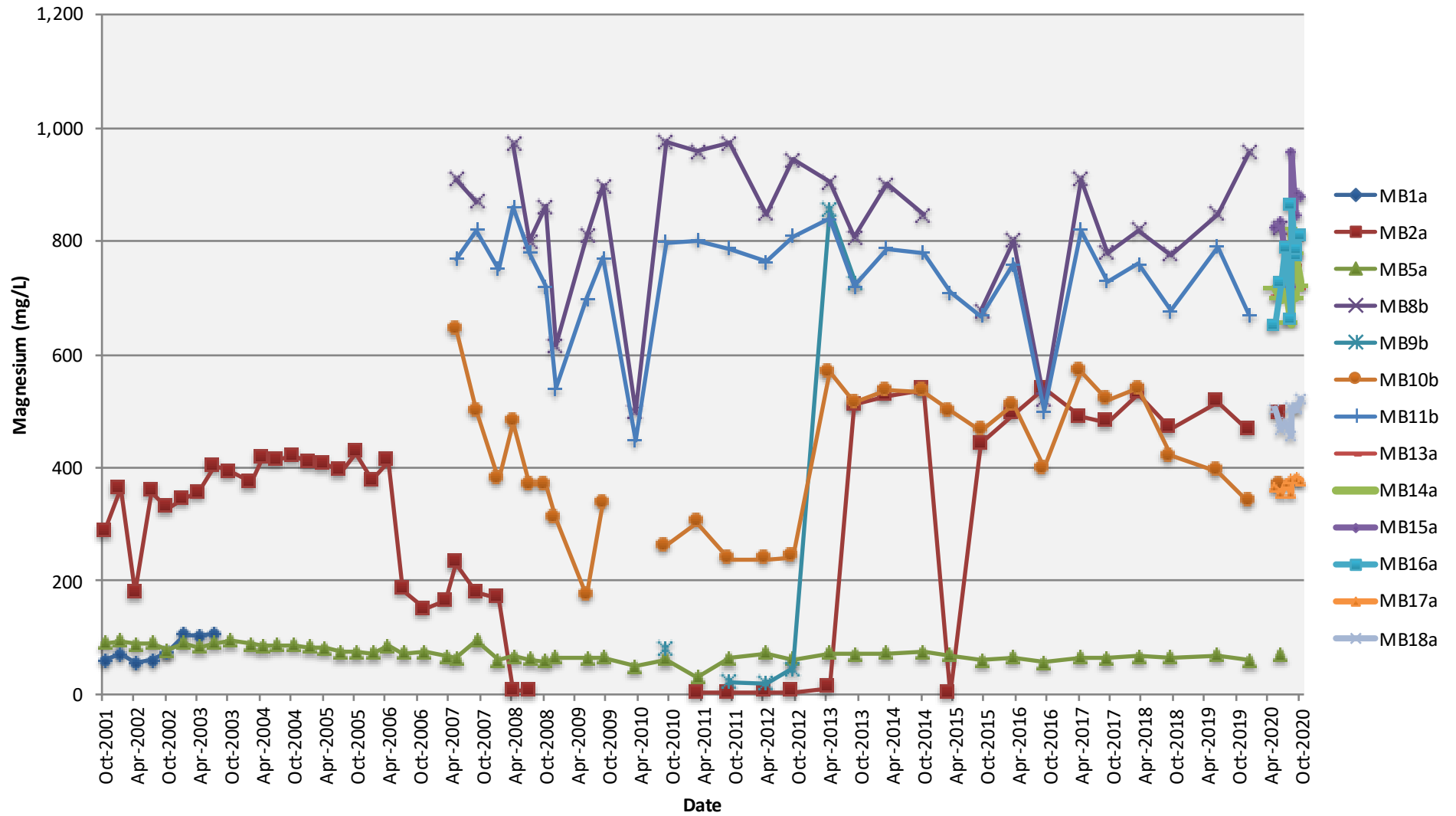


Figure A2.13 Shallow Groundwater | Chloride

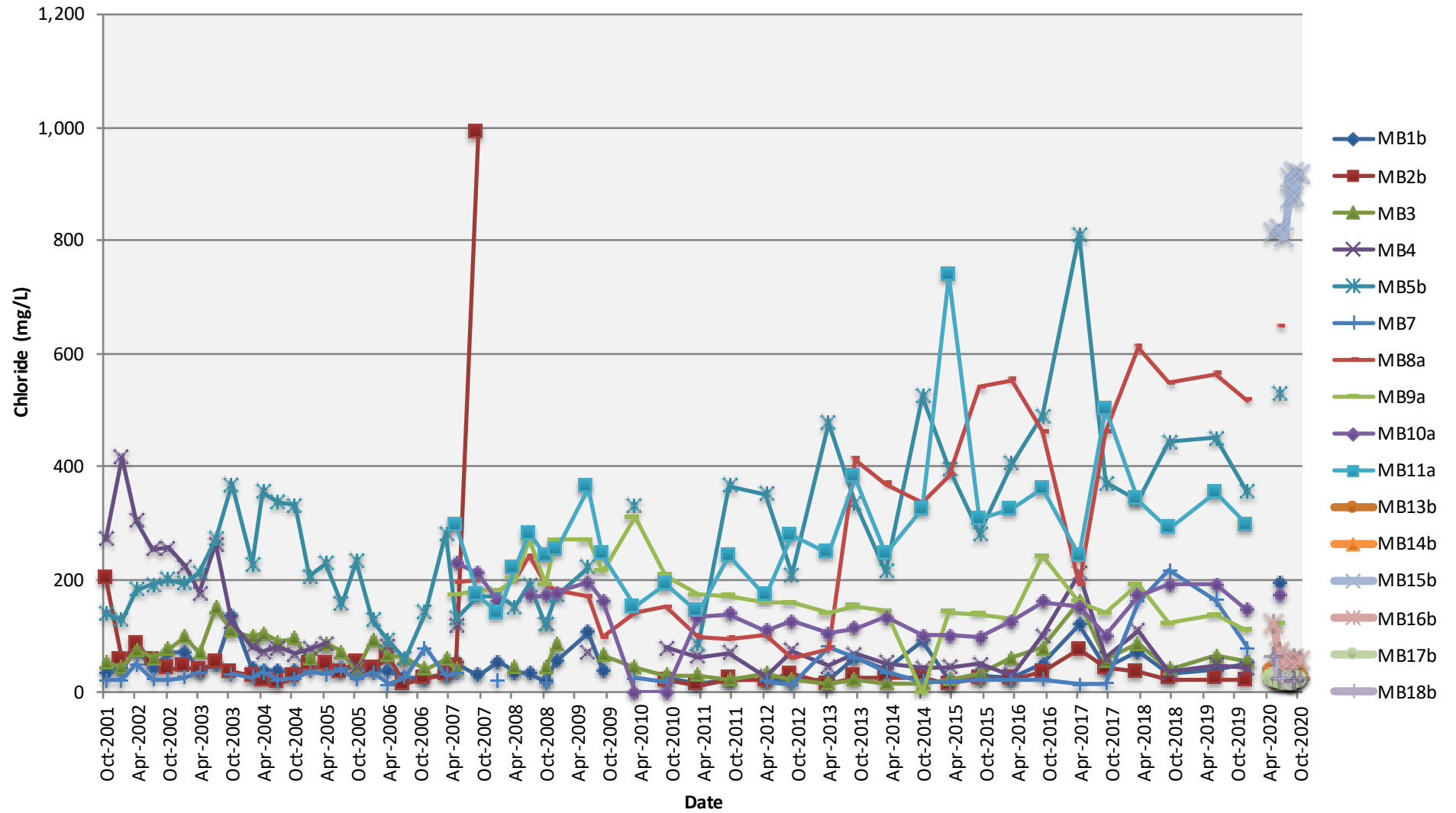


Figure A2.14 Deep Groundwater | Chloride

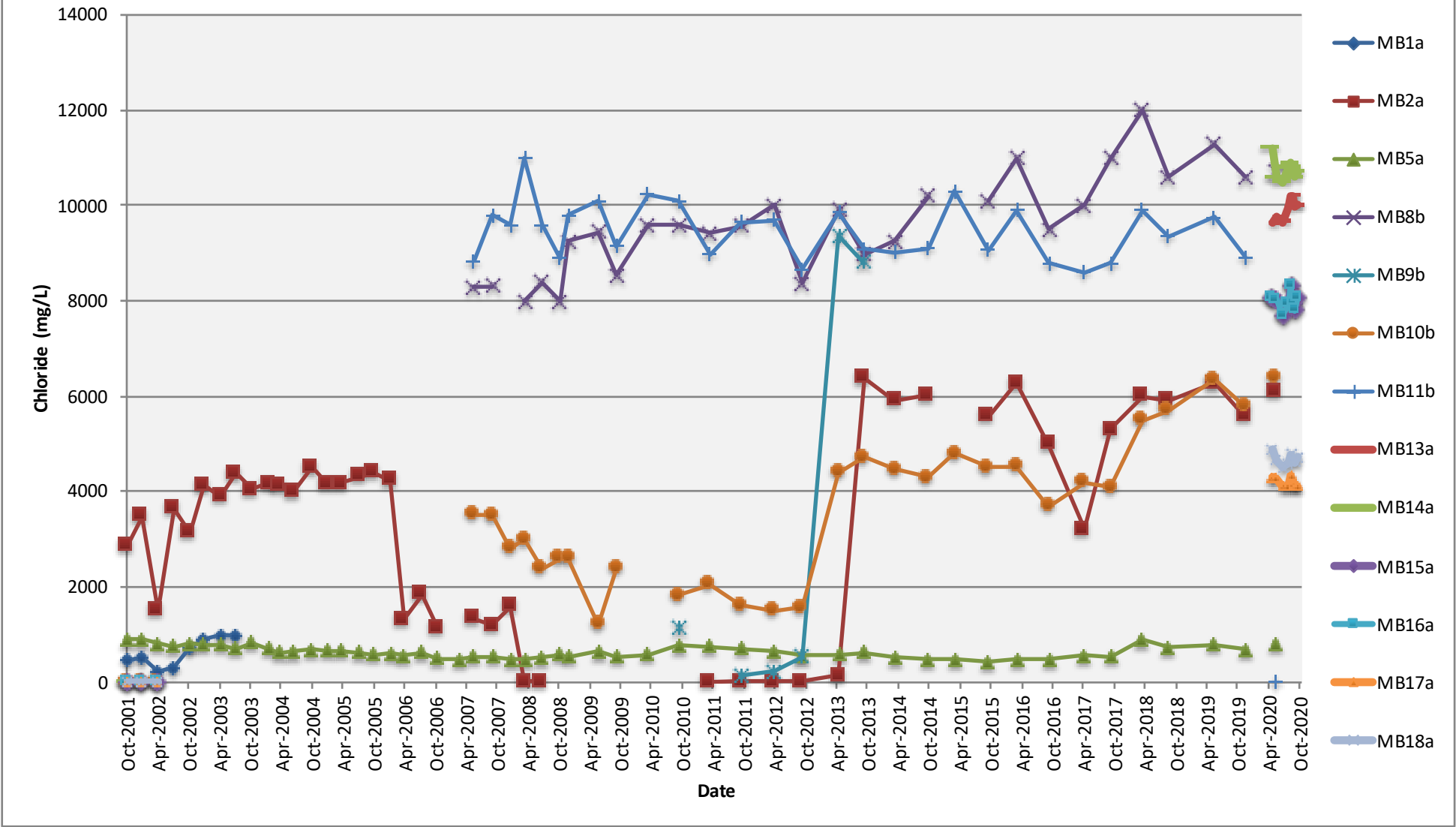


Figure A2.15 Shallow Groundwater | Sulfate

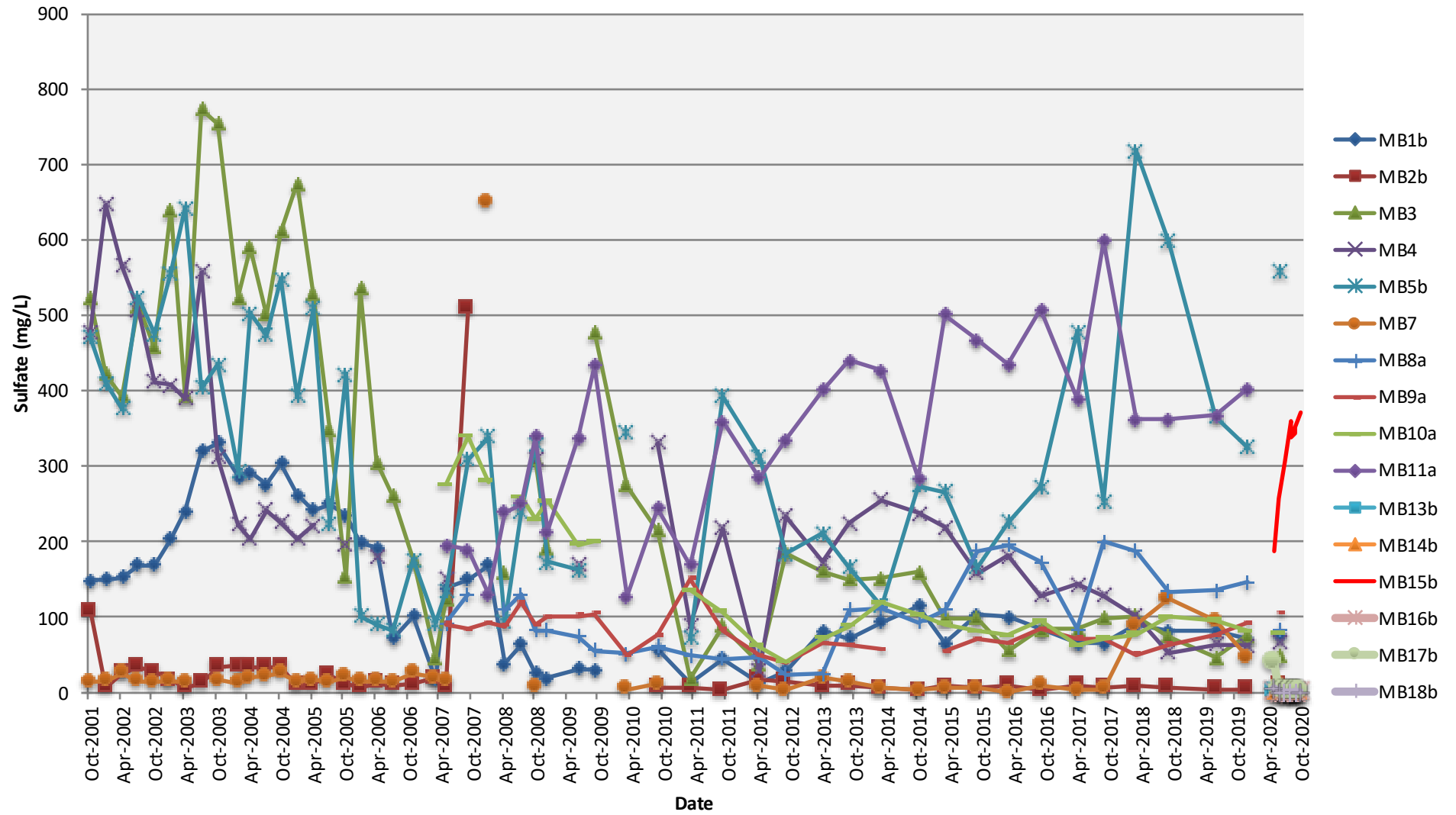


Figure A2.16 Deep Groundwater | Sulfate

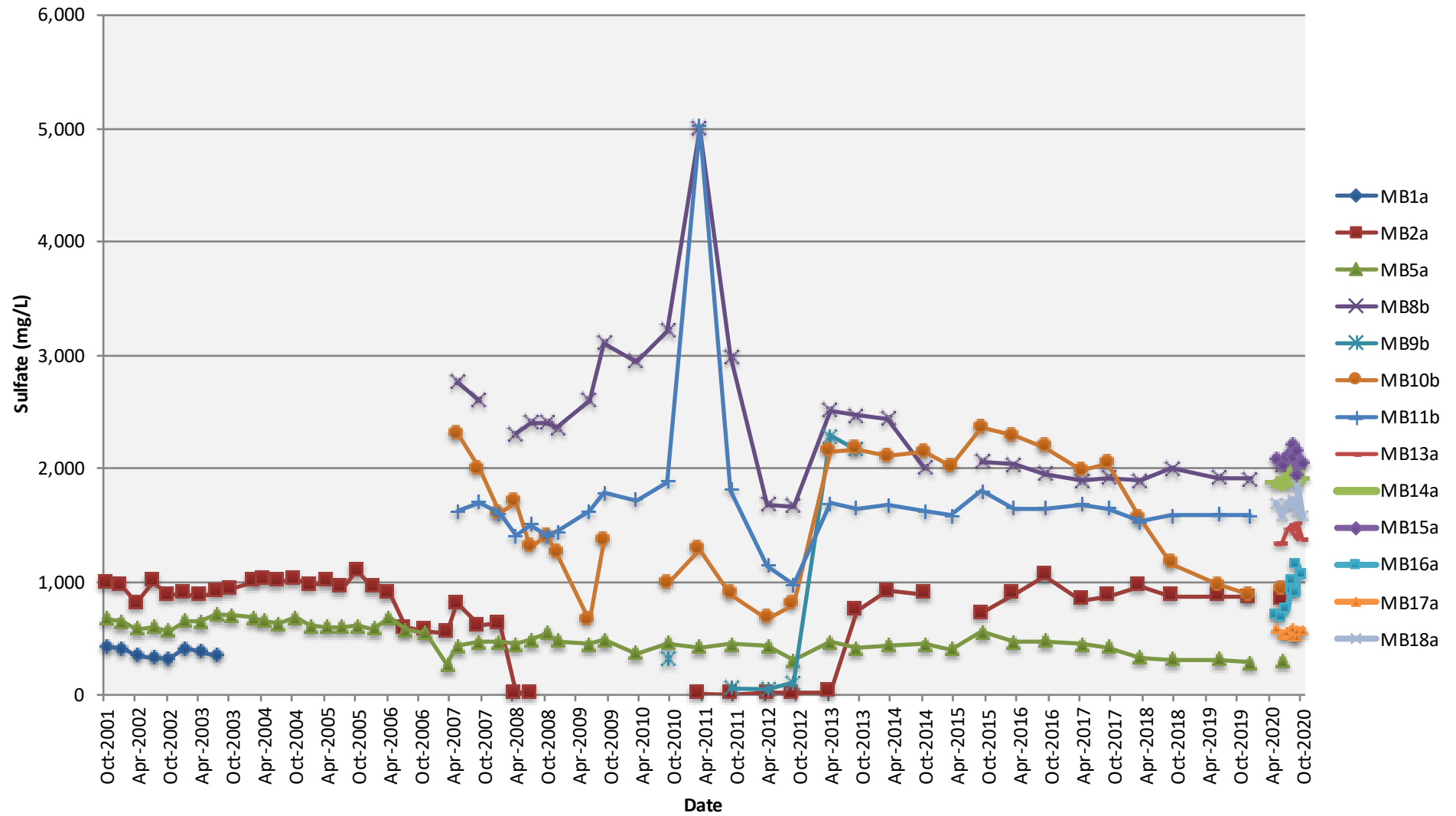


Figure A2.17 Shallow Groundwater | Alkalinity

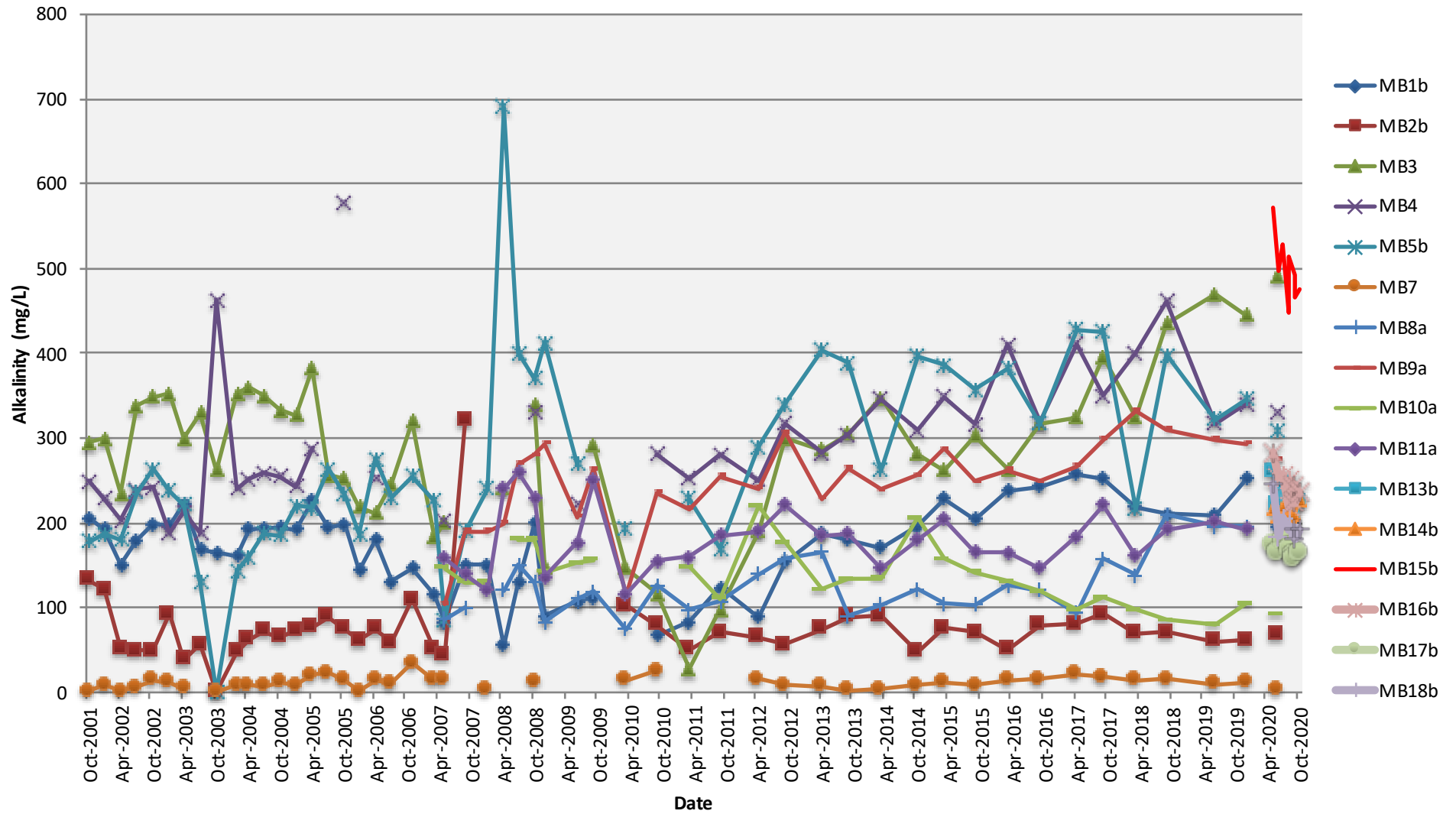


Figure A2.18 Deep Groundwater | Alkalinity

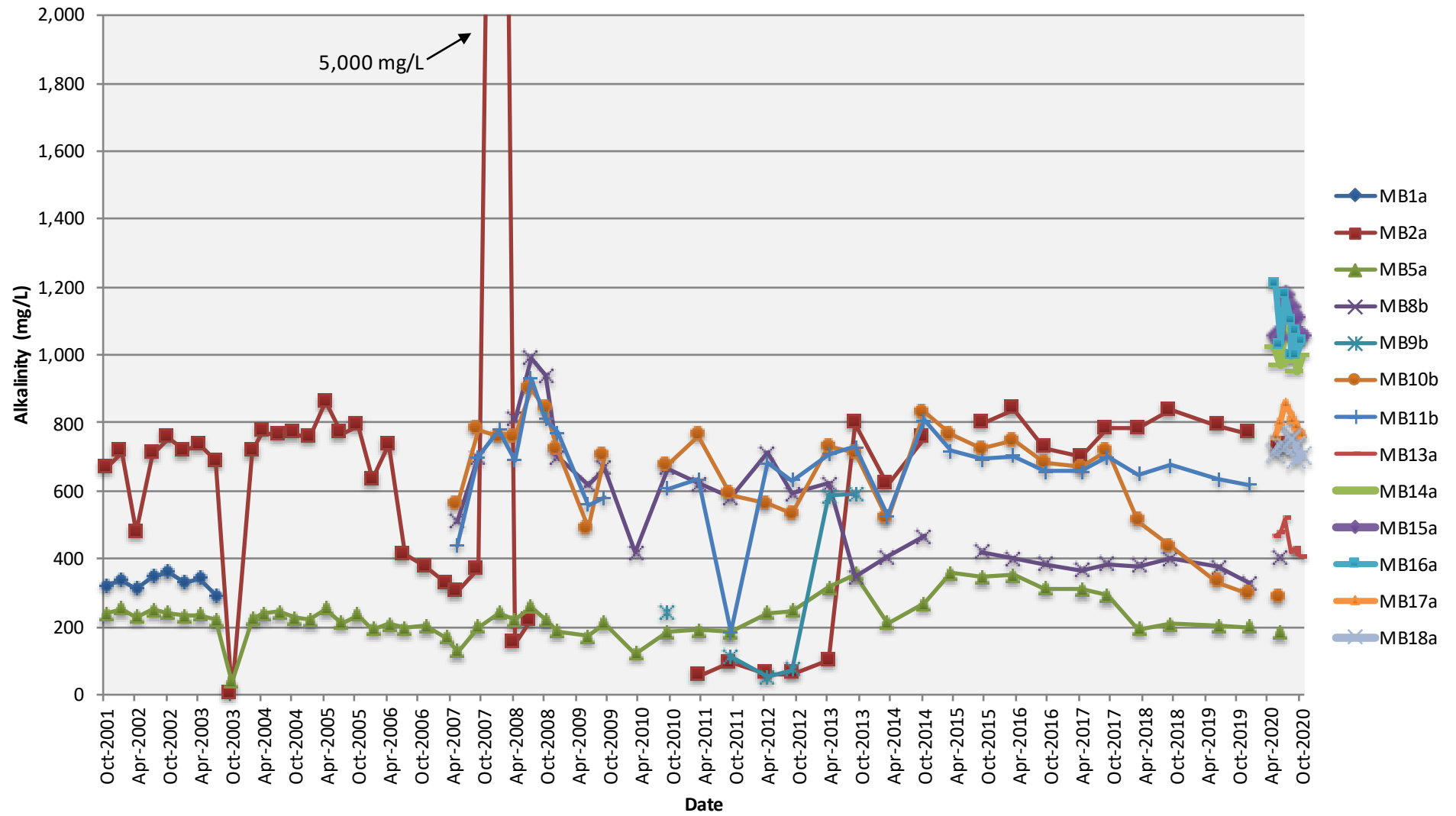


Figure A2.19 Shallow Groundwater | Dissolved Iron

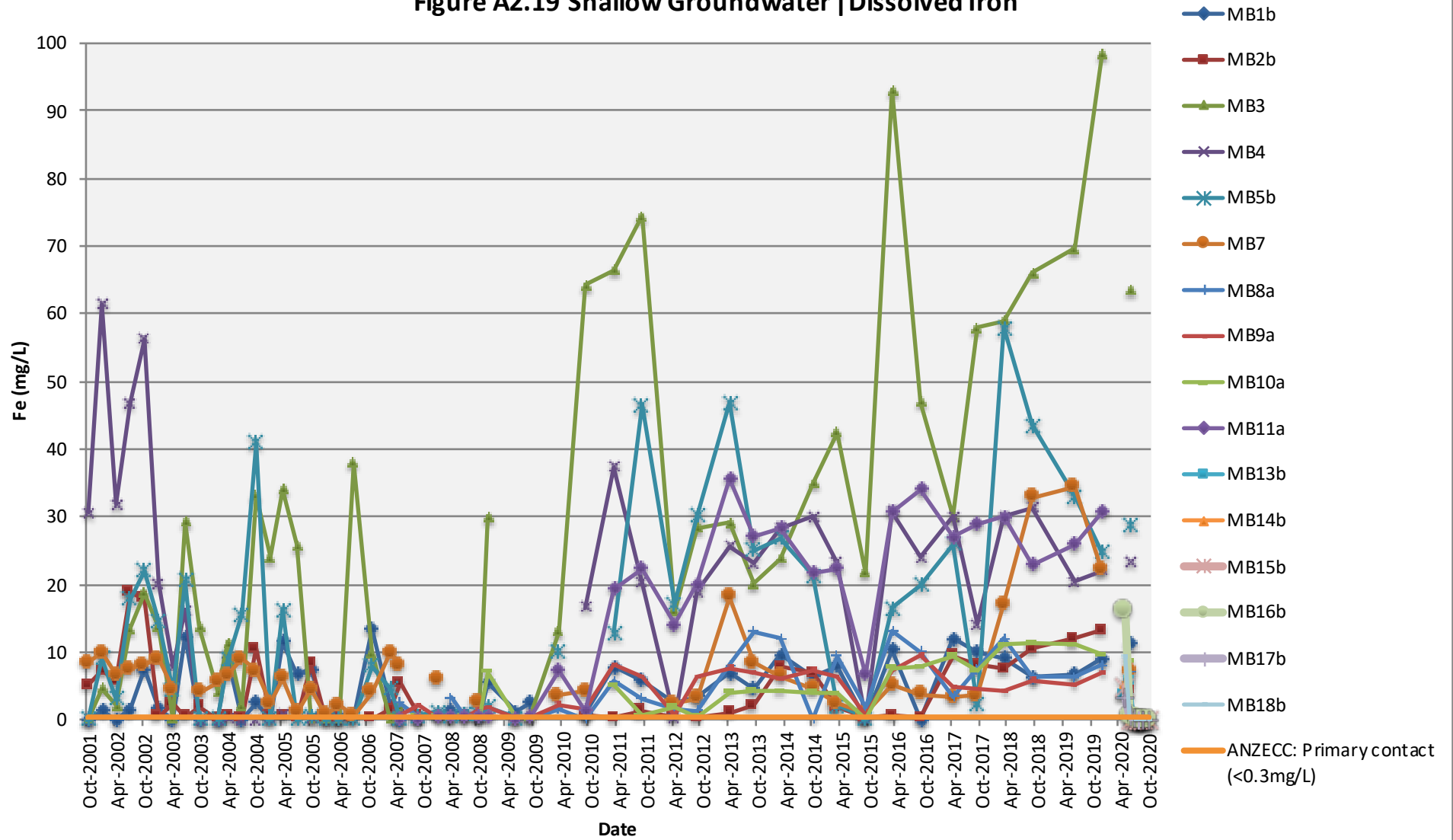


Figure A2.20 Deep Groundwater | Dissolved Iron

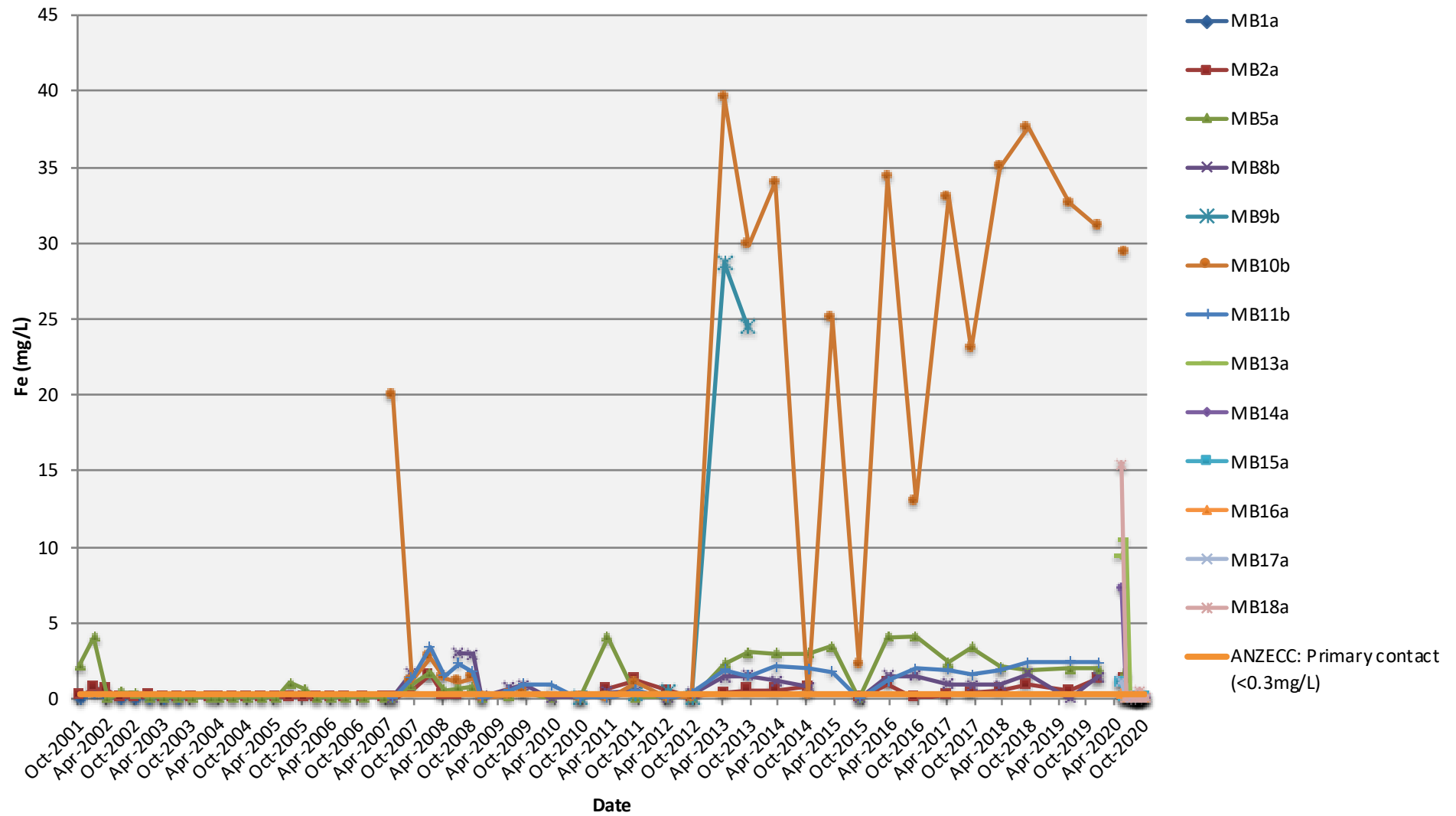


Figure A2.21 Shallow Groundwater | Dissolved Aluminium

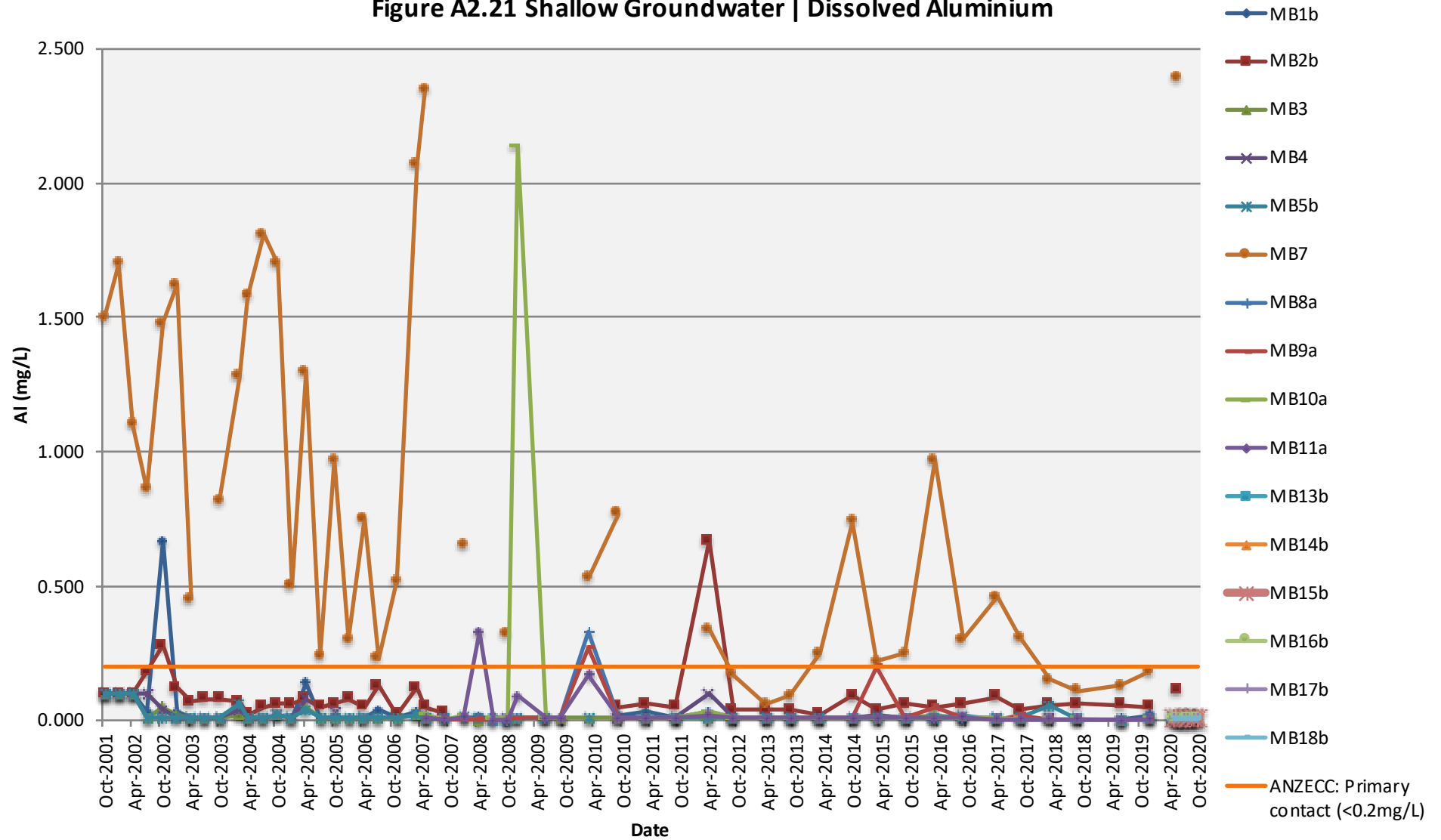


Figure A2.22 Deep Groundwater | Dissolved Aluminium

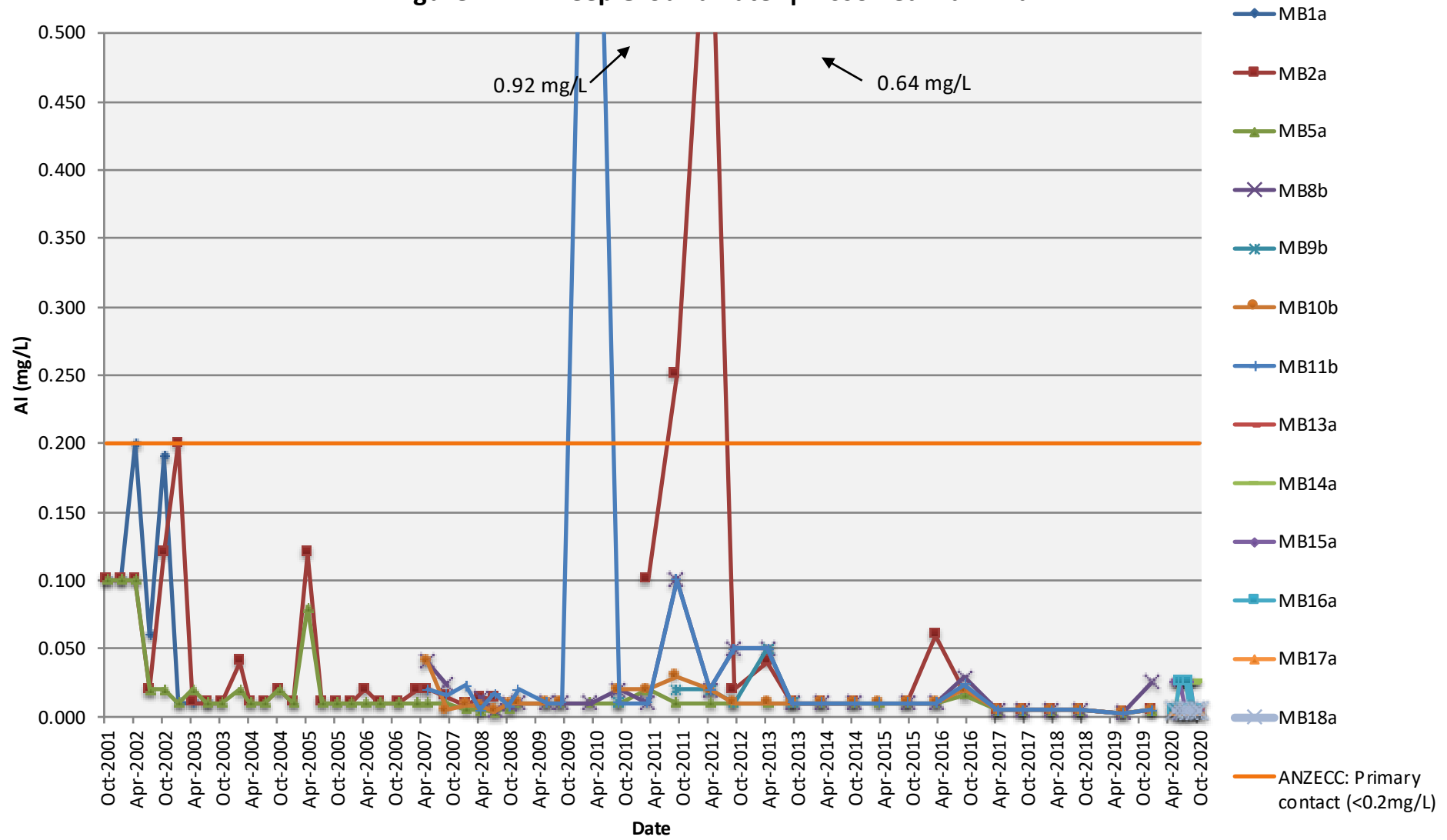


Figure A2.23 Shallow Groundwater | Arsenic

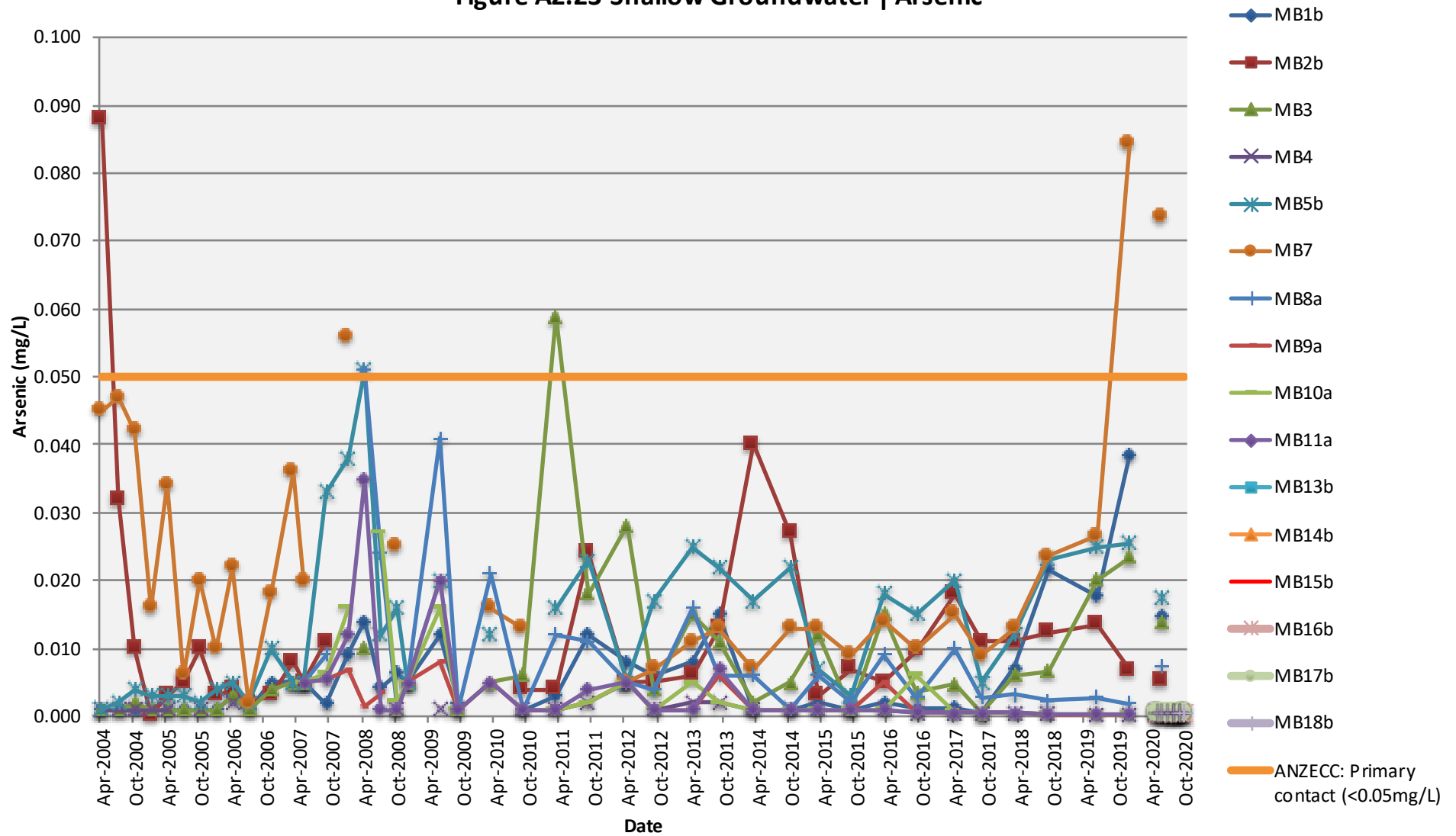


Figure A2.24 Deep Groundwater | Arsenic

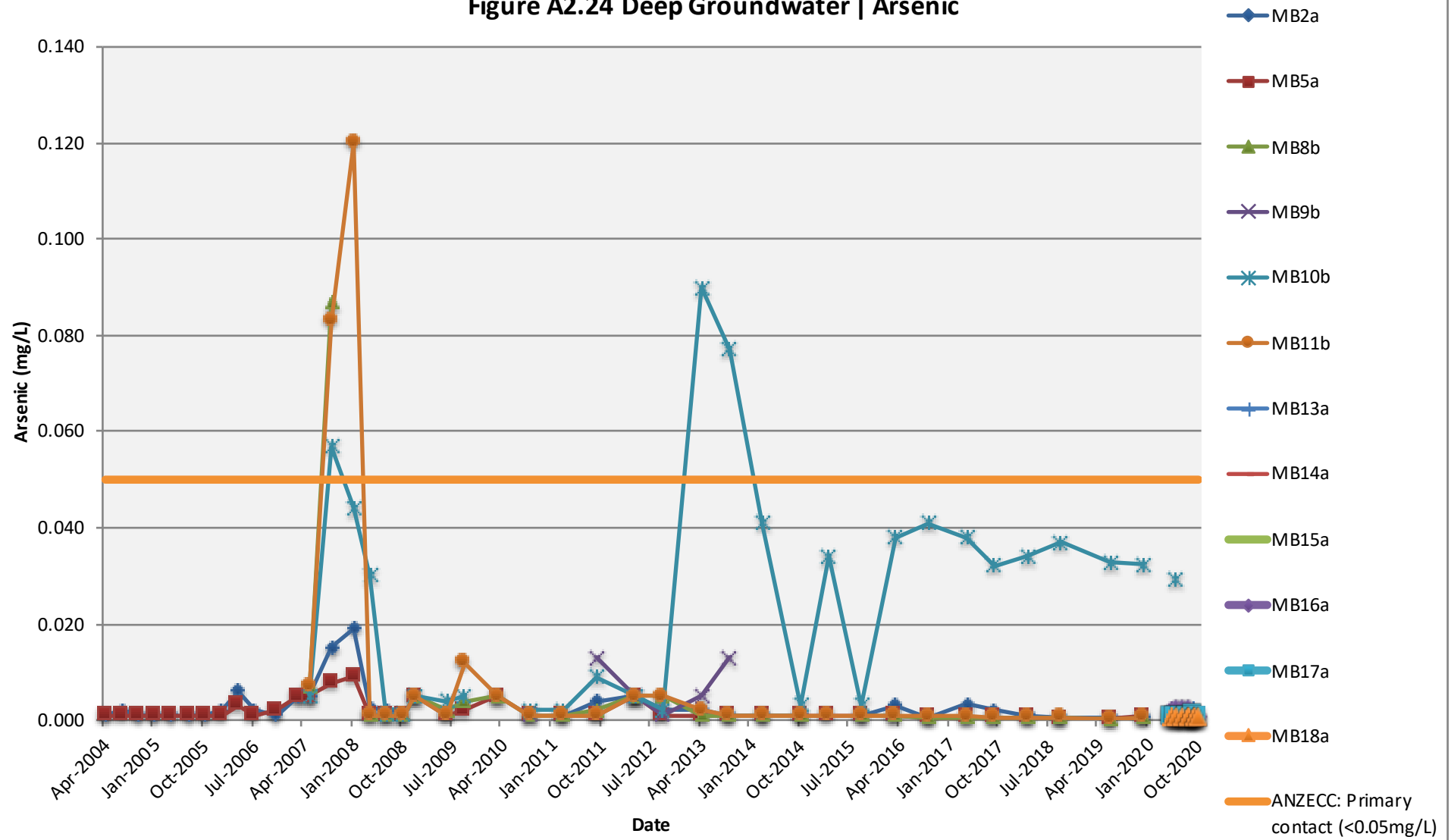


Figure A2.25 Shallow Groundwater | Ammonia

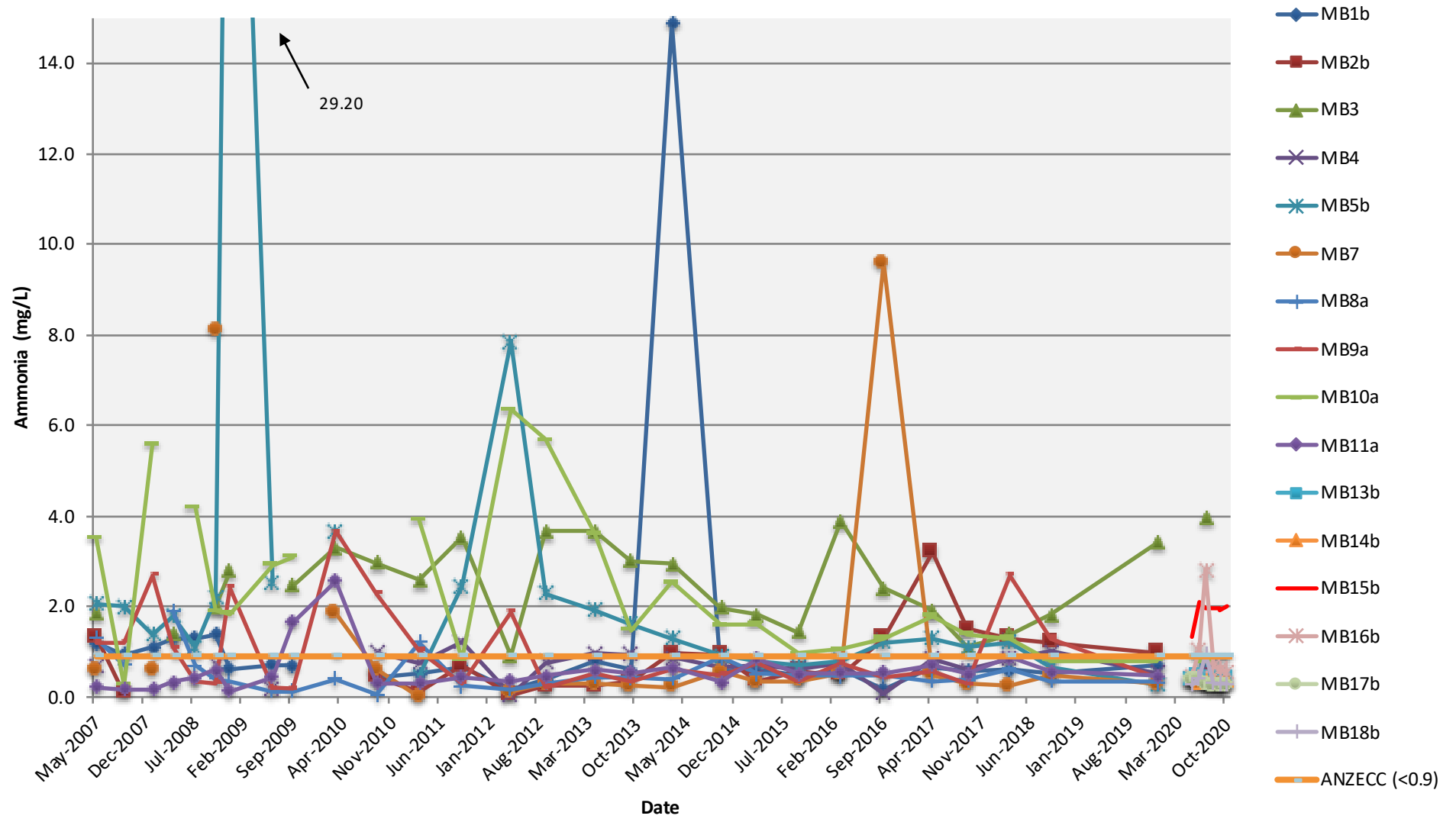


Figure A2.26 Deep Groundwater | Ammonia

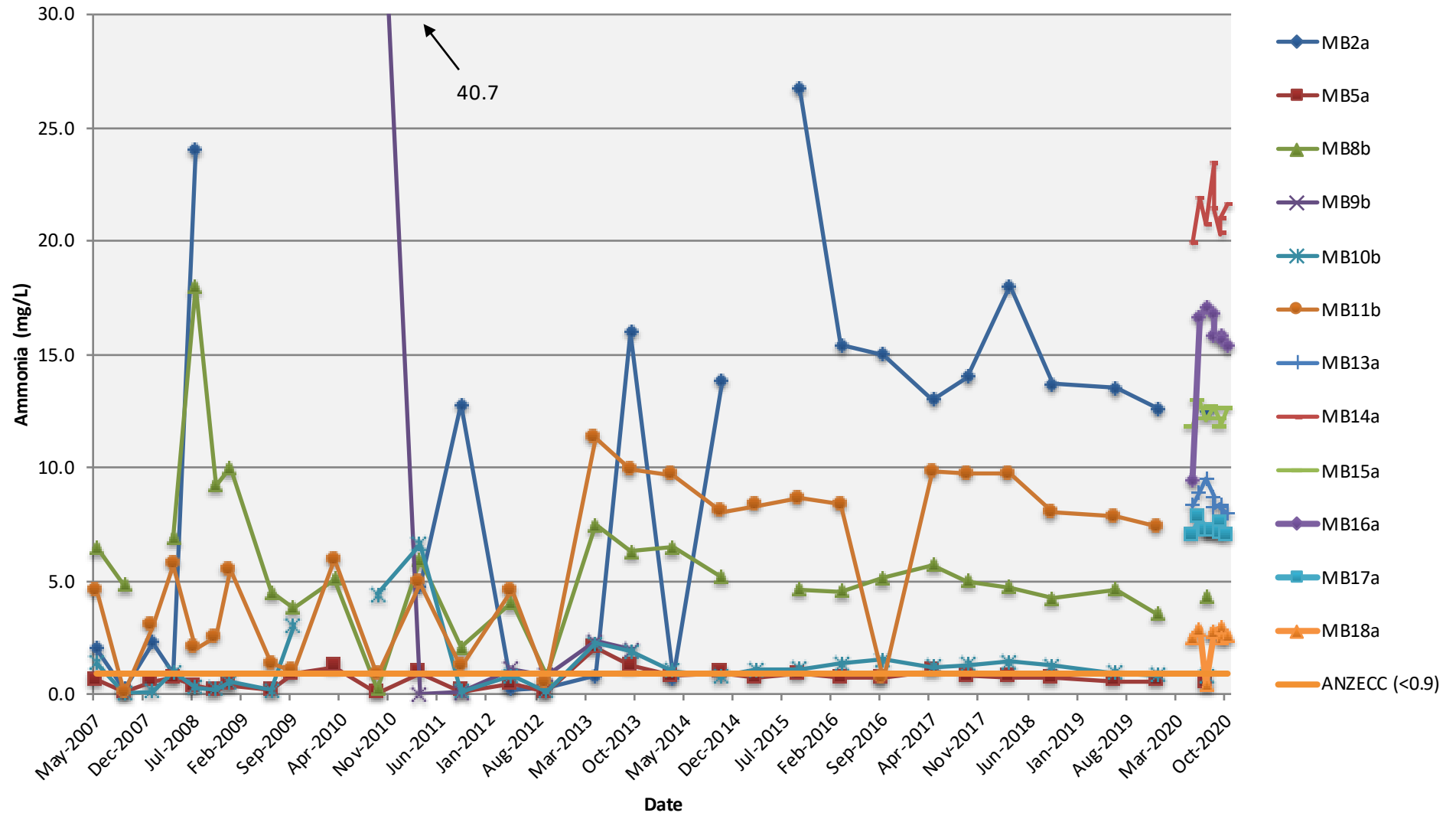


Figure A2.27 Shallow Groundwater | Faecal coliforms (cfu/100mL)

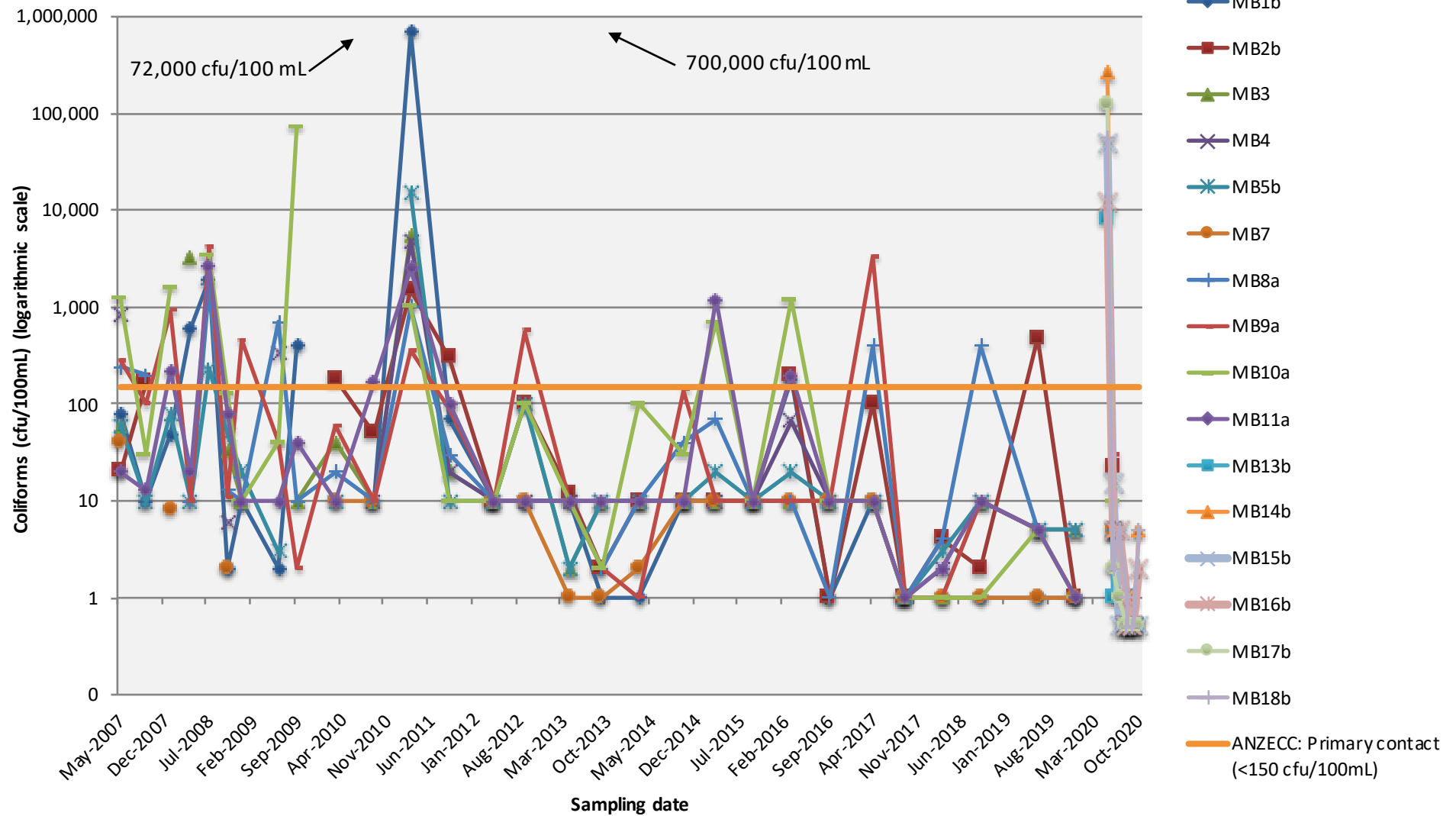


Figure A2.28 Deep Groundwater | Faecal coliforms (log10)

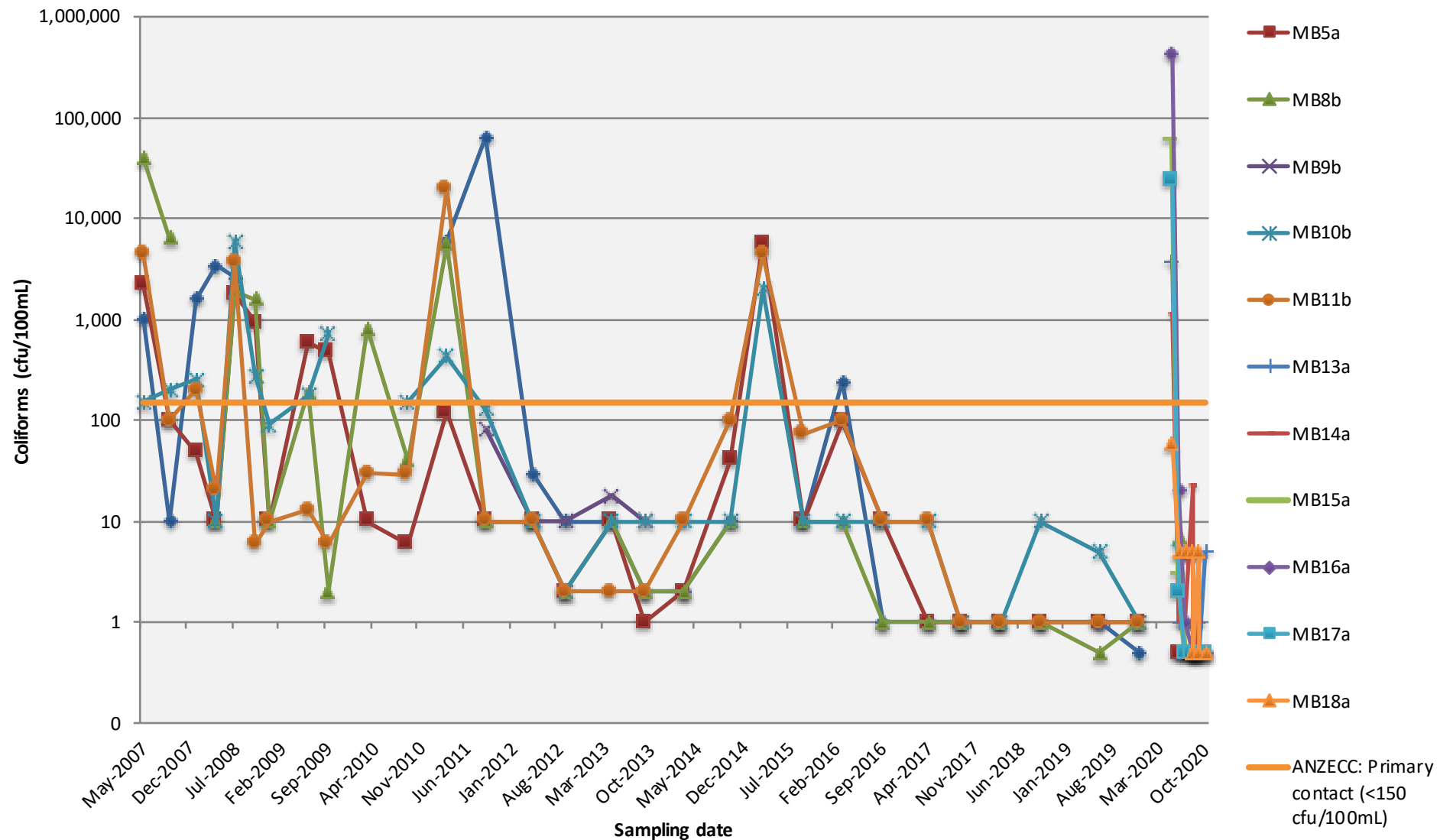


Figure A2.29 Shallow Groundwater | Enterococci (log10)

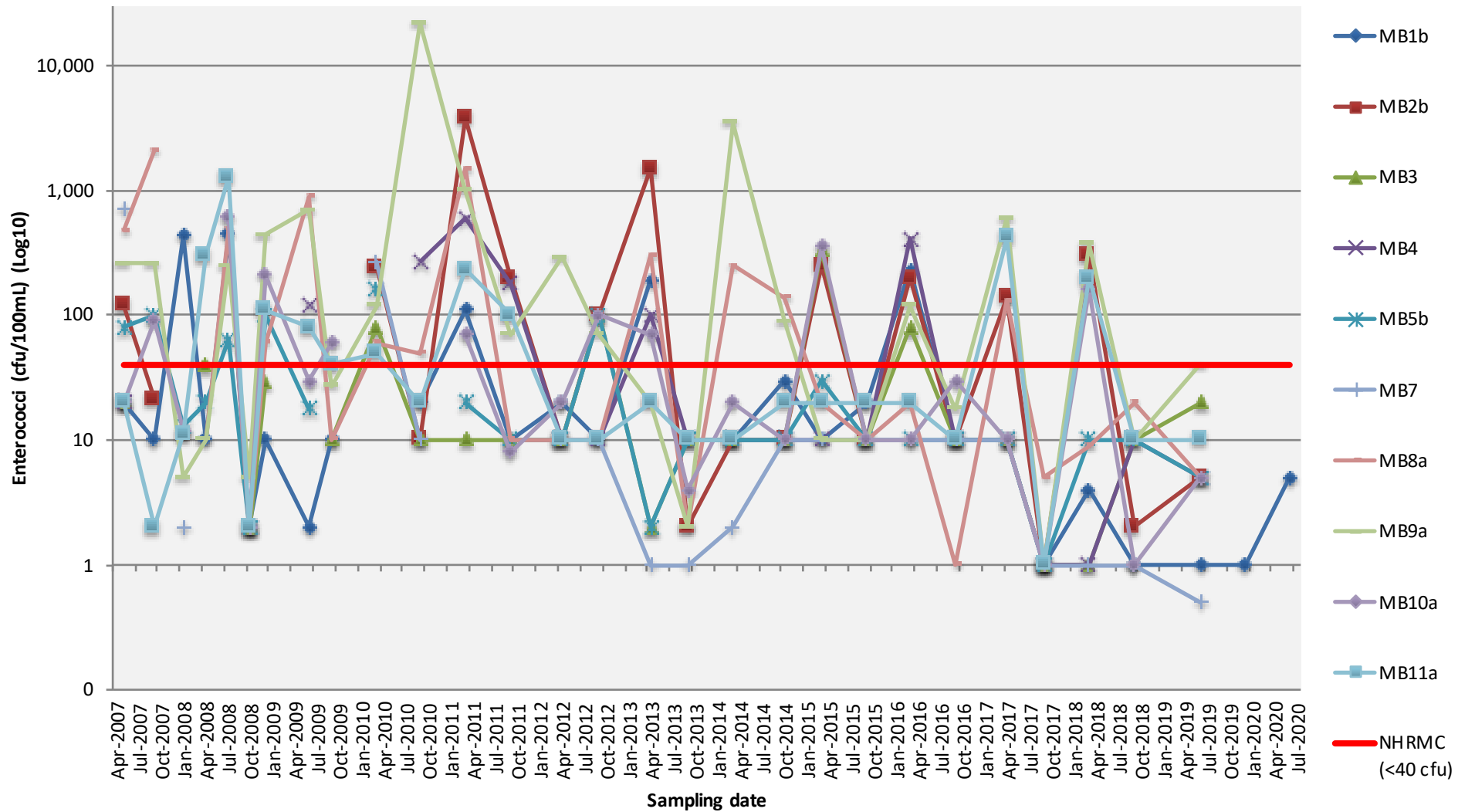


Figure A2.30 Deep Groundwater | Enterococci (log10)

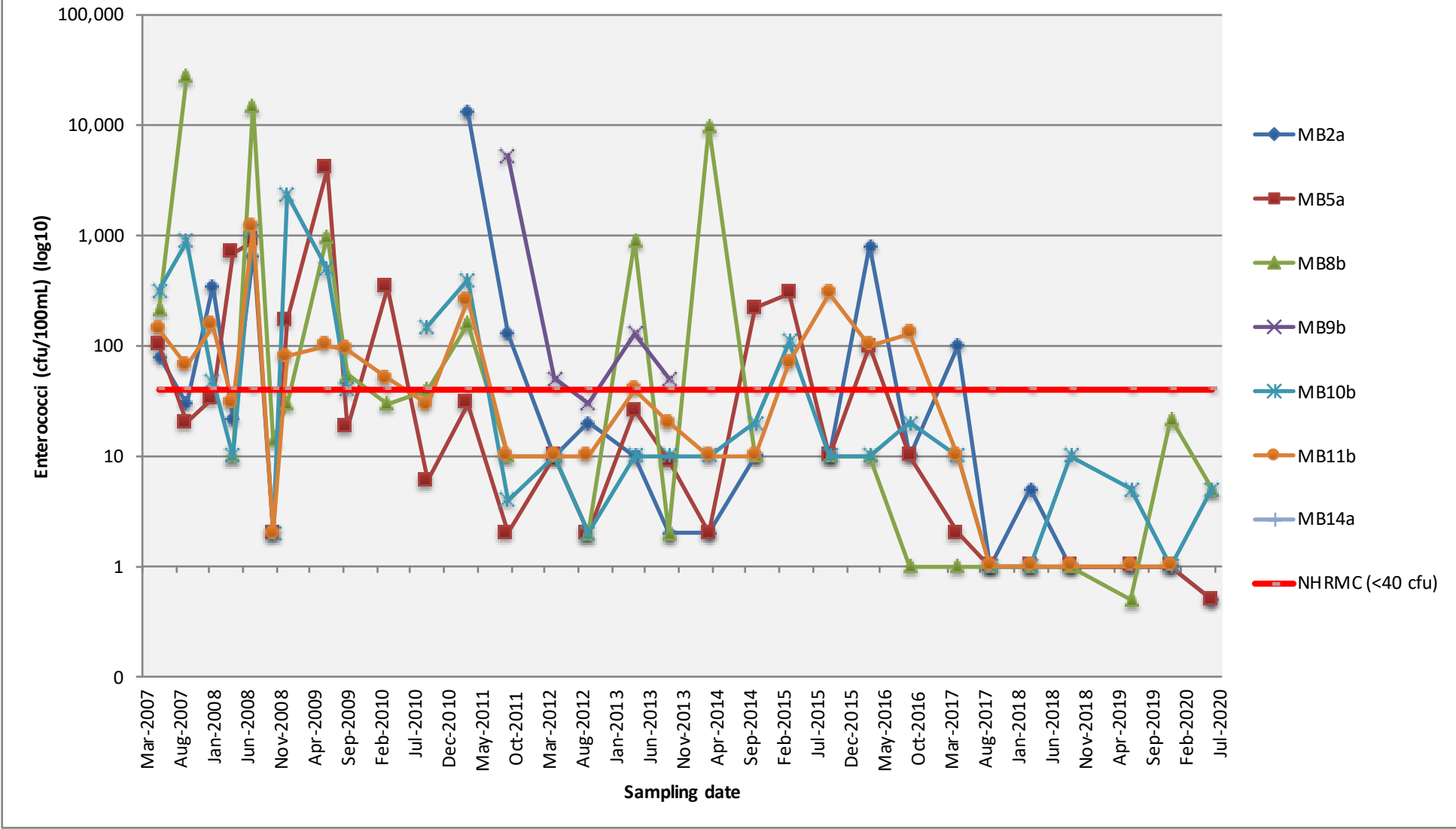


Figure A2.31 Shallow bores | Total Nitrogen

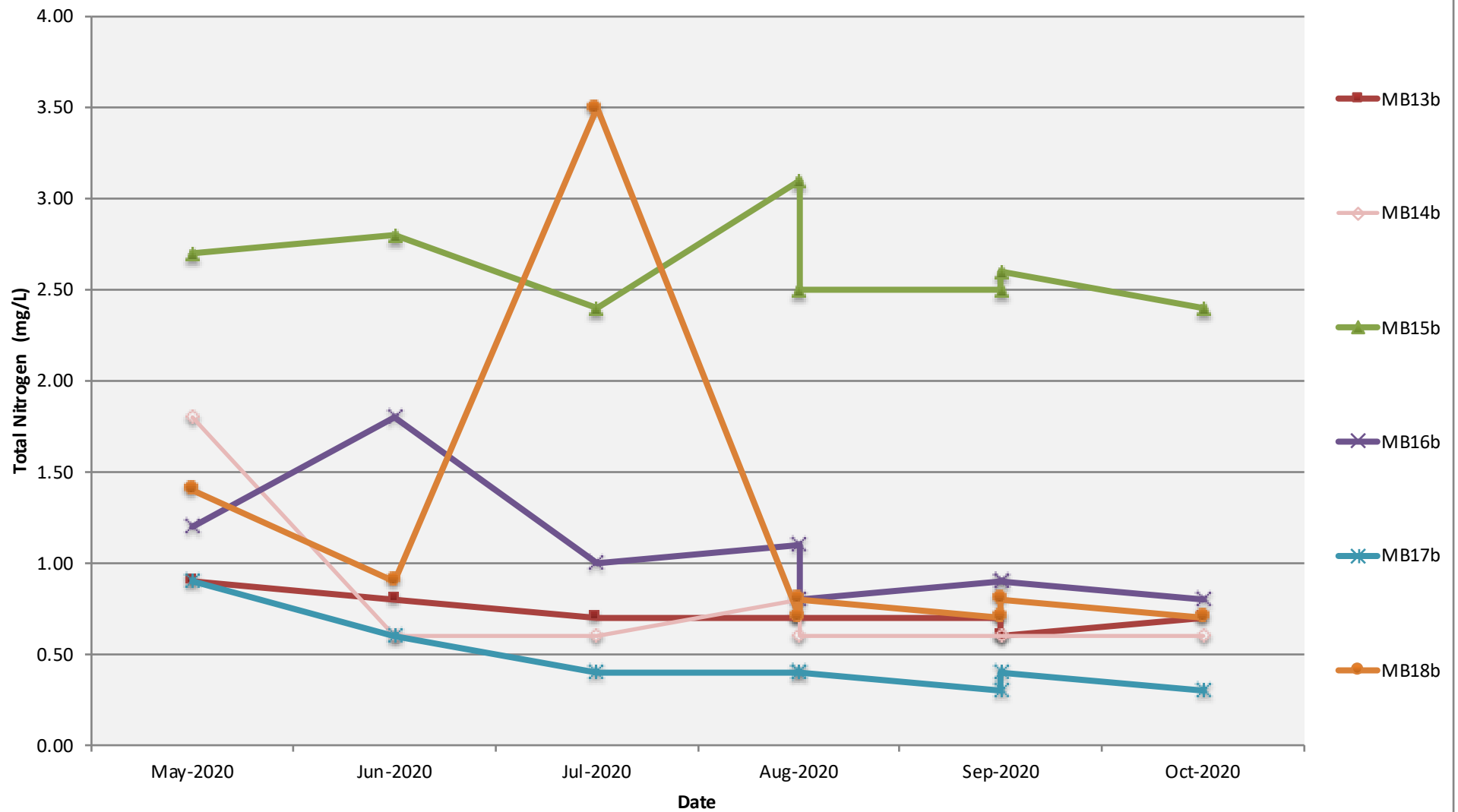


Figure A2.32 Deep bores | Total Nitrogen

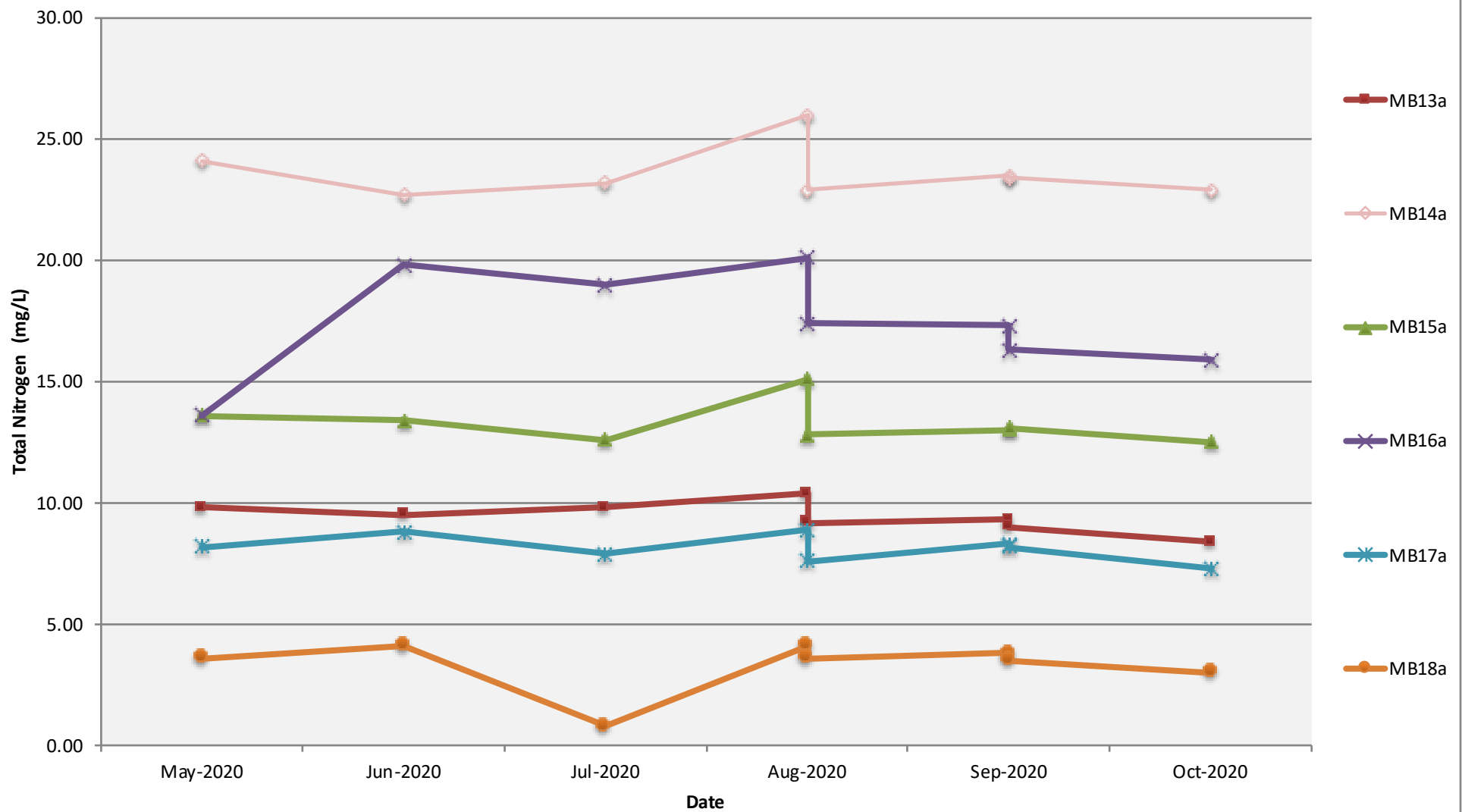


Figure A2.33 Shallow bores | Total Phosphorous

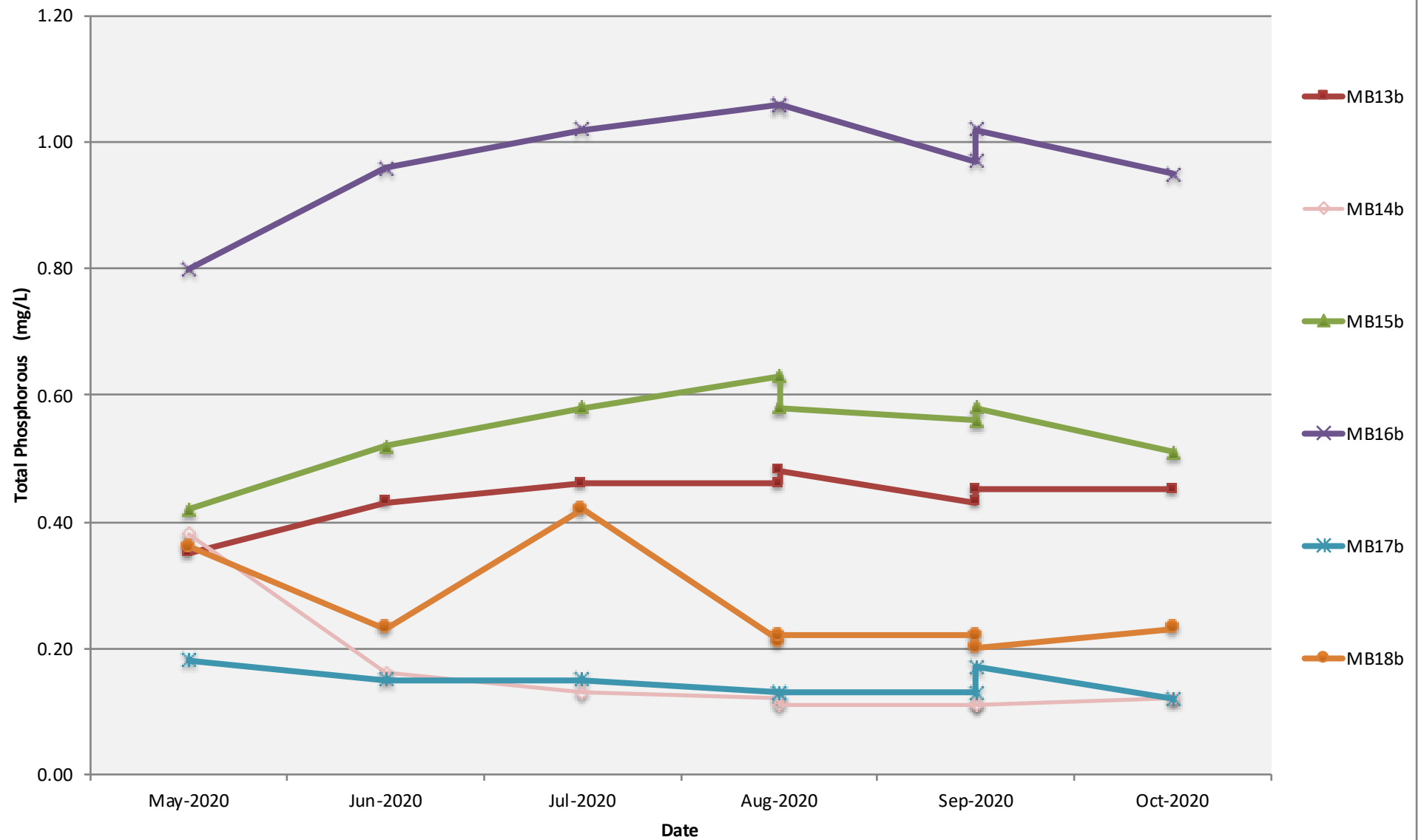
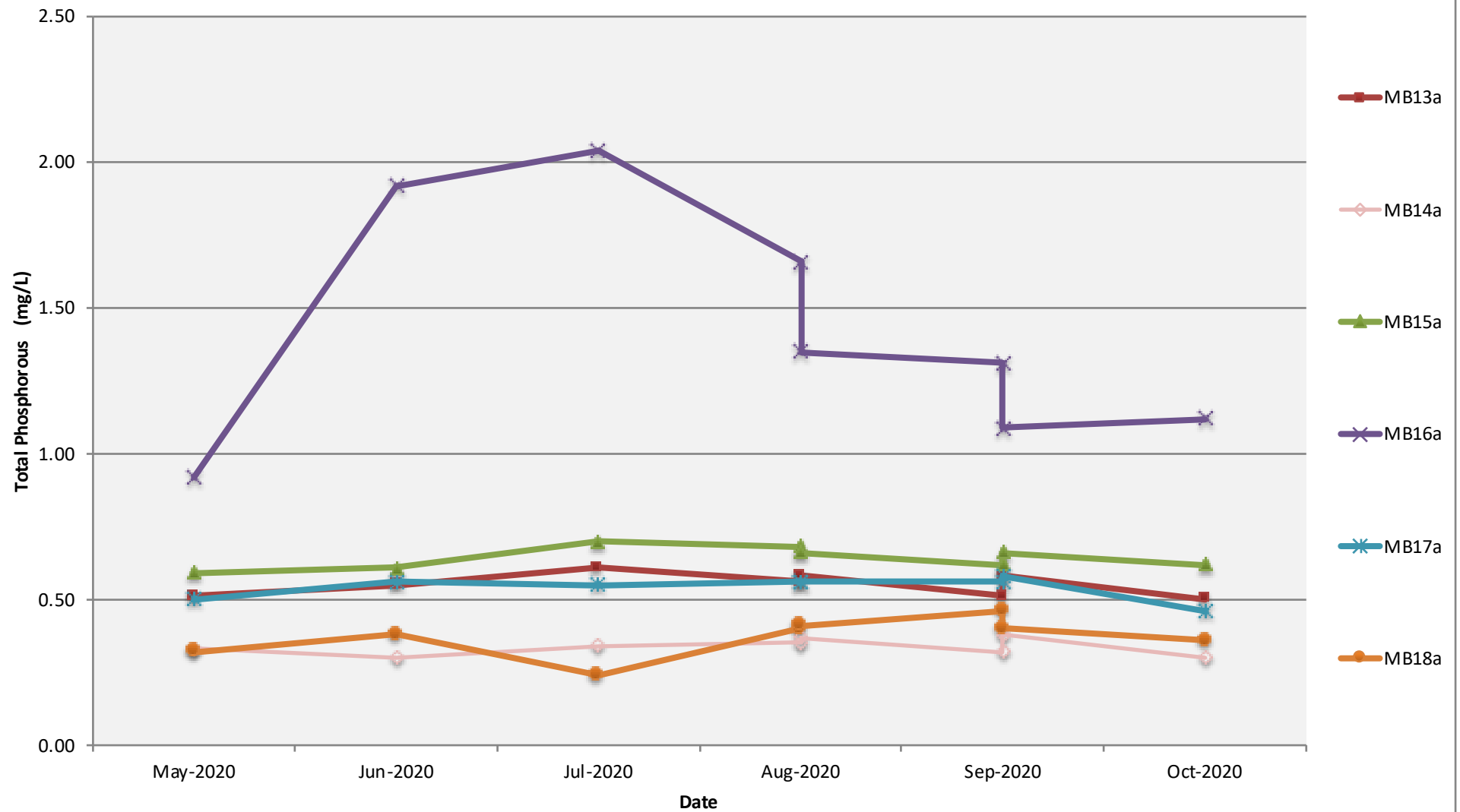


Figure A2.34 Deep bores | Total Phosphorous



Project TSP, Cudgen, NSW **<LOR**
Parameter: AI D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Deep Bores													
Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	0.1000	0.1000	0.1000	—	—	—	—	—	—	—	—	—	—
Jan-2002	0.1000	0.1000	0.1000	—	—	—	—	—	—	—	—	—	—
Apr-2002	0.2000	0.1000	0.1000	—	—	—	—	—	—	—	—	—	—
Jul-2002	0.0600	0.0200	0.0200	—	—	—	—	—	—	—	—	—	—
Oct-2002	0.1900	0.1200	0.0200	—	—	—	—	—	—	—	—	—	—
Jan-2003	0.0100	0.2000	0.0100	—	—	—	—	—	—	—	—	—	—
Apr-2003	0.0100	0.0100	0.0200	—	—	—	—	—	—	—	—	—	—
Jul-2003	0.0100	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Oct-2003	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Feb-2004	D	0.0400	0.0200	—	—	—	—	—	—	—	—	—	—
Apr-2004	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Jul-2004	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Oct-2004	D	0.0200	0.0200	—	—	—	—	—	—	—	—	—	—
Jan-2005	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Apr-2005	D	0.1200	0.0800	—	—	—	—	—	—	—	—	—	—
Jul-2005	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Oct-2005	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Jan-2006	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Apr-2006	D	0.0200	0.0100	—	—	—	—	—	—	—	—	—	—
Jul-2006	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Nov-2006	D	0.0100	0.0100	—	—	—	—	—	—	—	—	—	—
Mar-2007	D	0.0200	0.0100	—	—	—	—	—	—	—	—	—	—
May-2007	D	0.0200	0.0100	0.0400	—	0.0400	0.0200	—	—	—	—	—	—
Sep-2007	D	0.0150	0.0094	0.0240	—	0.0049	0.0160	—	—	—	—	—	—
Jan-2008	D	0.0090	0.0056	—	—	0.0084	0.0230	—	—	—	—	—	—
Apr-2008	D	0.0140	0.0051	0.0140	—	0.0078	0.0049	—	—	—	—	—	—
Jul-2008	D	0.0130	0.0032	0.0044	—	0.0045	0.0170	—	—	—	—	—	—
Oct-2008	D	—	0.0068	0.0094	—	0.0091	0.0079	—	—	—	—	—	—
Dec-2008	D	—	0.01	0.01	—	0.01	0.02	—	—	—	—	—	—
Jun-2009	D	—	0.01	0.01	—	0.01	0.01	—	—	—	—	—	—
Sep-2009	D	—	0.01	0.01	—	0.01	0.01	—	—	—	—	—	—
Mar-2010	D	—	0.01	0.01	—	—	0.92	—	—	—	—	—	—
Sep-2010	D	—	0.01	0.02	0.01	0.02	0.01	—	—	—	—	—	—
Mar-2011	D	0.1000	0.02	0.01	—	0.02	0.01	—	—	—	—	—	—
Sep-2011	D	0.2500	0.01	0.1	0.02	0.03	0.1	—	—	—	—	—	—
Apr-2012	D	0.6400	0.01	0.02	0.02	0.02	0.02	—	—	—	—	—	—
Sep-2012	D	0.02	0.01	0.05	0.01	0.01	0.05	—	—	—	—	—	—
Apr-2013	D	0.04	0.01	0.05	0.05	0.01	0.05	—	—	—	—	—	—
Sep-2013	D	0.01	0.01	0.01	0.01	0.01	0.01	—	—	—	—	—	—
Mar-2014	D	0.01	0.01	0.01	—	0.01	0.01	—	—	—	—	—	—
Oct-2014	D	0.01	0.01	0.01	—	0.01	0.01	—	—	—	—	—	—
Mar-2015	D	—	0.01	—	—	0.01	0.01	—	—	—	—	—	—
Sep-2015	D	0.01	0.01	0.01	—	0.01	0.01	—	—	—	—	—	—
Mar-2016	D	0.06	0.01	0.01	—	0.01	0.01	—	—	—	—	—	—
Sep-2016	D	0.019	0.016	0.029	—	0.02	0.024	—	—	—	—	—	—
Apr-2017	D	0.005	0.005	0.005	—	0.005	0.005	—	—	—	—	—	—
Sep-2017	D	0.005	0.005	0.005	—	0.005	0.005	—	—	—	—	—	—
Mar-2018	D	0.005	0.005	0.005	—	0.005	0.005	—	—	—	—	—	—
Sep-2018	D	0.005	0.005	0.005	—	0.005	0.005	—	—	—	—	—	—
Jun-2019	D	0.0025	0.0025	0.0025	—	0.0025	0.0025	—	—	—	—	—	—
Dec-2019	D	0.005	0.005	0.025	—	0.005	0.005	—	—	—	—	—	—
May-2020	D	—	—	—	—	—	—	0.025	0.005	0.025	0.005	0.005	0.005
Jun-2020	D	0.0025	0.0025	0.0025	—	0.0025	—	0.025	0.025	0.025	0.025	0.005	0.005
Jul-2020	D	—	—	—	—	—	—	0.025	0.025	0.005	0.025	0.005	0.005
Aug-2020	D	—	—	—	—	—	—	0.025	0.025	0.005	0.005	0.005	0.005
Aug-2020	D	—	—	—	—	—	—	0.025	0.025	0.025	0.025	0.005	0.005
Sep-2020	D	—	—	—	—	—	—	0.025	0.025	0.005	0.005	0.005	0.005
Sep-2020	D	—	—	—	—	—	—	—	—	—	—	—	—
Sep-2020	D	—	—	—	—	—	—	0.005	0.025	0.005	0.005	0.005	0.005
Oct-2020	D	—	—	—	—	—	—	0.005	0.025	0.005	0.005	0.005	0.005
Median	0.08	0.01	0.01	0.01	0.02	0.01	0.01	0.03	0.03	0.01	0.01	0.01	0.01
Mean	0.09	0.05	0.02	0.02	0.02	0.01	0.05	0.02	0.02	0.01	0.01	0.01	0.01
Min	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Max	0.20	0.64	0.10	0.10	0.05	0.04	0.92	0.03	0.03	0.03	0.03	0.01	0.01
80th percentile	0.15	0.07	0.01	0.02	0.02	0.01	0.02	0.03	0.03	0.03	0.03	0.01	0.01
20th percentile	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.01	0.01	0.01	0.01

Date	Shallow bores							MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
	MB1b	MB2b	MB3	MB4	MB5b	MB7											
Oct-2001	0.100	0.100	0.100	0.100	0.100	1.500	—	—	—	—	—	—	—	—	—	—	—
Jan-2002	0.100	0.100	0.100	0.100	0.100	1.700	—	—	—	—	—	—	—	—	—	—	—
Apr-2002	0.100	0.100	0.100	0.100	0.100	1.100	—	—	—	—	—	—	—	—	—	—	—
Jul-2002	0.030	0.180	0.010	0.100	0.010	0.860	—	—	—	—	—	—	—	—	—	—	—
Oct-2002	0.670	0.280	0.050	0.040	0.010	1.480	—	—	—	—	—	—	—	—	—	—	—
Jan-2003	0.030	0.120	0.020	0.010	0.010	1.620	—	—	—	—	—	—	—	—	—	—	—
Apr-2003	0.010	0.070	0.010	0.010	0.010	0.450	—	—	—	—	—	—	—	—	—	—	—
Jul-2003	0.010	0.080	0.010	0.010	0.010	—	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	0.010	0.080	0.010	0.010	0.010	0.820	—	—	—	—	—	—	—	—	—	—	—
Feb-2004	0.020	0.070	0.020	0.040	0.060	1.280	—	—	—	—	—	—	—	—	—	—	—
Apr-2004	0.010	0.020	0.010	0.010	0.010	1.580	—	—	—	—	—	—	—	—	—	—	—
Jul-2004	0.010	0.050	0.010	0.010	0.010	1.810	—	—	—	—	—	—	—	—	—	—	—
Oct-2004	0.020	0.060	0.020	0.020	0.020	1.700	—	—	—	—	—	—	—	—	—	—	—
Jan-2005	0.010	0.060	0.010	0.010	0.010	0.500	—	—	—	—	—	—	—	—	—	—	—
Apr-2005	0.140	0.080	0.050	0.080	0.040	1.300	—	—	—	—	—	—	—	—	—	—	—
Jul-2005	0.010	0.050	0.010	—	0.010	0.240	—	—	—	—	—	—	—	—	—	—	—
Oct-2005	0.010	0.060	0.010	0.030	0.010	0.970	—	—	—	—	—	—	—	—	—	—	—
Jan-2006	0.010	0.080	0.010	—	0.010	0.300	—	—	—	—	—	—	—	—	—	—	—
Apr-2006	0.010	0.050	0.010	0.010	0.010	0.750	—	—	—	—	—	—	—	—	—	—	—
Jul-2006	0.040	0.130	0.010	—	0.010	0.230	—	—	—	—	—	—	—	—	—	—	—
Nov-2006	0.010	0.020	0.010	—	0.010	0.520	—	—	—	—	—	—	—	—	—	—	—
Mar-2007	0.030	0.120	0.020	—	0.020	2.070	—	—	—	—	—	—	—	—	—	—	—
May-2007	0.010	0.050	0.010	0.010	0.010	2.350	0.020	0.010	0.020	0.010	—	—	—	—	—	—	—
Sep-2007	0.005	0.029	—	—	0.006	—	0.005	0.004	0.006	0.006	—	—	—	—	—	—	—
Jan-2008	0.009	—	—	—	0.012	0.650	—	0.006	0.016	0.011	—	—	—	—	—	—	—
Apr-2008	0.012	—	0.002	—	0.003	—	0.005	0.006	—	0.330	—	—	—	—	—	—	—
Jul-2008	0.013	—	—	—	0.002	—	0.009	0.006	0.007	0.001	—	—	—	—	—	—	—
Oct-2008	0.006	—	0.007	0.003	0.003	0.320	0.008	0.006	0.006								

Project TSP, Cudgen, NSW <LOR
Parameter: As D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Deep Bores													
Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Apr-2004	D	0.001	0.001	—	—	—	—	—	—	—	—	—	—
Jul-2004	D	0.002	0.001	—	—	—	—	—	—	—	—	—	—
Oct-2004	D	0.001	0.001	—	—	—	—	—	—	—	—	—	—
Jan-2005	D	0.001	0.001	—	—	—	—	—	—	—	—	—	—
Apr-2005	D	0.001	0.001	—	—	—	—	—	—	—	—	—	—
Jul-2005	D	0.001	0.001	—	—	—	—	—	—	—	—	—	—
Oct-2005	D	0.001	0.001	—	—	—	—	—	—	—	—	—	—
Jan-2006	D	0.002	0.001	—	—	—	—	—	—	—	—	—	—
Apr-2006	D	0.006	0.003	—	—	—	—	—	—	—	—	—	—
Jul-2006	D	0.002	0.001	—	—	—	—	—	—	—	—	—	—
Nov-2006	D	0.001	0.002	—	—	—	—	—	—	—	—	—	—
Mar-2007	D	0.005	0.005	—	—	—	—	—	—	—	—	—	—
May-2007	D	0.005	0.005	0.007	—	0.005	0.007	—	—	—	—	—	—
Sep-2007	D	0.015	0.0078	0.087	—	0.057	0.083	—	—	—	—	—	—
Jan-2008	D	0.019	0.0091	—	—	0.044	0.120	—	—	—	—	—	—
Apr-2008	D	0.0025	0.001	0.001	—	0.03	0.001	—	—	—	—	—	—
Jul-2008	D	0.0021	0.001	0.001	—	0.001	0.001	—	—	—	—	—	—
Oct-2008	D	—	0.001	0.001	—	0.001	0.001	—	—	—	—	—	—
Dec-2008	D	—	0.005	0.005	—	0.005	0.005	—	—	—	—	—	—
Jun-2009	D	—	0.001	0.002	—	0.004	0.001	—	—	—	—	—	—
Sep-2009	D	—	0.002	0.004	—	0.005	0.012	—	—	—	—	—	—
Mar-2010	D	—	0.005	0.005	—	—	0.005	—	—	—	—	—	—
Sep-2010	D	—	0.001	0.001	0.001	0.002	0.001	—	—	—	—	—	—
Mar-2011	D	0.001	0.001	0.001	—	0.002	0.001	—	—	—	—	—	—
Sep-2011	D	0.004	0.001	0.002	0.013	0.009	0.001	—	—	—	—	—	—
Apr-2012	D	0.005	0.005	0.005	0.005	0.005	0.005	—	—	—	—	—	—
Sep-2012	D	0.002	0.001	0.005	0.001	0.002	0.005	—	—	—	—	—	—
Apr-2013	D	0.002	0.001	0.001	0.005	0.09	0.002	—	—	—	—	—	—
Sep-2013	D	0.001	0.001	0.001	0.013	0.077	0.001	—	—	—	—	—	—
Mar-2014	D	0.001	0.001	0.001	—	0.041	0.001	—	—	—	—	—	—
Oct-2014	D	0.001	0.001	0.001	—	0.003	0.001	—	—	—	—	—	—
Mar-2015	D	—	0.001	—	—	0.034	0.001	—	—	—	—	—	—
Sep-2015	D	0.001	0.001	0.001	—	0.003	0.001	—	—	—	—	—	—
Mar-2016	D	0.003	0.001	0.001	—	0.038	0.001	—	—	—	—	—	—
Sep-2016	D	0.00056	0.0005	0.0005	—	0.041	0.00069	—	—	—	—	—	—
Apr-2017	D	0.0033	0.0005	0.0005	—	0.038	0.0007	—	—	—	—	—	—
Sep-2017	D	0.002	0.0005	0.0005	—	0.032	0.00053	—	—	—	—	—	—
Mar-2018	D	0.00098	0.0005	0.0005	—	0.034	0.00059	—	—	—	—	—	—
Sep-2018	D	0.0005	0.0003	0.0005	—	0.037	0.0005	—	—	—	—	—	—
Jun-2019	D	0.0005	0.0003	0.00025	—	0.0327	0.00025	—	—	—	—	—	—
Dec-2019	D	0.0005	0.0008	0.0005	—	0.0323	0.0005	—	—	—	—	—	—
May-2020	D	—	—	—	—	—	—	0.0025	0.0025	0.0005	0.002	0.0005	0.0005
Jun-2020	D	0.0013	0.0002	0.00025	—	0.0293	—	0.0025	0.0025	0.0025	0.0025	0.0005	0.0005
Jul-2020	D	—	—	—	—	—	—	0.0025	0.0025	0.0005	0.0025	0.0005	0.0005
Aug-2020	D	—	—	—	—	—	—	0.0025	0.0025	0.0005	0.0005	0.0005	0.0005
Aug-2020	D	—	—	—	—	—	—	0.0025	0.0025	0.0025	0.0025	0.0005	0.0005
Sep-2020	D	—	—	—	—	—	—	0.0025	0.0025	0.0005	0.0005	0.001	0.0005
Sep-2020	D	—	—	—	—	—	—	0.0005	0.0025	0.001	0.0005	0.0005	0.0005
Oct-2020	D	—	—	—	—	—	—	0.0005	0.0025	0.0005	0.0005	0.0005	0.0005
Median		0.001	0.001	0.001	0.005	0.030	0.001	0.003	0.003	0.001	0.001	0.001	0.001
Mean		0.003	0.002	0.005	0.006	0.025	0.009	0.002	0.003	0.001	0.001	0.001	0.001
Min		0.001	0.000	0.000	0.001	0.001	0.000	0.001	0.003	0.001	0.001	0.001	0.001
Max		0.019	0.009	0.087	0.013	0.090	0.120	0.003	0.003	0.003	0.003	0.001	0.001
80th percentile		0.003	0.002	0.005	0.013	0.039	0.005	0.003	0.003	0.002	0.003	0.001	0.001
20th percentile		0.001	0.001	0.001	0.001	0.003	0.001	0.001	0.003	0.001	0.001	0.001	0.001

Shallow Bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Apr-2004	0.001	0.088	0.001	0.001	0.001	0.045	—	—	—	—	—	—	—	—	—	—
Jul-2004	0.001	0.032	0.001	0.001	0.002	0.047	—	—	—	—	—	—	—	—	—	—
Oct-2004	0.001	0.01	0.002	0.001	0.004	0.042	—	—	—	—	—	—	—	—	—	—
Jan-2005	0.001	0.0002	0.001	0.001	0.003	0.016	—	—	—	—	—	—	—	—	—	—
Apr-2005	0.001	0.003	0.001	0.001	0.003	0.034	—	—	—	—	—	—	—	—	—	—
Jul-2005	0.001	0.005	0.001	—	0.003	0.006	—	—	—	—	—	—	—	—	—	—
Oct-2005	0.001	0.01	0.001	0.001	0.002	0.02	—	—	—	—	—	—	—	—	—	—
Jan-2006	0.001	0.003	0.001	—	0.004	0.01	—	—	—	—	—	—	—	—	—	—
Apr-2006	0.003	0.004	0.003	0.002	0.005	0.022	—	—	—	—	—	—	—	—	—	—
Jul-2006	0.001	0.002	0.001	—	0.002	0.002	—	—	—	—	—	—	—	—	—	—
Nov-2006	0.005	0.003	0.004	—	0.01	0.018	—	—	—	—	—	—	—	—	—	—
Mar-2007	0.005	0.008	0.005	—	0.005	0.036	—	—	—	—	—	—	—	—	—	—
May-2007	0.005	0.005	0.005	0.005	0.005	0.02	0.005	0.005	0.005	0.005	—	—	—	—	—	—
Sep-2007	0.0018	0.011	—	—	0.033	—	0.0091	0.0054	0.0064	0.0054	0.005	—	—	—	—	—
Jan-2008	0.0092	—	—	—	0.038	0.056	—	0.0068	0.016	0.012	—	—	—	—	—	—
Apr-2008	0.014	—	0.01	—	0.051	—	0.051	0.0014	—	0.035	—	—	—	—	—	—
Jul-2008	0.0042	—	—	—	0.012	—	0.024	0.0034	0.027	0.001	—	—	—	—	—	—
Oct-2008	0.0063	—	0.001	0.001	0.016	0.025	0.001	—	0.0021	0.001	—	—	—	—	—	—
Dec-2008	0.005	—	0.005	—	0.005	—	0.005	0.005	0.005	0.005	—	—	—	—	—	—
Jun-2009	0.012	—	—	0.001	0.02	—	0.041	0.008	0.016	0.02	—	—	—	—	—	—
Sep-2009	0.002	—	0.001	—	—	—	0.001	0.001	0.001	0.001	—	—	—	—	—	—
Mar-2010	—	—	0.005	—	0.012	0.016	0.021	0.005	—	0.005	—	—	—	—	—	—
Sep-2010	0.001	0.004	0.006	0.001	—	0.013	0.001	0.001	—	0.001	—	—	—	—	—	—
Mar-2011	0.003	0.004	0.059	0.001	0.016	—	0.012	0.001	0.001	0.001	—	—	—	—	—	—
Sep-2011	0.012	0.024	0.018	0.002	0.023	—	0.011	0.002	0.002	0.004	—	—	—	—	—	—
Apr-2012	0.008	0.005	0.028	0.005	0.005	0.005	0.005	0.005	0.005	0.005	—	—	—	—	—	—
Sep-2012	0.006	0.005	0.004	0.001	0.017	0.007	0.004	0.001	0.001	0.001	—	—	—	—	—	—
Apr-2013	0.008	0.006	0.015	0.002	0.025	0.011	0.016	0.001	0.005	0.001	—	—	—	—	—	—
Sep-2013	0.015	0.013	0.011	0.002</												

Project TSP, Cudgen, NSW **<LOR**
Parameter: Cl D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Date	Deep bores												
	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	465	2850	897	—	—	—	—	—	—	—	—	—	—
Jan-2002	524	3480	889	—	—	—	—	—	—	—	—	—	—
Apr-2002	228	1510	824	—	—	—	—	—	—	—	—	—	—
Jul-2002	317	3640	744	—	—	—	—	—	—	—	—	—	—
Oct-2002	725	3150	816	—	—	—	—	—	—	—	—	—	—
Jan-2003	903	4140	788	—	—	—	—	—	—	—	—	—	—
Apr-2003	983	3910	785	—	—	—	—	—	—	—	—	—	—
Jul-2003	985	4380	704	—	—	—	—	—	—	—	—	—	—
Oct-2003	—	4040	833	—	—	—	—	—	—	—	—	—	—
Feb-2004	—	4180	703	—	—	—	—	—	—	—	—	—	—
Apr-2004	—	4110	629	—	—	—	—	—	—	—	—	—	—
Jul-2004	—	4010	643	—	—	—	—	—	—	—	—	—	—
Oct-2004	—	4520	684	—	—	—	—	—	—	—	—	—	—
Jan-2005	—	4160	674	—	—	—	—	—	—	—	—	—	—
Apr-2005	—	4180	665	—	—	—	—	—	—	—	—	—	—
Jul-2005	—	4320	619	—	—	—	—	—	—	—	—	—	—
Oct-2005	—	4400	587	—	—	—	—	—	—	—	—	—	—
Jan-2006	—	4240	616	—	—	—	—	—	—	—	—	—	—
Apr-2006	—	1320	574	—	—	—	—	—	—	—	—	—	—
Jul-2006	—	1840	627	—	—	—	—	—	—	—	—	—	—
Nov-2006	—	1120	509	—	—	—	—	—	—	—	—	—	—
Mar-2007	—	—	480	—	—	—	—	—	—	—	—	—	—
May-2007	—	1341	551	8290	—	3520	8830	—	—	—	—	—	—
Sep-2007	—	1200	550	8300	—	3500	9800	—	—	—	—	—	—
Jan-2008	—	1600	490	—	—	2800	9600	—	—	—	—	—	—
Apr-2008	—	27	490	8000	—	3000	11000	—	—	—	—	—	—
Jul-2008	—	24	530	8400	—	2400	9600	—	—	—	—	—	—
Oct-2008	—	—	590	8000	—	2600	8900	—	—	—	—	—	—
Dec-2008	—	—	545	9250	—	2600	9800	—	—	—	—	—	—
Jun-2009	—	—	656	9450	—	1220	10100	—	—	—	—	—	—
Sep-2009	—	—	538	8540	—	2390	9140	—	—	—	—	—	—
Mar-2010	—	—	580	9600	—	—	10250	—	—	—	—	—	—
Sep-2010	—	—	764	9590	1120	1830	10100	—	—	—	—	—	—
Mar-2011	—	10	746	9420	—	2060	8990	—	—	—	—	—	—
Sep-2011	—	14	706	9560	145	1620	9650	—	—	—	—	—	—
Apr-2012	—	26	650	10000	220	1500	9700	—	—	—	—	—	—
Sep-2012	—	21	568	8370	541	1570	8660	—	—	—	—	—	—
Apr-2013	—	140	587	9910	9370	4410	9860	—	—	—	—	—	—
Sep-2013	—	6380	625	8990	8810	4730	9080	—	—	—	—	—	—
Mar-2014	—	5920	528	9260	—	4460	9020	—	—	—	—	—	—
Oct-2014	—	6020	470	10200	—	4300	9110	—	—	—	—	—	—
Mar-2015	—	—	476	—	—	4800	10300	—	—	—	—	—	—
Sep-2015	—	5580	436	10100	—	4500	9070	—	—	—	—	—	—
Mar-2016	—	6280	484	11000	—	4530	9910	—	—	—	—	—	—
Sep-2016	—	5000	470	9500	—	3700	8800	—	—	—	—	—	—
Apr-2017	—	3200	560	10000	—	4200	8600	—	—	—	—	—	—
Sep-2017	—	5300	540	11000	—	4100	8800	—	—	—	—	—	—
Mar-2018	—	6000	900	12000	—	5500	9900	—	—	—	—	—	—
Sep-2018	—	5910	735	10600	—	5700	9360	—	—	—	—	—	—
Jun-2019	—	6270	790	11300	—	6360	9760	—	—	—	—	—	—
Dec-2019	—	5590	685	10600	—	5780	8910	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	9630	11200	8080	8090	4310	4890
Jun-2020	—	6090	791	10700	—	6380	—	9760	10600	8040	8860	4280	4650
Jul-2020	—	—	—	—	—	—	—	9660	10500	7690	8950	4120	4510
Aug-2020	—	—	—	—	—	—	—	9960	10800	7930	8550	4140	4600
Aug-2020	—	—	—	—	—	—	—	10200	10900	8320	8860	4340	4780
Sep-2020	—	—	—	—	—	—	—	10200	10800	7940	8820	4180	4670
Sep-2020	—	—	—	—	—	—	—	9980	10600	7810	8440	4130	4620
Oct-2020	—	—	—	—	—	—	—	10000	10700	8070	8610	4120	4710
Median	625	4075	626	9575	831	3700	9600	9970	10750	7990	8715	4160	4660
Mean	641	3442	641	9640	3368	3657	9469	9924	10763	7985	8648	4203	4679
Min	228	10	436	8000	145	1220	8600	9630	10500	7690	8090	4120	4510
Max	985	6380	900	12000	9370	6380	11000	10200	11200	8320	8950	4340	4890
80th percentile	951	5584	760	10600	8810	4758	9904	10120	10860	8076	8860	4298	4752
20th percentile	376	1272	532	8456	220	2258	8906	9700	10600	7858	8484	4124	4608

Project: TSP, Cudgen, NSW
Parameter: Cl
Units: mg/L
Data Collected by: G+S

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 D Destroyed
 — Not monitored

Shallow bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	35	201	53	272	139	20	—	—	—	—	—	—	—	—	—	—
Jan-2002	40	57	45	415	127	21	—	—	—	—	—	—	—	—	—	—
Apr-2002	75	84	74	304	181	50	—	—	—	—	—	—	—	—	—	—
Jul-2002	42	57	60	253	191	22	—	—	—	—	—	—	—	—	—	—
Oct-2002	70	41	77	256	200	23	—	—	—	—	—	—	—	—	—	—
Jan-2003	72	45	98	223	192	26	—	—	—	—	—	—	—	—	—	—
Apr-2003	39	39	70	176	212	36	—	—	—	—	—	—	—	—	—	—
Jul-2003	47	51	148	263	271	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	136	36	109	123	367	31	—	—	—	—	—	—	—	—	—	—
Feb-2004	41	28	98	80	227	27	—	—	—	—	—	—	—	—	—	—
Apr-2004	38	21	104	71	354	36	—	—	—	—	—	—	—	—	—	—
Jul-2004	37	16	90	78	336	21	—	—	—	—	—	—	—	—	—	—
Oct-2004	38	27	94	67	330	24	—	—	—	—	—	—	—	—	—	—
Jan-2005	44	47	58	76	204	37	—	—	—	—	—	—	—	—	—	—
Apr-2005	48	49	85	86	228	31	—	—	—	—	—	—	—	—	—	—
Jul-2005	40	36	72	—	156	40	—	—	—	—	—	—	—	—	—	—
Oct-2005	47	54	37	44	231	23	—	—	—	—	—	—	—	—	—	—
Jan-2006	41	40	93	—	128	35	—	—	—	—	—	—	—	—	—	—
Apr-2006	37	63	66	82	92	14	—	—	—	—	—	—	—	—	—	—
Jul-2006	27	14	61	—	58	27	—	—	—	—	—	—	—	—	—	—
Nov-2006	24	25	41	—	142	79	—	—	—	—	—	—	—	—	—	—
Mar-2007	31	30	58	—	280	30	—	—	—	—	—	—	—	—	—	—
May-2007	51	46	41	117	130	33	194	173	229	293	—	—	—	—	—	—
Sep-2007	30	990	—	—	170	—	200	180	210	170	—	—	—	—	—	—
Jan-2008	54	—	—	—	170	21	—	180	160	140	—	—	—	—	—	—
Apr-2008	35	—	44	—	150	—	200	200	—	220	—	—	—	—	—	—
Jul-2008	33	—	—	—	190	—	240	270	170	280	—	—	—	—	—	—
Oct-2008	19	—	45	120	120	16	190	190	170	240	—	—	—	—	—	—
Dec-2008	55	—	83	—	170	—	180	270	175	250	—	—	—	—	—	—
Jun-2009	105	—	—	72	221	—	169	270	193	362	—	—	—	—	—	—
Sep-2009	38	—	66	—	—	—	97	214	162	242	—	—	—	—	—	—
Mar-2010	—	—	45	—	330	25	140	310	—	150	—	—	—	—	—	—
Sep-2010	25	20	30	79	—	17	150	207	—	191	—	—	—	—	—	—
Mar-2011	15	11	29	62	84	—	99	172	132	141	—	—	—	—	—	—
Sep-2011	21	23	22	70	365	—	95	171	138	240	—	—	—	—	—	—
Apr-2012	20	20	33	27	350	19	100	160	110	170	—	—	—	—	—	—
Sep-2012	23	32	22	73	209	13	60	157	125	277	—	—	—	—	—	—
Apr-2013	22	14	16	46	476	80	76	139	103	246	—	—	—	—	—	—
Sep-2013	61	26	22	68	334	61	412	153	112	379	—	—	—	—	—	—
Mar-2014	40	26	15	52	213	35	369	144	133	244	—	—	—	—	—	—
Oct-2014	91	27	15	42	523	19	335	—	100	323	—	—	—	—	—	—
Mar-2015	21	14	23	44	395	18	384	141	100	736	—	—	—	—	—	—
Sep-2015	30	25	34	49	280	21	540	138	96	306	—	—	—	—	—	—
Mar-2016	25	22	61	29	405	21	553	129	126	323	—	—	—	—	—	—
Sep-2016	50	36	79	100	490	22	460	240	160	360	—	—	—	—	—	—
Apr-2017	120	75	160	210	810	14	190	160	150	240	—	—	—	—	—	—
Sep-2017	43	43	57	61	370	15	460	140	100	500	—	—	—	—	—	—
Mar-2018	72	35	86	110	340	160	610	190	170	340	—	—	—	—	—	—
Sep-2018	31	22	40	36	442	216	548	122	191	290	—	—	—	—	—	—
Jun-2019	38	22	64	47	449	163	563	137	191	353	—	—	—	—	—	—
Dec-2019	51	21	55	42	354	78	516	110	145	295	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	35	36	812	122	24	64
Jun-2020	194	15	54	44	527	35	646	120	171	—	24	32	822	69	21	24
Jul-2020	—	—	—	—	—	—	—	—	—	—	22	30	806	52	17	23
Aug-2020	—	—	—	—	—	—	—	—	—	—	23	35	873	50	17	23
Aug-2020	—	—	—	—	—	—	—	—	—	—	21	34	910	55	19	21
Sep-2020	—	—	—	—	—	—	—	—	—	—	21	35	922	58	18	20
Sep-2020	—	—	—	—	—	—	—	—	—	—	22	34	879	48	18	21
Oct-2020	—	—	—	—	—	—	—	—	—	—	23	39	918	56	19	22
Median	40	31	58	75	228	26	200	171	150	277	23	35	876	56	19	23
Mean	48	60	61	112	274	41	303	179	149	286	24	34	868	64	19	27
Min	15	11	15	27	58	13	60	110	96	140	21	30	806	48	17	20
Max	194	990	160	415	810	216	646	310	229	736	35	39	922	122	24	64
80th percentile	55	50	86	183	368	39	526	210	174	345	24	36	915	65	20	24
20th percentile	27	21	33	46	155	19	124	139	110	208	21	33	816	51	17	21

Project TSP, Cudgen, NSW <LOR
Parameter: DO D Destroyed
Units: mg/L — Not monitored or inaccessible
Data Collected G+S

Deep bores														
Date	MB1A	MB2A	MB5A	MB8b	MB9b	MB10b	MB11b	MB12b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	0.54	1.14	0.76	—	—	—	—	—	—	—	—	—	—	—
Jan-2002	0.10	0.05	0.19	—	—	—	—	—	—	—	—	—	—	—
Apr-2002	0.55	0.73	0.84	—	—	—	—	—	—	—	—	—	—	—
Jul-2002	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Oct-2002	0.87	1.04	4.01	—	—	—	—	—	—	—	—	—	—	—
Jan-2003	0.89	3.49	1.54	—	—	—	—	—	—	—	—	—	—	—
Apr-2003	1.17	0.10	1.18	—	—	—	—	—	—	—	—	—	—	—
Jul-2003	1.70	1.45	10.31	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	D	0.83	0.67	—	—	—	—	—	—	—	—	—	—	—
Feb-2004	D	1.52	0.68	—	—	—	—	—	—	—	—	—	—	—
Apr-2004	D	1.00	3.47	—	—	—	—	—	—	—	—	—	—	—
Jul-2004	D	4.78	1.00	—	—	—	—	—	—	—	—	—	—	—
Oct-2004	D	1.14	2.48	—	—	—	—	—	—	—	—	—	—	—
Jan-2005	D	1.33	0.60	—	—	—	—	—	—	—	—	—	—	—
Apr-2005	D	1.41	1.32	—	—	—	—	—	—	—	—	—	—	—
Jul-2005	D	1.34	0.74	0.98	1.12	0.69	4.38	0.94	—	—	—	—	—	—
Oct-2005	D	1.64	0.91	2.2	4.84	5.07	4.31	1.75	—	—	—	—	—	—
Dec-2005	D	—	—	4.46	6.2	4.14	4.55	5.28	—	—	—	—	—	—
Jan-2006	D	7.92	7.70	5.43	6.71	7.01	5.64	7.99	—	—	—	—	—	—
Apr-2006	D	—	—	—	—	—	—	—	—	—	—	—	—	—
Jul-2006	D	—	—	—	—	—	—	—	—	—	—	—	—	—
Nov-2006	D	—	—	—	—	—	—	—	—	—	—	—	—	—
Mar-2007	D	5.60	2.63	4.86	2.11	5.17	—	2.47	—	—	—	—	—	—
May-2007	D	3.60	2.98	3.6	—	—	3.07	5.35	—	—	—	—	—	—
Sep-2007	D	5.80	2.83	2.66	—	4.12	2.2	1.73	—	—	—	—	—	—
Jan-2008	D	2.09	1.42	—	—	2.68	2.95	D	—	—	—	—	—	—
Apr-2008	D	2.42	3.39	2.86	—	2.32	3.04	D	—	—	—	—	—	—
Jul-2008	D	—	—	—	—	—	—	D	—	—	—	—	—	—
Oct-2008	D	—	3.21	2.14	—	1.56	2.32	D	—	—	—	—	—	—
Dec-2008	D	—	3.30	3.18	—	2.72	4.14	D	—	—	—	—	—	—
Jun-2009	D	—	2.82	4.92	—	5.98	7.53	D	—	—	—	—	—	—
Sep-2009	D	—	—	—	—	—	—	D	—	—	—	—	—	—
Mar-2010	D	—	2.93	3.97	—	—	3.37	D	—	—	—	—	—	—
Sep-2010	D	—	2.84	2.3	1.44	2.4	1.83	D	—	—	—	—	—	—
Mar-2011	D	4.37	3.86	2.51	—	3.27	4.66	D	—	—	—	—	—	—
Sep-2011	D	2.56	2.68	4.36	3.71	3.52	2.93	D	—	—	—	—	—	—
Apr-2012	D	3.24	3.34	3.02	4.53	2.64	1.95	D	—	—	—	—	—	—
Sep-2012	D	4.33	7.25	5.52	4.88	5.48	6.99	D	—	—	—	—	—	—
Apr-2013	D	3.39	3.15	3.6	2.15	3.29	3.82	D	—	—	—	—	—	—
Sep-2013	D	1.67	1.11	2.18	2.51	2.92	2.07	D	—	—	—	—	—	—
Mar-2014	D	9.67	10.53	10.18	D	10.34	9.87	D	—	—	—	—	—	—
Oct-2014	D	8.48	6.60	8.14	D	9.05	8.38	D	—	—	—	—	—	—
Mar-2015	D	—	6.50	5.60	D	6.60	6.30	D	—	—	—	—	—	—
Sep-2015	D	6.75	7.23	6.94	D	6.70	7.09	D	—	—	—	—	—	—
Mar-2016	D	4.07	7.11	5.35	D	3.03	5.38	D	—	—	—	—	—	—
Sep-2016	D	1.33	1.73	—	D	0.78	1.62	D	—	—	—	—	—	—
Mar-2017	D	0.71	0.69	0.75	D	0.76	0.68	D	—	—	—	—	—	—
Sep-2017	D	0.85	0.89	1	D	0.8	0.87	D	—	—	—	—	—	—
Mar-2018	D	—	—	—	D	—	—	D	—	—	—	—	—	—
Sep-2018	D	0.4	0.8	0.51	D	0.58	1.08	D	—	—	—	—	—	—
Jun-2019	D	1.64	1.28	1.09	D	3.03	1.48	D	—	—	—	—	—	—
Dec-2019	D	2.51	2.5	2.77	D	2.23	1.85	D	—	—	—	—	—	—
Jun-2020	D	—	—	—	D	—	—	D	—	—	—	—	—	—
Mar-2020	D	—	—	—	D	—	—	D	—	—	—	—	—	—
May-2020	D	—	—	—	D	—	—	D	1.19	1.45	1.77	1.11	2.27	1.43
Jun-2020	D	1.24	2.18	1.76	D	1.59	—	D	1.65	1.41	1.6	3.21	1.79	1.71
Jul-2020	D	—	—	—	D	—	—	D	0.92	0.75	1.41	1.35	1.22	1.25
Aug-2020	D	—	—	—	D	—	—	D	0.83	0.98	1.8	1.4	1.6	1.48
Aug-2020	D	—	—	—	D	—	—	D	0.9	1.3	1.38	1.27	1.36	1.31
Sep-2020	D	—	—	—	D	—	—	D	1.75	0.53	1.45	1.32	1.65	1.88
Sep-2020	D	—	—	—	D	—	—	D	—	—	—	—	—	—
Sep-2020	D	—	—	—	D	—	—	D	4.7	5.78	5.4	5.01	5.44	5.99
Oct-2020	D	—	—	—	D	—	—	D	6.1	5.99	6.68	5.78	6.43	7.75
Median	0.87	1.64	2.63	3.10	3.71	3.03	3.22	2.47	1.42	1.36	1.69	1.38	1.72	1.60
Mean	0.83	2.76	3.03	3.63	3.65	3.68	3.88	3.64	2.26	2.27	2.69	2.56	2.72	2.85
Min	0.10	0.05	0.19	0.51	1.12	0.58	0.68	0.94	0.83	0.53	1.38	1.11	1.22	1.25
Max	1.70	9.67	10.53	10.18	6.71	10.34	9.87	7.99	6.10	5.99	6.68	5.78	6.43	7.75
80th percentile	1.11	4.35	3.89	5.37	4.88	5.58	5.77	5.34	3.52	4.05	3.96	4.29	4.17	4.35
20th percentile	0.54	1.02	0.88	2.06	2.11	1.58	1.85	1.73	0.91	0.84	1.43	1.29	1.46	1.36

Project TSP, Cudgen, NSW <LOR
Parameter: DO D Destroyed
Units: mg/L — Not monitored or inaccessible
Data Collected t G+S

Shallow bores																			
Target	Minimum	Date	MB1B	MB2B	MB3	MB4	MB5B	MB7	MB8a	MB9a	MB10a	MB11a	MB12a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
6.00		Oct-2001	0.82	0.55	0.51	0.37	0.78	0.77	—	—	—	—	—	—	—	—	—	—	—
6.00		Jan-2002	0.36	1.19	0.18	0.26	0.46	0.16	—	—	—	—	—	—	—	—	—	—	—
6.00		Apr-2002	0.64	0.80	0.82	0.87	1.00	3.06	—	—	—	—	—	—	—	—	—	—	—
6.00		Jul-2002	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6.00		Oct-2002	0.71	0.80	1.93	0.99	0.71	0.50	—	—	—	—	—	—	—	—	—	—	—
6.00		Jan-2003	0.93	3.43	1.91	1.22	2.64	1.11	—	—	—	—	—	—	—	—	—	—	—
6.00		Apr-2003	1.11	4.20	0.56	-0.13	0.95	0.96	—	—	—	—	—	—	—	—	—	—	—
6.00		Jul-2003	0.96	4.10	4.63	5.29	8.31	5.09	—	—	—	—	—	—	—	—	—	—	—
6.00		Oct-2003	3.65	3.54	1.58	1.54	3.90	3.47	—	—	—	—	—	—	—	—	—	—	—
6.00		Feb-2004	1.16	0.45	1.31	1.95	1.06	0.82	—	—	—	—	—	—	—	—	—	—	—
6.00		Apr-2004	0.89	1.75	1.14	1.18	1.14	3.18	—	—	—	—	—	—	—	—	—	—	—
6.00		Jul-2004	1.69	2.59	2.76	0.64	0.63	5.01	—	—	—	—	—	—	—	—	—	—	—
6.00		Oct-2004	1.32	0.90	1.46	1.04	1.28	2.26	—	—	—	—	—	—	—	—	—	—	—
6.00		Jan-2005	1.89	1.34	1.81	1.70	1.15	4.12	—	—	—	—	—	—	—	—	—	—	—
6.00		Apr-2005	1.97	3.36	2.54	1.57	2.31	4.07	—	—	—	—	—	—	—	—	—	—	—
6.00		Jul-2005	2.55	4.28	4.93	—	2.82	4.02	3.78	0.14	—	1.52	1.93	—	—	—	—	—	—
6.00		Oct-2005	2.51	1.15	3.09	2.19	3.12	2.57	4.12	2.77	0.43	0.41	0.78	—	—	—	—	—	—
6.00		Dec-2005	—	—	—	—	—	—	5.13	4.16	5.42	3.7	2.15	—	—	—	—	—	—
6.00		Jan-2006	7.26	6.03	5.33	—	7.45	6.01	4.27	4.65	7.04	3.76	3.5	—	—	—	—	—	—
6.00		Apr-2006	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6.00		Jul-2006	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6.00		Nov-2006	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6.00		Mar-2007	2.34	3.22	1.22	—	1.23	3.46	2.13	2.06	1.27	—	2.93	—	—	—	—	—	—
6.00		May-2007	2.11	2.51	2.93	2.32	3.39	4.19	4.16	2.77	3.41	6.26	1.41	—	—	—	—	—	—
6.00		Sep-2007	2.37	4.78	—	—	4.80	3.27	2.55	2.24	4.01	1.74	—	—	—	—	—	—	—
6.00		Jan-2008	3.72	—	—	—	2.90	1.22	1.73	0.82	2.41	D	—	—	—	—	—	—	—
6.00		Apr-2008	2.86	—	2.47	—	2.60	—	4.07	3.22	—	1.34	D	—	—	—	—	—	—
6.00		Jul-2008	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
6.00		Oct-2008	2.57	—	2.46	2.93	2.60	2.94	2.45	1.92	2.15	2.89	D	—	—	—	—	—	—
6.00		Dec-2008	3.85	—	2.64	—	1.57	—	2.19	2.41	3.81	3.16	D	—	—	—	—	—	—
6.00		Jun-2009	3.44	—	—	6.00	4.80	—	3.27	3.01	3.11	3.09	D	—	—	—	—	—	—
6.00		Sep-2009	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
6.00		Mar-2010	—	2.51	2.65	—	3.30	2.44	3.44	3.18	—	2.61	D	—	—	—	—	—	—
6.00		Sep-2010	1.60	1.92	1.50	1.50	—	2.00	2.44	3.4	—	1.95	D	—	—	—	—	—	—
6.00		Mar-2011	3.06	4.22	3.15	1.98	2.72	—	2.42	3.02	3.54	3.05	D	—	—	—	—	—	—
6.00		Sep-2011	4.06	4.36	3.77	3.40	3.51	—	4.01	3.44	1.98	2.59	D	—	—	—	—	—	—
6.00		Apr-2012	3.30	2.36	1.37	2.02	3.20	1.56	2.06	2.1	2.76	1.35	D	—	—	—	—	—	—
6.00		Sep-2012	3.15	5.43	5.53	2.95	2.32	2.53	5.25	5.27	2.92	5.85	D	—	—	—	—	—	—
6.00		Apr-2013	5.22	2.64	2.82	7.07	2.57	2.76	3.87	3.12	4.29	2.49	D	—	—	—	—	—	—
6.00		Sep-2013	1.99	2.63	2.96	2.09	1.82	1.9	2.74	5.25	2.95	2.15	D	—	—	—	—	—	—
6.00		Mar-2014	10.89	6.68	10.61	11.54	9.73	10.12	9.33	9.8	9.71	9.82	D	—	—	—	—	—	—
6.00		Oct-2014	6.59	9.77	9.83	6.65	10.14	9.96	9.56	10.16	10.31	10.24	D	—	—	—	—	—	—
6.00		Mar-2015	7.40	7.70	7.20	6.60	5.00	5.80	6.40	—	7.10	7.30	D	—	—	—	—	—	—
6.00		Sep-2015	7.3	7	6.38	6.88	6.84	6.8	6.5	6.95	6.79	7.35	D	—	—	—	—	—	—
6.00		Mar-2016	9.4	4.84	4.35	4.83	—	—	6.13	2.39	6.6	6.7	D	—	—	—	—	—	—
6.00		Sep-2016	1.14	2.94	—	—	4.38	4.98	2.33	3.15	4.86	4.7	D	—	—	—	—	—	—
6.00		Apr-2017	1.12	2.13	0.83	0.92	3.14	1.8	3.65	4.6	4.26	1.5	D	—	—	—	—	—	—
6.00		Sep-2017	1.12	3.95	1.13	1.1	2.5	1.9	2.45	4.27	3.12	2.65	D	—	—	—	—	—	—
6.00		Mar-2018	0.1	0.12	0.48	0.2	1.41	3.1	3.6	4.5	3.5	3.2	D	—	—	—	—	—	—
6.00		Sep-2018	0.6	2.1	-0.01	-0.02	1.96	0.87	3.69	2	2.17	1.41	D	—	—	—	—	—	—
6.00		Jun-2019	1.36	3.66	1.97	1.99	1.8	3.01	2.34	2.82	4.23	2.55	D	—	—	—	—	—	—
6.00		Dec-2019	2.74	2.6	3.73	3.03	3.51	3.3	2.7	4.01	4.73	3.15	D	—	—	—	—	—	—
6.00		Jun-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
6.00		Mar-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
6.00		May-2020	—	—	—	—	—	—	—	—	—	—	D	1.51	2.1	2.33	1.77	2.23	1.57
6.00		Jun-2020	1.5	2.84	1.71	1.9	1.68	2.9	3.19	4.5	4.19	—	D	1.98	1.92	2.84	2.18	2.72	1.86
6.00		Jul-2020	—	—	—	—	—	—	—	—	—	—	D	2.23	2.03	2.69	2.5	2.73	2.53
6.00		Aug-2020	—	—	—	—	—	—	—	—	—	—	D	2.05	1.81	1.98	2	1.72	2.01
6.00		Aug-2020	—	—	—	—	—	—	—	—	—	—	D	1.98	1.52	2.99	2.12	2.6	3.21
6.00		Sep-2020	—	—	—	—	—	—	—	—	—	—	D	2.39	1.96	2.37	1.25	2.08	1.43
6.00		Sep-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
6.00		Sep-2020	—	—	—	—	—	—	—	—	—	—	D	4.7	4.39	5.82	3.9	4.45	4.69
6.00		Oct-2020	—	—	—	—	—	—	—	—	—	—	D	4.79	5.15	6.15	5.71	5.4	5.6
		Median	2.11	2.84	2.47	1.95	2.60	2.94	3.63	3.17	3.54	3.05	1.93	2.14	2.00	2.77	2.15	2.66	2.27
		Mean	2.83	3.25	2.86	2.66	3.07	3.25	3.97	3.73	4.13	3.71	2.06	2.70	2.61	3.40	2.68	2.99	2.86
		Min	0.10	0.12	-0.01	-0.13	0.46	0.16	0.06	0.14	0.43	0.41	0.78	1.51	1.52	1.98	1.25	1.72	1.43
		Max	10.89	9.77	10.61	11.54	10.14	10.12	9.56	10.16	10.31	10.24	3.50	4.79	5.15	6.15	5.71	5.40	5.60
		80th percentile	3.75	4.36	4.23	4.54	4.09	4.51	4.96	4.58	5.89	5.85	2.77	3.78	3.47	4.69	3.34	3.76	4.10
		20th percentile	1.08	1.34	1.16	0.93	1.20	1.42	2.44	2.39	2.21	1.95	1.48	1.98	1.85	2.35	1.86	2.14	1.69

Project TSP, Cudgen, NSW <LOR

Parameter: EC

Units: uS/cm

D Destroyed

Data Collected t G+S

— Not monitored or inaccessible

Deep Bores

Sampling Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB12b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	2,470	6,150	4,440	—	—	—	—	—	—	—	—	—	—	—
Jan-2002	2,412	11,110	4,270	—	—	—	—	—	—	—	—	—	—	—
Apr-2002	1,878	6,810	4,000	—	—	—	—	—	—	—	—	—	—	—
Jul-2002	2,980	15,710	4,650	—	—	—	—	—	—	—	—	—	—	—
Oct-2002	4,280	17,790	4,840	—	—	—	—	—	—	—	—	—	—	—
Jan-2003	3,610	11,400	3,700	—	—	—	—	—	—	—	—	—	—	—
Apr-2003	4,370	14,680	4,180	—	—	—	—	—	—	—	—	—	—	—
Jul-2003	4,550	15,110	4,080	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	D	14,750	3,930	—	—	—	—	—	—	—	—	—	—	—
Feb-2004	D	12,900	3,400	—	—	—	—	—	—	—	—	—	—	—
Apr-2004	D	15,530	3,630	—	—	—	—	—	—	—	—	—	—	—
Jul-2004	D	9,080	3,800	—	—	—	—	—	—	—	—	—	—	—
Oct-2004	D	12,170	3,450	—	—	—	—	—	—	—	—	—	—	—
Jan-2005	D	15,310	3,630	—	—	—	—	—	—	—	—	—	—	—
Apr-2005	D	16,540	3,610	—	—	—	—	—	—	—	—	—	—	—
Jul-2005	D	13,880	3,110	23,380	4,830	4,730	22,870	20,680	—	—	—	—	—	—
Oct-2005	D	14,280	267	19,950	11,880	4,750	20,350	18,400	—	—	—	—	—	—
Dec-2005	D	—	—	14,860	16,950	7,030	18,700	15,470	—	—	—	—	—	—
Jan-2006	D	10,990	2,587	17,170	18,920	11,070	19,150	15,630	—	—	—	—	—	—
Apr-2006	D	1,414	2,940	24,560	—	12,300	—	21,250	—	—	—	—	—	—
Jul-2006	D	4,990	3,190	27,120	—	—	—	23,170	—	—	—	—	—	—
Nov-2006	D	4,550	2,656	22,130	22,370	8,900	22,340	17,890	—	—	—	—	—	—
Mar-2007	D	3,810	1,920	18,400	18,400	8,820	—	15,180	—	—	—	—	—	—
May-2007	D	5,180	2,640	—	—	—	—	—	—	—	—	—	—	—
Sep-2007	D	4,740	3,060	24,000	—	14,690	30,000	22,870	—	—	—	—	—	—
Jan-2008	D	6,190	2,954	—	—	11,910	27,000	D	—	—	—	—	—	—
Apr-2008	D	410	2,800	30,000	—	13,000	30,000	D	—	—	—	—	—	—
Jul-2008	D	447	2,700	24,500	—	5,910	19,900	D	—	—	—	—	—	—
Oct-2008	D	—	3,200	35,000	—	10,000	36,000	D	—	—	—	—	—	—
Dec-2008	D	—	3,090	29,000	—	10,070	29,190	D	—	—	—	—	—	—
Jun-2009	D	—	2,068	—	—	5,800	—	D	—	—	—	—	—	—
Sep-2009	D	—	2,957	20,840	—	10,240	24,340	D	—	—	—	—	—	—
Mar-2010	D	—	3,136	30,620	—	—	45,600	D	—	—	—	—	—	—
Sep-2010	D	—	3,320	28,010	4,460	12,090	28,500	D	—	—	—	—	—	—
Mar-2011	D	—	3,480	31,050	—	9,240	30,320	D	—	—	—	—	—	—
Sep-2011	D	275	3,526	29,810	807	7,440	29,260	D	—	—	—	—	—	—
Apr-2012	D	237	3,063	29,650	813	6,860	24,340	D	—	—	—	—	—	—
Sep-2012	D	565	3,001	31,000	20,140	6,680	31,320	D	—	—	—	—	—	—
Apr-2013	D	597	2,597	29,090	27,119	14,507	27,776	D	—	—	—	—	—	—
Sep-2013	D	18,448	2,478	27,985	26,955	14,806	28,060	D	—	—	—	—	—	—
Mar-2014	D	19,740	2,865	31,770	D	16,240	30,590	D	—	—	—	—	—	—
Oct-2014	D	19,900	2,770	33,300	D	16,700	29,700	D	—	—	—	—	—	—
Mar-2015	D	—	2,580	—	D	15,900	29,400	D	—	—	—	—	—	—
Sep-2015	D	20,480	3,060	36,850	D	18,250	30,370	D	—	—	—	—	—	—
Mar-2016	D	20,250	2,750	34,950	D	16,190	30,640	D	—	—	—	—	—	—
Sep-2016	D	19,400	2,639	33,700	D	17,290	31,440	D	—	—	—	—	—	—
Apr-2017	D	18,560	2,951	38,250	D	18,280	32,860	D	—	—	—	—	—	—
Sep-2017	D	19,800	2,839	35,310	D	17,380	30,930	D	—	—	—	—	—	—
Mar-2018	D	17,047	2,996	29,250	D	15,490	25,892	D	—	—	—	—	—	—
Sep-2018	D	18900	3210	32400	D	18100	28500	D	—	—	—	—	—	—
Jun-2019	D	19,010	3,147	33,460	D	18,640	29,230	D	—	—	—	—	—	—
Dec-2020	D	20,600	3,326	37,010	D	20,460	31,600	D	—	—	—	—	—	—
Mar-2020	D	—	—	—	D	—	—	D	—	—	—	—	—	—
May-2020	D	—	—	—	D	—	—	D	27,100	31,400	25,300	23,900	13,400	15,600
Jun-2020	D	21,180	3,174	36,130	D	21,480	—	D	28,300	32,300	24,900	25,800	13,600	15,400
Jul-2020	D	—	—	—	D	—	—	D	29,500	33,000	25,000	27,200	13,300	15,500
Aug-2020	D	—	—	—	D	—	—	D	28,000	31,800	24,200	25,000	13,200	15,000
Aug-2020	D	—	—	—	D	—	—	D	29,500	31,900	24,000	24,200	12,500	14,500
Sep-2020	D	—	—	—	D	—	—	D	29,300	32,200	24,800	25,900	13,300	15,500
Sep-2020	D	—	—	—	D	—	—	D	—	—	—	—	—	—
Sep-2020	D	—	—	—	D	—	—	D	29,200	32,300	24,700	25,100	12,800	15,100
Oct-2020	D	—	—	—	D	—	—	D	29,200	32,500	25,200	25,900	13,200	15,800

Median	3295	13880	3090	29650	17675	12195	29260	18400	29200	32250	24850	25450	13250	15450
Mean	3610	14080	3077	29650	17675	12195	29260	18400	29200	32250	24850	25450	13250	15450
Min	1878	237	267	14860	807	4730	18700	15180	27100	31400	24000	23900	12500	14500
Max	4550	21180	4840	38250	27119	21480	45600	23170	29500	33000	25300	27200	13600	15800
80th percentile	4334	18830	3630	34450	21924	16936	30930	21898	29420	32420	25120	25900	13360	15560
20th percentile	2435.2	4626	2700	23628	4534	7276	24340	15566	28120	31840	24400	24520	12960	15040

Project TSP, Cudgen, NSW <LOR
Parameter: EC
Units: uS/cm D Destroyed
Data Collected by: G+S — Not monitored or inaccessible

Shallow Bore	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB12a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Sampling Date																	
Oct-2001	933	1,405	1,831	2,526	1,814	180	—	—	—	—	—	—	—	—	—	—	—
Jan-2002	874	1,811	1,589	3,073	1,748	184	—	—	—	—	—	—	—	—	—	—	—
Apr-2002	818	722	1,614	2,860	1,804	285	—	—	—	—	—	—	—	—	—	—	—
Jul-2002	1,030	680	2,130	2,700	2,400	180	—	—	—	—	—	—	—	—	—	—	—
Oct-2002	1,345	453	2,235	2,635	2,568	197	—	—	—	—	—	—	—	—	—	—	—
Jan-2003	1,131	461	2,057	1,870	2,106	207	—	—	—	—	—	—	—	—	—	—	—
Apr-2003	1,150	287	1,676	2,046	2,410	184	—	—	—	—	—	—	—	—	—	—	—
Jul-2003	1,313	573	2,690	2,182	1,111	207	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	1,227	286	2,450	1,604	2,316	180	—	—	—	—	—	—	—	—	—	—	—
Feb-2004	1,065	573	1,816	1,127	1,579	175	—	—	—	—	—	—	—	—	—	—	—
Apr-2004	1,099	328	2,130	1,240	2,495	166	—	—	—	—	—	—	—	—	—	—	—
Jul-2004	1,239	577	1,967	1,378	2,527	223	—	—	—	—	—	—	—	—	—	—	—
Oct-2004	1,218	771	2,037	1,293	2,396	267	—	—	—	—	—	—	—	—	—	—	—
Jan-2005	1,318	352	2,188	1,176	1,951	220	—	—	—	—	—	—	—	—	—	—	—
Apr-2005	1,078	390	1,928	1,256	2,123	136	—	—	—	—	—	—	—	—	—	—	—
Jul-2005	1,044	348	1,425	—	1,433	248	1,044	1,497	—	3,740	2,940	—	—	—	—	—	—
Oct-2005	1,056	374	846	1,574	1,692	214	1,042	1,498	1,612	2,905	2,800	—	—	—	—	—	—
Dec-2005	—	—	—	—	—	—	953	1,314	1,497	1,343	2,230	—	—	—	—	—	—
Jan-2006	848	320	1,845	—	1,293	234	11,480	1,842	2,378	1,242	3,020	—	—	—	—	—	—
Apr-2006	1,199	339	1,213	1,038	948	210	1,157	2,172	2,076	1,069	3,080	—	—	—	—	—	—
Jul-2006	678	267	1,645	—	867	194	1,004	—	—	3,220	—	—	—	—	—	—	—
Nov-2006	506	399	1,518	—	1,624	503	1,987	1,344	—	1,944	1,849	—	—	—	—	—	—
Mar-2007	378	239	796	—	1,022	429	614	1,433	1,870	—	1,507	—	—	—	—	—	—
May-2007	—	4,470	917	1,648	996	210	2,041	1,009	1,380	1,912	1,993	—	—	—	—	—	—
Sep-2007	828	292	—	—	2,219	—	1,890	1,979	2,249	1,315	2,291	—	—	—	—	—	—
Jan-2008	970	—	—	—	2,159	200	—	1,285	1,505	1,121	D	—	—	—	—	—	—
Apr-2008	370	—	990	—	1,900	—	1,200	1,400	—	1,800	D	—	—	—	—	—	—
Jul-2008	879	—	—	—	1,531	—	1,236	1,219	1,212	2,570	D	—	—	—	—	—	—
Oct-2008	1,392	—	1,297	1,335	1,816	1,025	1,086	2,172	1,546	1,854	D	—	—	—	—	—	—
Dec-2008	644	—	1,266	—	1,812	—	883	2,489	1,497	2,055	D	—	—	—	—	—	—
Jun-2009	693	—	1,348	—	615	—	913	520	298	1,029	D	—	—	—	—	—	—
Sep-2009	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
Mar-2010	—	904	1,450	—	2,636	—	861	2,313	—	1,602	D	—	—	—	—	—	—
Sep-2010	340	240	1150	1350	—	110	710	1070	—	1260	D	—	—	—	—	—	—
Mar-2011	373	194	704	1470	1019	—	1477	133.2	1116	1387	D	—	—	—	—	—	—
Sep-2011	437	275	1,331	1,351	2,397	—	1,399	1,146	1,084	1,699	D	—	—	—	—	—	—
Apr-2012	342	302	960	940	2,216	156	634	1,329	915	1,392	D	—	—	—	—	—	—
Sep-2012	467	282	1,137	1,506	1,678	102	581	1,578	1,232	1,675	D	—	—	—	—	—	—
Apr-2013	647	226	1,003	1,105	2,542	408	653	1,051	1,045	2,506	D	—	—	—	—	—	—
Sep-2013	1,591	271	983	1,259	1,944	248	1,559	1,051	807	2,015	D	—	—	—	—	—	—
Mar-2014	732	329	1,013	1,337	1,535	187	1,642	1,075	1,040	2,082	D	—	—	—	—	—	—
Oct-2014	671	214	923	1,280	2,820	121	1,480	1,080	923	1,860	D	—	—	—	—	—	—
Mar-2015	633	215	744	1,200	2,180	108	1,510	1,050	806	3,250	D	—	—	—	—	—	—
Sep-2015	611	225	799	1,050	1,567	104	2,370	929	870	2,100	D	—	—	—	—	—	—
Mar-2016	715	191	1,050	1,185	2,220	127	2,226	991	781	1,931	D	—	—	—	—	—	—
Sep-2016	804	321	980	1,060	2,626	97	2,044	1,087	924	2,115	D	—	—	—	—	—	—
Apr-2017	734	353	890	1,215	3,883	93	1,027	993	817	1,818	D	—	—	—	—	—	—
Sep-2017	706	286	1,043	1,039	2,422	86	2,468	1,067	882	2,275	D	—	—	—	—	—	—
Mar-2018	669	254	947	968	2,663	750	2,255	997	866	1,713	D	—	—	—	—	—	—
Sep-2018	664	235	1010	1070	2980	1010	2300	1070	986	1850	D	—	—	—	—	—	—
Jun-2019	696	224	1,226	890	2,439	753	2,182	1,094	935	1,924	D	—	—	—	—	—	—
Dec-2019	868	241	1,481	1,009	2,256	405	2,476	1,201	963	2,175	D	—	—	—	—	—	—
Mar-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	D	626	530	3710	955	510	693
Jun-2020	1,122	208	1,310	936	3,052	147	2,357	1,095	861	—	D	532	517	3700	695	408	464
Jul-2020	—	—	—	—	—	—	—	—	—	—	D	496	474	3680	604	372	426
Aug-2020	—	—	—	—	—	—	—	—	—	—	D	501	510	3860	592	373	424
Aug-2020	—	—	—	—	—	—	—	—	—	—	D	490	507	3970	615	359	426
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	471	504	4100	636	357	412
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	492	516	3880	600	363	426
Oct-2020	—	—	—	—	—	—	—	—	—	—	D	480	530	4070	620	376	425
Median	828	320	1304	1280	2115	197	1438	1121	1040	1857	2546	494	513	3870	618	373	426
Mean	823	311	1297	1270	2123	198	1438	1121	1040	1857	2546	494	513	3870	618	373	426
Min	340	191	704	890	615	86	581	133	298	1029	1507	471	474	3680	592	357	412
Max	1591	4470	2690	3073	3883	1025	11480	2489	2378	3740	3220	626	530	4100	955	510	693
80th percentile	1138.6	573	1894.8	1736.8	2501.4	277.76	2226	1498	1505	2139	3032	519.6	524.8	4030	671.4	395.2	448.8
20th percentile	639.6	238.2	968	1056	1534.2	130.4	913	1050	866	1369.4	1964.2	484	505.2	3704	601.6	360.6	424.4

Project TSP, Cudgen, NSW **<LOR**
Parameter: Enterococci D Destroyed
Units: cfu/100ml — Not monitored
Data Collected G+S

Shallow Bores										
Sampling Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a
May-2007	20	120	20	20	80	720	480	260	20	20
Sep-2007	10	21	—	—	100	—	2100	260	92	2
Jan-2008	430	—	—	—	13	2	—	5	12	11
Apr-2008	10	—	40	—	20	—	10	10	—	300
Jul-2008	450	—	—	—	64	—	490	250	610	1280
Oct-2008	2	—	2	2	2	2	2	5	2	2
Dec-2008	10	—	30	—	100	—	60	440	210	110
Jun-2009	2	—	—	120	18	—	900	700	30	80
Sep-2009	10	—	10	—	—	—	10	27	60	40
Mar-2010	—	240	80	—	160	270	60	120	—	50
Sep-2010	20	10	10	270	—	10	50	22000	—	20
Mar-2011	110	3800	10	600	20	—	1500	1000	70	230
Sep-2011	10	200	10	180	10	—	10	70	8	100
Apr-2012	20	10	10	10	10	10	10	290	20	10
Sep-2012	10	100	100	10	100	10	10	70	100	10
Apr-2013	190	1500	2	100	2	1	300	20	70	20
Sep-2013	—	2	10	10	10	1	2	2	4	10
Mar-2014	10	10	10	10	10	2	250	3500	20	10
Oct-2014	30	10	10	10	10	10	140	90	10	20
Mar-2015	10	250	330	10	30	10	20	10	360	20
Sep-2015	20	10	10	10	10	10	10	10	10	20
Mar-2016	230	200	80	410	10	10	20	120	10	20
Sep-2016	10	10	10	10	10	10	1	18	30	10
Apr-2017	10	140	10	10	10	10	130	600	10	420
Sep-2017	1	1	1	1	1	1	5	1	1	1
Mar-2018	4	300	1	1	10	1	9	370	160	200
Sep-2018	1	2	10	10	10	1	20	10	1	10
Jun-2019	1	5	20	5	5	0.5	5	40	5	10
Dec-2019	1	2	5	5	10	1	120	1000	1	1
Jun-2020	5	6	5	5	5	5	20	5	10	—

Project TSP, Cudgen, NSW **<LOR**
Parameter: Enterococci D Destroyed
Units: cfu/100ml — Not monitored
Data Collected G+S

Shallow Bores										
Sampling Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a
May-2007	20	120	20	20	80	720	480	260	20	20
Sep-2007	10	21	—	—	100	—	2100	260	92	2
Jan-2008	430	—	—	—	13	2	—	5	12	11
Apr-2008	10	—	40	—	20	—	10	10	—	300
Jul-2008	450	—	—	—	64	—	490	250	610	1280
Oct-2008	2	—	2	2	2	2	2	5	2	2
Dec-2008	10	—	30	—	100	—	60	440	210	110
Jun-2009	2	—	—	120	18	—	900	700	30	80
Sep-2009	10	—	10	—	—	—	10	27	60	40
Mar-2010	—	240	80	—	160	270	60	120	—	50
Sep-2010	20	10	10	270	—	10	50	22000	—	20
Mar-2011	110	3800	10	600	20	—	1500	1000	70	230
Sep-2011	10	200	10	180	10	—	10	70	8	100
Apr-2012	20	10	10	10	10	10	10	290	20	10
Sep-2012	10	100	100	10	100	10	10	70	100	10
Apr-2013	190	1500	2	100	2	1	300	20	70	20
Sep-2013	—	2	10	10	10	1	2	2	4	10
Mar-2014	10	10	10	10	10	2	250	3500	20	10
Oct-2014	30	10	10	10	10	10	140	90	10	20
Mar-2015	10	250	330	10	30	10	20	10	360	20
Sep-2015	20	10	10	10	10	10	10	10	10	20
Mar-2016	230	200	80	410	10	10	20	120	10	20
Sep-2016	10	10	10	10	10	10	1	18	30	10
Apr-2017	10	140	10	10	10	10	130	600	10	420
Sep-2017	1	1	1	1	1	1	5	1	1	1
Mar-2018	4	300	1	1	10	1	9	370	160	200
Sep-2018	1	2	10	10	10	1	20	10	1	10
Jun-2019	1	5	20	5	5	0.5	5	40	5	10
Dec-2019	1	2	5	5	10	1	120	1000	1	1
Jun-2020	5	6	5	5	5	5	20	5	10	—

Project TSP, Cudgen, NSW <LOR
Parameter: Faecal coliforms D Destroyed
Units: cfu/100ml — Not monitored

Data Collected by: G+S

Deep Bores												
Date	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
May-2007	1020	2200	39700	—	150	4380	—	—	—	—	—	—
Sep-2007	10	100	6386	—	200	100	—	—	—	—	—	—
Jan-2008	1600	49	—	—	250	200	—	—	—	—	—	—
Apr-2008	3430	10	10	—	10	20	—	—	—	—	—	—
Jul-2008	2600	1800	1900	—	5800	3700	—	—	—	—	—	—
Oct-2008	—	920	1600	—	280	6	—	—	—	—	—	—
Dec-2008	—	10	10	—	90	10	—	—	—	—	—	—
Jun-2009	—	590	190	—	180	13	—	—	—	—	—	—
Sep-2009	—	470	2	—	720	6	—	—	—	—	—	—
Mar-2010	—	10	800	—	—	30	—	—	—	—	—	—
Sep-2010	—	6	40	—	150	29	—	—	—	—	—	—
Mar-2011	6000	120	5600	—	430	20000	—	—	—	—	—	—
Sep-2011	64000	10	10	80	130	10	—	—	—	—	—	—
Apr-2012	30	10	10	10	10	10	—	—	—	—	—	—
Sep-2012	10	2	2	10	2	2	—	—	—	—	—	—
Apr-2013	10	10	10	18	10	2	—	—	—	—	—	—
Sep-2013	2	1	2	10	10	2	—	—	—	—	—	—
Mar-2014	2	2	2	—	10	10	—	—	—	—	—	—
Oct-2014	10	40	10	—	10	100	—	—	—	—	—	—
Mar-2015	—	5700	—	—	2000	4400	—	—	—	—	—	—
Sep-2015	10	10	10	—	10	73	—	—	—	—	—	—
Mar-2016	240	98	10	—	10	100	—	—	—	—	—	—
Sep-2016	1	10	1	—	10	10	—	—	—	—	—	—
Apr-2017	1	1	1	—	10	10	—	—	—	—	—	—
Sep-2017	1	1	1	—	1	1	—	—	—	—	—	—
Mar-2018	1	1	1	—	1	1	—	—	—	—	—	—
Sep-2018	1	1	1	—	10	1	—	—	—	—	—	—
Jun-2019	1	1	0.5	—	5	1	—	—	—	—	—	—
Dec-2019	0.5	1	1	—	1	1	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	3700	1100	61000	430000	24000	60
Jun-2020	0.5	0.5	7	—	5	—	1	1	3	20	2	5
Jul-2020	—	—	—	—	—	—	1	1	0.5	1	0.5	5
Aug-2020	—	—	—	—	—	—	1	22	0.5	0.5	0.5	5
Aug-2020	—	—	—	—	—	—	0.5	0.5	0.5	0.5	0.5	0.5
Sep-2020	—	—	—	—	—	—	1	1	0.5	0.5	0.5	5
Sep-2020	—	—	—	—	—	—	0.5	0.5	0.5	0.5	0.5	0.5
Oct-2020	—	—	—	—	—	—	5	0.5	0.5	0.5	0.5	0.5
Median	10.0	10.0	10.0	10.0	10.0	10.0	1.0	1.0	0.5	0.5	0.5	5.0
Mean	3434.0	406.2	2011.3	25.6	362.2	1145.8	463.8	140.8	7625.8	53752.9	3000.6	10.2
Min	0.5	0.5	0.5	10.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.5
Max	64000.0	5700.0	39700.0	80.0	5800.0	20000.0	3700.0	1100.0	61000.0	430000.0	24000.0	60.0
80th percentile	1368.0	190.0	556.0	30.4	220.0	100.0	3.4	13.6	2.0	12.4	1.4	5.0
20th percentile	1.0	1.0	1.0	10.0	8.0	2.0	0.7	0.5	0.5	0.5	0.5	0.5

Project: TSP, Cudgen, NSW
 Parameter: Faecal coliforms
 Units: cfu/100ml
 Data Collected by: G+S

<LOR
 D Destroyed
 — Not monitored

Date	Shallow Bores															
	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
May-2007	80	20	60	840	60	40	240	280	1230	20	—	—	—	—	—	—
Sep-2007	10	170	—	—	10	—	200	100	30	13	—	—	—	—	—	—
Jan-2008	49	—	—	—	79	8	—	920	1600	220	—	—	—	—	—	—
Apr-2008	600	—	3200	—	10	—	10	10	—	20	—	—	—	—	—	—
Jul-2008	1930	—	—	—	230	—	1700	4200	3400	2700	—	—	—	—	—	—
Oct-2008	2	—	33	6	49	2	13	11	130	79	—	—	—	—	—	—
Dec-2008	10	—	10	—	20	—	10	450	10	10	—	—	—	—	—	—
Jun-2009	2	—	—	330	3	—	700	40	40	10	—	—	—	—	—	—
Sep-2009	400	—	10	—	—	—	10	2	72000	40	—	—	—	—	—	—
Mar-2010	—	180	40	—	10	10	20	60	—	10	—	—	—	—	—	—
Sep-2010	10	50	10	10	—	10	10	10	—	170	—	—	—	—	—	—
Mar-2011	700000	1500	5600	4800	15000	—	1000	360	1000	2500	—	—	—	—	—	—
Sep-2011	70	300	20	20	10	—	30	90	10	100	—	—	—	—	—	—
Apr-2012	10	10	10	10	10	10	10	10	10	10	—	—	—	—	—	—
Sep-2012	10	100	100	10	100	10	10	560	100	10	—	—	—	—	—	—
Apr-2013	10	12	2	10	2	1	10	10	10	10	—	—	—	—	—	—
Sep-2013	1	2	10	10	10	1	2	2	2	10	—	—	—	—	—	—
Mar-2014	1	10	10	10	10	2	10	1	100	10	—	—	—	—	—	—
Oct-2014	10	10	10	10	10	10	40	140	30	10	—	—	—	—	—	—
Mar-2015	10	10	10	10	20	10	70	10	700	1200	—	—	—	—	—	—
Sep-2015	10	10	10	10	10	10	10	10	10	10	—	—	—	—	—	—
Mar-2016	180	200	10	67	20	10	10	10	1200	200	—	—	—	—	—	—
Sep-2016	1	1	10	10	10	10	1	10	10	10	—	—	—	—	—	—
Apr-2017	10	100	10	10	10	10	400	3300	10	10	—	—	—	—	—	—
Sep-2017	1	1	1	1	1	1	1	1	1	1	—	—	—	—	—	—
Mar-2018	1	4	1	2	3	1	4	1	1	2	—	—	—	—	—	—
Sep-2018	1	2	10	10	10	1	400	10	1	10	—	—	—	—	—	—
Jun-2019	1	480	5	5	5	1	5	5	5	5	—	—	—	—	—	—
Dec-2019	1	1	5	5	5	1	1	1	1	1	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	8100	270000	48000	12000	120000	57000
Jun-2020	5	22	5	5	5	5	5	30	10	—	1	5	15	5	2	2
Jul-2020	—	—	—	—	—	—	—	—	—	—	1	2	0.5	5	1	5
Aug-2020	—	—	—	—	—	—	—	—	—	—	1	1	0.5	1	0.5	1
Aug-2020	—	—	—	—	—	—	—	—	—	—	0.5	0.5	0.5	0.5	0.5	0.5
Sep-2020	—	—	—	—	—	—	—	—	—	—	1	1	0.5	0.5	0.5	0.5
Sep-2020	—	—	—	—	—	—	—	—	—	—	0.5	0.5	0.5	0.5	0.5	0.5
Oct-2020	—	—	—	—	—	—	—	—	—	—	0.5	5	0.5	2	0.5	5
Median	10.0	12.0	10.0	10.0	10.0	9.0	10.0	10.0	10.0	10.0	1.0	1.5	0.5	1.5	0.5	1.5
Mean	24256.1	138.9	353.9	269.6	561.5	7.5	170.1	354.8	3024.1	255.2	1013.2	33751.9	6002.3	1501.8	15000.7	7126.8
Min	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.5	0.5	0.5	0.5	0.5	0.5
Max	700000.0	1500.0	5600.0	4800.0	15000.0	40.0	1700.0	4200.0	72000.0	2700.0	8100.0	270000.0	48000.0	12000.0	120000.0	57000.0
80th percentile	74.0	176.0	33.0	16.0	37.4	10.0	216.0	296.0	940.0	128.0	1.0	5.0	9.2	5.0	1.6	5.0
20th percentile	1.0	2.8	5.0	5.4	5.0	1.0	5.0	4.4	6.0	10.0	0.5	0.7	0.5	0.5	0.5	0.5

Project TSP, Cudgen, NSW **<LOR**
Parameter: Fe D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Deep bores													
Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	0.02	0.19	2.26	—	—	—	—	—	—	—	—	—	—
Jan-2002	0.46	0.67	4.03	—	—	—	—	—	—	—	—	—	—
Apr-2002	0.18	0.57	0.04	—	—	—	—	—	—	—	—	—	—
Jul-2002	0.04	0.06	0.41	—	—	—	—	—	—	—	—	—	—
Oct-2002	0.06	0.10	0.35	—	—	—	—	—	—	—	—	—	—
Jan-2003	0.01	0.18	0.03	—	—	—	—	—	—	—	—	—	—
Apr-2003	0.01	0.01	0.01	—	—	—	—	—	—	—	—	—	—
Jul-2003	0.04	0.06	0.01	—	—	—	—	—	—	—	—	—	—
Oct-2003	—	0.05	0.02	—	—	—	—	—	—	—	—	—	—
Feb-2004	—	0.02	0.01	—	—	—	—	—	—	—	—	—	—
Apr-2004	—	0.07	0.01	—	—	—	—	—	—	—	—	—	—
Jul-2004	—	0.01	0.01	—	—	—	—	—	—	—	—	—	—
Oct-2004	—	0.02	0.01	—	—	—	—	—	—	—	—	—	—
Jan-2005	—	0.03	0.03	—	—	—	—	—	—	—	—	—	—
Apr-2005	—	0.04	0.02	—	—	—	—	—	—	—	—	—	—
Jul-2005	—	0.08	1.06	—	—	—	—	—	—	—	—	—	—
Oct-2005	—	0.05	0.64	—	—	—	—	—	—	—	—	—	—
Jan-2006	—	0.05	0.05	—	—	—	—	—	—	—	—	—	—
Apr-2006	—	0.05	0.05	—	—	—	—	—	—	—	—	—	—
Jul-2006	—	0.05	0.06	—	—	—	—	—	—	—	—	—	—
Nov-2006	—	0.05	0.05	—	—	—	—	—	—	—	—	—	—
Mar-2007	—	0.02	0.04	—	—	—	—	—	—	—	—	—	—
May-2007	—	0.01	0.01	0.07	—	20.00	0.01	—	—	—	—	—	—
Sep-2007	—	0.59	0.88	1.70	—	1.20	1.40	—	—	—	—	—	—
Jan-2008	—	1.60	1.70	—	—	2.70	3.40	—	—	—	—	—	—
Apr-2008	—	0.18	0.57	—	—	1.40	1.50	—	—	—	—	—	—
Jul-2008	—	0.19	0.67	3.00	—	1.10	2.30	—	—	—	—	—	—
Oct-2008	—	—	0.78	2.90	—	1.40	1.80	—	—	—	—	—	—
Dec-2008	—	—	0.08	0.14	—	0.05	0.02	—	—	—	—	—	—
Jun-2009	—	—	0.24	0.69	—	0.22	0.57	—	—	—	—	—	—
Sep-2009	—	—	0.45	0.90	—	0.42	0.97	—	—	—	—	—	—
Mar-2010	—	—	0.01	0.01	—	—	0.91	—	—	—	—	—	—
Sep-2010	—	—	0.05	0.05	0.09	0.09	0.06	—	—	—	—	—	—
Mar-2011	—	0.61	4.04	0.40	—	0.05	0.05	—	—	—	—	—	—
Sep-2011	—	1.23	0.13	0.50	0.30	1.03	0.55	—	—	—	—	—	—
Apr-2012	—	0.53	0.01	0.01	0.46	0.01	0.01	—	—	—	—	—	—
Sep-2012	—	0.09	0.05	0.30	0.05	0.13	0.35	—	—	—	—	—	—
Apr-2013	—	0.34	2.32	1.45	28.70	39.60	1.90	—	—	—	—	—	—
Sep-2013	—	0.57	3.03	1.48	24.50	29.90	1.54	—	—	—	—	—	—
Mar-2014	—	0.60	2.97	1.18	—	34.00	2.12	—	—	—	—	—	—
Oct-2014	—	0.76	2.96	0.80	—	0.22	2.01	—	—	—	—	—	—
Mar-2015	—	—	3.49	—	—	25.00	1.80	—	—	—	—	—	—
Sep-2015	—	0.05	0.05	0.05	—	2.28	0.05	—	—	—	—	—	—
Mar-2016	—	0.99	4.04	1.50	—	34.30	1.14	—	—	—	—	—	—
Sep-2016	—	0.02	4.10	1.50	—	13.00	2.00	—	—	—	—	—	—
Apr-2017	—	0.26	2.40	1.00	—	33.00	1.90	—	—	—	—	—	—
Sep-2017	—	0.39	3.40	0.88	—	23.00	1.60	—	—	—	—	—	—
Mar-2018	—	0.59	2.10	0.89	—	35.00	1.90	—	—	—	—	—	—
Sep-2018	—	0.90	1.83	1.66	—	37.60	2.40	—	—	—	—	—	—
Jun-2019	—	0.50	1.98	0.05	—	32.60	2.46	—	—	—	—	—	—
Dec-2019	—	1.28	1.95	1.44	—	31.10	2.40	—	—	—	—	—	—
Mar-2020	—	—	—	—	—	—	—	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	9.28	7.38	0.96	0.29	1.11	15.40
Jun-2020	—	1.30	1.78	0.25	—	29.30	—	10.40	0.03	0.03	0.03	0.03	0.06
Jul-2020	—	—	—	—	—	—	—	0.03	0.05	0.03	0.09	0.03	0.18
Aug-2020	—	—	—	—	—	—	—	0.03	0.03	0.03	0.03	0.03	0.03
Aug-2020	—	—	—	—	—	—	—	0.03	0.06	0.03	0.03	0.03	0.03
Sep-2020	—	—	—	—	—	—	—	0.03	0.03	0.03	0.03	0.03	0.03
Sep-2020	—	—	—	—	—	—	—	—	—	—	—	—	—
Sep-2020	—	—	—	—	—	—	—	0.18	0.03	0.03	0.03	0.03	0.52
Oct-2020	—	—	—	—	—	—	—	0.03	0.03	0.03	0.03	0.03	0.08
Median	0.04	0.18	0.38	0.88	0.38	2.70	1.54	0.03	0.03	0.03	0.03	0.03	0.07
Mean	0.10	0.36	1.10	0.92	9.02	14.82	1.35	2.50	0.95	0.14	0.07	0.16	2.04
Min	0.01	0.01	0.01	0.01	0.05	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.03
Max	0.46	1.60	4.10	3.00	28.70	39.60	3.40	10.40	7.38	0.96	0.29	1.11	15.40
80th percentile	0.13	0.60	2.31	1.50	24.50	32.76	2.05	5.64	0.06	0.03	0.06	0.03	0.38
20th percentile	0.01	0.05	0.02	0.08	0.09	0.22	0.23	0.03	0.03	0.03	0.03	0.03	0.03

Project: TSP, Cudgen, NSW **<LOR**
Parameter: Fe **D** Destroyed
Units: mg/L **—** Not monitored
Data Collected by: G+S

Shallow bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	0.01	5.11	0.08	30.60	0.05	8.34	—	—	—	—	—	—	—	—	—	—
Jan-2002	1.37	7.10	4.62	61.40	9.08	9.84	—	—	—	—	—	—	—	—	—	—
Apr-2002	0.01	5.61	2.12	31.80	3.04	6.52	—	—	—	—	—	—	—	—	—	—
Jul-2002	1.45	18.80	13.40	46.80	17.80	7.50	—	—	—	—	—	—	—	—	—	—
Oct-2002	7.39	17.80	18.70	56.20	22.10	8.05	—	—	—	—	—	—	—	—	—	—
Jan-2003	1.59	0.44	13.60	20.10	14.50	8.95	—	—	—	—	—	—	—	—	—	—
Apr-2003	0.02	2.36	0.03	7.70	4.30	4.41	—	—	—	—	—	—	—	—	—	—
Jul-2003	12.20	0.43	29.30	16.20	20.50	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	0.02	1.92	13.60	0.02	0.03	4.06	—	—	—	—	—	—	—	—	—	—
Feb-2004	0.01	0.11	4.10	0.01	0.04	5.50	—	—	—	—	—	—	—	—	—	—
Apr-2004	9.07	0.38	11.30	0.08	8.78	6.59	—	—	—	—	—	—	—	—	—	—
Jul-2004	0.01	0.12	1.87	0.01	15.50	8.98	—	—	—	—	—	—	—	—	—	—
Oct-2004	2.44	10.50	33.10	0.01	41.00	7.10	—	—	—	—	—	—	—	—	—	—
Jan-2005	0.03	0.38	24.00	0.13	0.04	2.41	—	—	—	—	—	—	—	—	—	—
Apr-2005	11.50	0.42	34.10	0.75	16.20	6.14	—	—	—	—	—	—	—	—	—	—
Jul-2005	6.77	0.11	25.80	—	0.09	1.07	—	—	—	—	—	—	—	—	—	—
Oct-2005	7.51	8.19	0.05	0.09	0.44	4.39	—	—	—	—	—	—	—	—	—	—
Jan-2006	0.05	0.23	0.05	—	0.06	0.72	—	—	—	—	—	—	—	—	—	—
Apr-2006	0.05	0.22	0.18	0.19	0.05	2.10	—	—	—	—	—	—	—	—	—	—
Jul-2006	0.38	0.17	37.90	—	0.09	0.53	—	—	—	—	—	—	—	—	—	—
Nov-2006	13.40	0.07	9.84	—	7.92	4.03	—	—	—	—	—	—	—	—	—	—
Mar-2007	2.07	1.52	0.16	—	4.55	9.85	—	—	—	—	—	—	—	—	—	—
May-2007	0.01	5.39	2.12	0.64	0.10	8.12	2.51	0.54	0.16	0.06	—	—	—	—	—	—
Sep-2007	0.23	0.53	—	—	0.62	—	0.23	2.00	0.38	0.21	—	—	—	—	—	—
Jan-2008	0.71	—	—	—	1.10	5.90	—	0.23	0.42	0.33	—	—	—	—	—	—
Apr-2008	1.50	—	0.40	—	0.58	—	3.20	0.24	—	0.40	—	—	—	—	—	—
Jul-2008	0.76	—	—	—	0.91	—	0.33	0.28	0.55	0.57	—	—	—	—	—	—
Oct-2008	0.47	—	3.10	0.61	0.63	2.50	0.31	1.40	0.24	0.46	—	—	—	—	—	—
Dec-2008	5.55	—	30.00	—	1.93	—	0.35	1.71	6.96	0.34	—	—	—	—	—	—
Jun-2009	1.12	—	—	0.12	0.26	—	0.08	0.19	0.20	0.16	—	—	—	—	—	—
Sep-2009	2.56	—	0.48	—	—	—	0.17	0.23	0.14	0.34	—	—	—	—	—	—
Mar-2010	—	—	13.00	—	10.00	3.56	1.53	2.25	—	7.29	—	—	—	—	—	—
Sep-2010	0.84	0.57	64.20	16.60	—	4.13	0.08	1.62	—	1.25	—	—	—	—	—	—
Mar-2011	7.82	0.23	66.50	37.30	12.90	—	5.64	8.10	5.01	19.40	—	—	—	—	—	—
Sep-2011	5.76	1.35	74.40	20.30	46.50	—	3.05	6.22	0.54	22.40	—	—	—	—	—	—
Apr-2012	2.41	0.44	16.00	0.10	17.00	2.35	1.40	0.54	1.91	14.00	—	—	—	—	—	—
Sep-2012	3.35	0.31	28.40	18.80	30.20	3.05	1.34	6.27	0.40	20.10	—	—	—	—	—	—
Apr-2013	6.91	0.98	29.10	25.60	46.80	18.10	7.99	7.58	4.01	35.60	—	—	—	—	—	—
Sep-2013	4.60	2.08	20.10	23.10	25.00	8.35	13.00	6.88	4.30	27.20	—	—	—	—	—	—
Mar-2014	9.62	7.81	23.90	28.40	26.80	6.36	12.00	5.91	4.15	28.40	—	—	—	—	—	—
Oct-2014	6.46	6.82	35.00	30.00	21.30	4.68	0.05	7.26	4.06	21.80	—	—	—	—	—	—
Mar-2015	7.91	1.80	42.40	23.30	1.99	2.37	9.45	6.28	3.84	22.30	—	—	—	—	—	—
Sep-2015	0.05	0.22	21.70	0.05	0.23	0.81	1.76	0.77	0.08	6.74	—	—	—	—	—	—
Mar-2016	10.30	0.61	93.00	30.80	16.50	5.07	13.10	7.26	7.61	30.80	—	—	—	—	—	—
Sep-2016	0.02	0.31	47.00	24.00	20.00	3.70	10.00	9.50	7.70	34.00	—	—	—	—	—	—
Apr-2017	12.00	9.40	30.00	30.00	26.00	3.30	3.40	4.70	9.40	27.00	—	—	—	—	—	—
Sep-2017	10.00	8.10	58.00	14.00	2.20	3.50	7.50	4.50	7.20	29.00	—	—	—	—	—	—
Mar-2018	9.10	7.40	59.00	30.00	58.00	17.00	12.00	4.20	11.00	30.00	—	—	—	—	—	—
Sep-2018	6.24	10.40	66.00	31.40	43.50	32.80	6.33	5.83	11.30	23.00	—	—	—	—	—	—
Jun-2019	6.69	11.90	69.60	20.40	33.00	34.40	6.25	5.11	11.10	25.90	—	—	—	—	—	—
Dec-2019	8.90	13.20	98.30	22.00	24.80	22.00	8.06	6.79	9.50	30.80	—	—	—	—	—	—
Mar-2020	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	3.59	5.17	4.60	16.10	3.25	9.31
Jun-2020	11.20	4.52	63.70	23.40	28.80	7.17	7.05	6.30	8.72	—	5.64	0.03	0.03	0.50	0.38	0.06
Jul-2020	—	—	—	—	—	—	—	—	—	—	0.03	0.03	0.03	0.05	0.06	0.03
Aug-2020	—	—	—	—	—	—	—	—	—	—	0.03	0.03	0.03	0.03	0.03	0.03
Sep-2020	—	—	—	—	—	—	—	—	—	—	0.03	0.03	0.03	0.03	0.03	0.03
Oct-2020	—	—	—	—	—	—	—	—	—	—	0.03	0.03	0.03	0.03	0.03	0.03
Median	2.44	1.44	22.80	20.20	8.93	5.50	3.20	4.60	4.06	20.10	0.03	0.03	0.03	0.03	0.03	0.03
Mean	4.32	4.01	27.78	18.08	13.68	7.36	4.76	4.02	4.48	15.86	1.17	0.67	0.60	2.10	0.48	1.20
Min	0.01	0.07	0.03	0.01	0.03	0.53	0.05	0.19	0.08	0.06	0.03	0.03	0.03	0.03	0.03	0.03
Max	13.40	18.80	98.30	61.40	58.00	34.40	13.10	9.50	11.30	35.60	5.64	5.17	4.60	16.10	3.25	9.31
80th percentile	8.90	7.93	53.60	30.12	25.20	8.71	8.62	6.81	8.52	28.64	2.16	0.03	0.03	0.32	0.25	0.08
20th percentile	0.05	0.28	2.12	0.12	0.25	2.72	0.32	0.54	0.38	0.38	0.03	0.03	0.03	0.03	0.03	0.03

Project TSP, Cudgen, NSW <LOR
Parameter: HCO3 D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Deep Bores													
Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	323	665	238	—	—	—	—	—	—	—	—	—	—
Jan-2002	336	715	254	—	—	—	—	—	—	—	—	—	—
Apr-2002	314	478	228	—	—	—	—	—	—	—	—	—	—
Jul-2002	348	707	249	—	—	—	—	—	—	—	—	—	—
Oct-2002	360	757	242	—	—	—	—	—	—	—	—	—	—
Jan-2003	331	717	233	—	—	—	—	—	—	—	—	—	—
Apr-2003	342	734	234	—	—	—	—	—	—	—	—	—	—
Jul-2003	293	686	220	—	—	—	—	—	—	—	—	—	—
Oct-2003	—	0.5	36	—	—	—	—	—	—	—	—	—	—
Feb-2004	—	717	222	—	—	—	—	—	—	—	—	—	—
Apr-2004	—	773	239	—	—	—	—	—	—	—	—	—	—
Jul-2004	—	763	244	—	—	—	—	—	—	—	—	—	—
Oct-2004	—	767	225	—	—	—	—	—	—	—	—	—	—
Jan-2005	—	755	221	—	—	—	—	—	—	—	—	—	—
Apr-2005	—	861	254	—	—	—	—	—	—	—	—	—	—
Jul-2005	—	769	210	—	—	—	—	—	—	—	—	—	—
Oct-2005	—	792	236	—	—	—	—	—	—	—	—	—	—
Jan-2006	—	633	194	—	—	—	—	—	—	—	—	—	—
Apr-2006	—	736	209	—	—	—	—	—	—	—	—	—	—
Jul-2006	—	411	195	—	—	—	—	—	—	—	—	—	—
Nov-2006	—	376	202	—	—	—	—	—	—	—	—	—	—
Mar-2007	—	328	168	—	—	—	—	—	—	—	—	—	—
May-2007	—	303	126	511	—	559	438	—	—	—	—	—	—
Sep-2007	—	370	200	700	—	780	700	—	—	—	—	—	—
Jan-2008	—	5000	240	—	—	760	780	—	—	—	—	—	—
Apr-2008	—	150	220	810	—	760	690	—	—	—	—	—	—
Jul-2008	—	220	260	990	—	900	930	—	—	—	—	—	—
Oct-2008	—	—	220	940	—	840	810	—	—	—	—	—	—
Dec-2008	—	—	187	700	—	720	770	—	—	—	—	—	—
Jun-2009	—	—	171	618	—	489	559	—	—	—	—	—	—
Sep-2009	—	—	212	666	—	703	579	—	—	—	—	—	—
Mar-2010	—	—	120	417	—	—	—	—	—	—	—	—	—
Sep-2010	—	—	184	667	244	676	607	—	—	—	—	—	—
Mar-2011	—	54	189	622	—	761	633	—	—	—	—	—	—
Sep-2011	—	94	184	578	112	587	185	—	—	—	—	—	—
Apr-2012	—	60	240	710	53	560	680	—	—	—	—	—	—
Sep-2012	—	60	246	592	73	530	631	—	—	—	—	—	—
Apr-2013	—	100	316	620	585	730	709	—	—	—	—	—	—
Sep-2013	—	799	356	346	591	712	729	—	—	—	—	—	—
Mar-2014	—	618	212	407	—	517	525	—	—	—	—	—	—
Oct-2014	—	756	267	466	—	831	806	—	—	—	—	—	—
Mar-2015	—	—	359	—	—	765	718	—	—	—	—	—	—
Sep-2015	—	798	346	420	—	722	692	—	—	—	—	—	—
Mar-2016	—	839	351	400	—	747	702	—	—	—	—	—	—
Sep-2016	—	727	314	385	—	682	656	—	—	—	—	—	—
Apr-2017	—	699	310	367	—	668	658	—	—	—	—	—	—
Sep-2017	—	782	293	386	—	716	698	—	—	—	—	—	—
Mar-2018	—	784	192	378	—	510	648	—	—	—	—	—	—
Sep-2018	—	838	209	401	—	435	674	—	—	—	—	—	—
Jun-2019	—	791	203	377	—	330	634	—	—	—	—	—	—
Dec-2019	—	767	199	329	—	296	619	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	465	1020	1060	1210	763	710
Jun-2020	—	733	181	403	—	286	—	479	970	1050	1030	808	736
Jul-2020	—	—	—	—	—	—	—	516	1150	1180	1180	858	725
Aug-2020	—	—	—	—	—	—	—	421	1070	1120	1100	824	755
Aug-2020	—	—	—	—	—	—	—	423	1060	1140	995	813	752
Sep-2020	—	—	—	—	—	—	—	431	977	1110	1070	794	734
Sep-2020	—	—	—	—	—	—	—	416	952	1050	1000	745	691
Oct-2020	—	—	—	—	—	—	—	407	996	1060	1040	772	706
Median	334	717	222	489	178	703	677	427	1008	1085	1055	801	730
Mean	331	677	228	543	276	640	659	445	1024	1096	1078	797	726
Min	293	0.5	36	329	53	286	185	407	952	1050	995	745	691
Max	360	5000	359	990	591	900	930	516	1150	1180	1210	858	755
80th percentile	346	782	254	687	585	760	725	473	1066	1132	1148	820	746
20th percentile	318	323	192	385	73	514	612	418	973	1054	1012	767	708

Project TSP, Cudgen, NSW **<LOR**
Parameter: HCO3 D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Shallow bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	206	132	295	249	178	1	—	—	—	—	—	—	—	—	—	—
Jan-2002	192	122	299	228	186	8	—	—	—	—	—	—	—	—	—	—
Apr-2002	150	52	234	203	181	1	—	—	—	—	—	—	—	—	—	—
Jul-2002	179	49	338	239	236	6	—	—	—	—	—	—	—	—	—	—
Oct-2002	198	49	349	242	263	15	—	—	—	—	—	—	—	—	—	—
Jan-2003	197	93	353	188	238	12	—	—	—	—	—	—	—	—	—	—
Apr-2003	222	38	299	213	221	5	—	—	—	—	—	—	—	—	—	—
Jul-2003	168	57	330	188	130	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	165	0.5	262	463	0.5	0.5	—	—	—	—	—	—	—	—	—	—
Feb-2004	161	48	352	241	143	9	—	—	—	—	—	—	—	—	—	—
Apr-2004	193	62	360	251	160	9	—	—	—	—	—	—	—	—	—	—
Jul-2004	194	72	350	259	188	7	—	—	—	—	—	—	—	—	—	—
Oct-2004	195	65	333	255	185	12	—	—	—	—	—	—	—	—	—	—
Jan-2005	192	73	327	243	220	8	—	—	—	—	—	—	—	—	—	—
Apr-2005	226	77	382	287	218	20	—	—	—	—	—	—	—	—	—	—
Jul-2005	195	89	256	N/A	264	23	—	—	—	—	—	—	—	—	—	—
Oct-2005	199	74	253	578	233	14	—	—	—	—	—	—	—	—	—	—
Jan-2006	144	61	219	N/A	187	1	—	—	—	—	—	—	—	—	—	—
Apr-2006	181	75	212	254	275	14	—	—	—	—	—	—	—	—	—	—
Jul-2006	131	59	246	N/A	230	11	—	—	—	—	—	—	—	—	—	—
Nov-2006	147	109	320	N/A	255	35	—	—	—	—	—	—	—	—	—	—
Mar-2007	115	51	183	N/A	226	15	—	—	—	—	—	—	—	—	—	—
May-2007	83	43	201	203	85	15	87	104	147	159	—	—	—	—	—	—
Sep-2007	150	320	—	—	190	—	100	190	130	140	—	—	—	—	—	—
Jan-2008	150	—	—	—	240	3.4	—	190	130	120	—	—	—	—	—	—
Apr-2008	55	—	240	—	690	—	120	200	—	240	—	—	—	—	—	—
Jul-2008	130	—	—	—	400	—	150	270	180	260	—	—	—	—	—	—
Oct-2008	200	—	340	330	370	12	130	280	180	230	—	—	—	—	—	—
Dec-2008	90	—	148	—	413	—	83	293	142	136	—	—	—	—	—	—
Jun-2009	107	—	—	222	269	—	111	207	153	177	—	—	—	—	—	—
Sep-2009	112	—	291	—	—	—	119	264	156	250	—	—	—	—	—	—
Mar-2010	—	102	147	—	192	14	74	116	—	116	—	—	—	—	—	—
Sep-2010	67	79	117	281	—	25	126	236	—	155	—	—	—	—	—	—
Mar-2011	83	51	28	252	229	—	97	217	148	160	—	—	—	—	—	—
Sep-2011	124	71	97	280	170	—	107	255	111	185	—	—	—	—	—	—
Apr-2012	89	65	190	250	290	16	140	240	220	190	—	—	—	—	—	—
Sep-2012	154	57	300	317	340	8	158	307	177	221	—	—	—	—	—	—
Apr-2013	188	74	286	283	404	7	166	229	121	185	—	—	—	—	—	—
Sep-2013	181	89	305	304	389	3	90	265	134	188	—	—	—	—	—	—
Mar-2014	171	90	348	346	262	4	104	239	135	147	—	—	—	—	—	—
Oct-2014	196	48	281	309	397	8	122	256	206	180	—	—	—	—	—	—
Mar-2015	229	76	262	349	386	12	105	287	158	205	—	—	—	—	—	—
Sep-2015	205	71	303	316	357	8	104	249	142	166	—	—	—	—	—	—
Mar-2016	238	51	263	410	383	14	126	262	131	165	—	—	—	—	—	—
Sep-2016	243	79	318	319	318	16	120	249	119	147	—	—	—	—	—	—
Apr-2017	257	81	325	411	428	22	94	267	97	184	—	—	—	—	—	—
Sep-2017	253	93	396	350	426	18	157	298	112	221	—	—	—	—	—	—
Mar-2018	219	70	325	400	216	14	138	332	97	161	—	—	—	—	—	—
Sep-2018	210	71	435	462	398	16	210	310	86	192	—	—	—	—	—	—
Jun-2019	209	60	470	317	322	10	196	298	80	202	—	—	—	—	—	—
Dec-2019	253	61	445	340	347	12	196	293	105	193	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	261	216	572	283	175	246
Jun-2020	196	69	491	331	309	3	200	275	91	—	222	208	497	254	165	184
Jul-2020	—	—	—	—	—	—	—	—	—	—	246	219	529	256	179	206
Aug-2020	—	—	—	—	—	—	—	—	—	—	217	207	448	219	171	193
Aug-2020	—	—	—	—	—	—	—	—	—	—	231	199	515	250	168	197
Sep-2020	—	—	—	—	—	—	—	—	—	—	227	209	493	244	162	192
Sep-2020	—	—	—	—	—	—	—	—	—	—	212	210	465	224	158	181
Oct-2020	—	—	—	—	—	—	—	—	—	—	224	227	476	236	164	192
Median	188.0	71.0	299.5	282.0	247.5	12.0	120.0	259.0	134.0	184.0	225.5	209.5	495.0	247.0	166.5	192.5
Mean	172.4	75.1	289.7	299.1	272.8	11.3	128.6	249.3	136.6	181.9	230.0	211.9	499.4	245.8	167.8	198.9
Min	55.0	0.5	28.0	188.0	0.5	0.5	74.0	104.0	80.0	116.0	212.0	199.0	448.0	219.0	158.0	181.0
Max	257.0	320.0	491.0	578.0	690.0	35.0	210.0	332.0	220.0	260.0	261.0	227.0	572.0	283.0	179.0	246.0
80th percentile	209.0	89.0	349.6	346.6	383.6	15.6	157.4	293.0	157.6	211.4	240.0	217.8	523.4	255.2	173.4	202.4
20th percentile	130.0	51.0	225.0	240.6	186.8	5.4	98.8	215.0	106.2	151.8	219.0	207.4	469.4	228.8	162.8	187.2

Project TSP, Cudgen, NSW <LOR
Parameter: K D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Date	Deep bores												
	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	22	87	26	-	-	-	-	-	-	-	-	-	-
Jan-2002	24	87	27	-	-	-	-	-	-	-	-	-	-
Apr-2002	14	52	26	-	-	-	-	-	-	-	-	-	-
Jul-2002	20	118	30	-	-	-	-	-	-	-	-	-	-
Oct-2002	26	113	28	-	-	-	-	-	-	-	-	-	-
Jan-2003	32	115	31	-	-	-	-	-	-	-	-	-	-
Apr-2003	33	108	26	-	-	-	-	-	-	-	-	-	-
Jul-2003	40	129	26	-	-	-	-	-	-	-	-	-	-
Oct-2003	-	119	27	-	-	-	-	-	-	-	-	-	-
Feb-2004	-	128	29.7	-	-	-	-	-	-	-	-	-	-
Apr-2004	-	125	26	-	-	-	-	-	-	-	-	-	-
Jul-2004	-	127	25	-	-	-	-	-	-	-	-	-	-
Oct-2004	-	119	25	-	-	-	-	-	-	-	-	-	-
Jan-2005	-	128	25	-	-	-	-	-	-	-	-	-	-
Apr-2005	-	160	25	-	-	-	-	-	-	-	-	-	-
Jul-2005	-	128	22	-	-	-	-	-	-	-	-	-	-
Oct-2005	-	117	21	-	-	-	-	-	-	-	-	-	-
Jan-2006	-	111	22	-	-	-	-	-	-	-	-	-	-
Apr-2006	-	120	26	-	-	-	-	-	-	-	-	-	-
Jul-2006	-	54	21	-	-	-	-	-	-	-	-	-	-
Nov-2006	-	47	23	-	-	-	-	-	-	-	-	-	-
Mar-2007	-	57	23	-	-	-	-	-	-	-	-	-	-
May-2007	-	72	22	168	-	128	155	-	-	-	-	-	-
Sep-2007	-	58	38	200	-	130	200	-	-	-	-	-	-
Jan-2008	-	51	18	-	-	81	170	-	-	-	-	-	-
Apr-2008	-	12	20	180	-	100	180	-	-	-	-	-	-
Jul-2008	-	18	22	150	-	80	170	-	-	-	-	-	-
Oct-2008	-	-	18	170	-	78	160	-	-	-	-	-	-
Dec-2008	-	-	17	155	-	62	157	-	-	-	-	-	-
Jun-2009	-	-	24	196	-	48	202	-	-	-	-	-	-
Sep-2009	-	-	22	215	-	84	213	-	-	-	-	-	-
Mar-2010	-	-	16	137	-	-	147	-	-	-	-	-	-
Sep-2010	-	-	22	197	37	69	200	-	-	-	-	-	-
Mar-2011	-	10	21	210	-	79	205	-	-	-	-	-	-
Sep-2011	-	9	19	198	7	60	195	-	-	-	-	-	-
Apr-2012	-	6	26	350	9	81	349	-	-	-	-	-	-
Sep-2012	-	6	18	201	13	66	197	-	-	-	-	-	-
Apr-2013	-	8	21	202	166	150	211	-	-	-	-	-	-
Sep-2013	-	134	21	161	136	105	165	-	-	-	-	-	-
Mar-2014	-	137	22	181	-	117	187	-	-	-	-	-	-
Oct-2014	-	136	20	202	-	122	185	-	-	-	-	-	-
Mar-2015	-	-	20	-	-	95	165	-	-	-	-	-	-
Sep-2015	-	117	18	166	-	94	154	-	-	-	-	-	-
Mar-2016	-	123	18	181	-	102	167	-	-	-	-	-	-
Sep-2016	-	170	21	210	-	100	190	-	-	-	-	-	-
Apr-2017	-	140	24	230	-	140	220	-	-	-	-	-	-
Sep-2017	-	120	20	200	-	110	180	-	-	-	-	-	-
Mar-2018	-	150	27	220	-	130	180	-	-	-	-	-	-
Sep-2018	-	126	24	185	-	116	165	-	-	-	-	-	-
Jun-2019	-	124	22	204	-	101	171	-	-	-	-	-	-
Dec-2019	-	129	23	199	-	92	170	-	-	-	-	-	-
May-2020	-	-	-	-	-	-	-	142	148	164	144	83	86
Jun-2020	-	124	23	184	-	82	-	148	152	168	158	87	88
Jul-2020	-	-	-	-	-	-	-	156	157	151	169	88	86
Aug-2020	-	-	-	-	-	-	-	171	162	159	154	92	91
Aug-2020	-	-	-	-	-	-	-	159	177	192	186	90	90
Sep-2020	-	-	-	-	-	-	-	152	150	161	160	88	87
Sep-2020	-	-	-	-	-	-	-	152	168	170	161	88	90
Oct-2020	-	-	-	-	-	-	-	152	159	180	174	91	96
Median	25	118	23	198	25	95	180	152	158	166	161	88	89
Mean	26	96	23	195	61	97	187	154	159	168	163	88	89
Min	14	6	16	137	7	48	147	142	148	151	144	83	86
Max	40	170	38	350	166	150	349	171	177	192	186	92	96
80th percentile	33	128	26	208	136	119	201	158	166	176	172	91	91
20th percentile	21	52	20	169	9	79	165	150	151	160	156	87	86

Project TSP, Cudgen, NSW
 Parameter: K
 Units: mg/L
 Data Collected by: G+S

<LOR
 D Destroyed
 — Not monitored

Shallow bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	10	14	5	8	6	6	-	-	-	-	-	-	-	-	-	-
Jan-2002	10	11	5	12	6	7	-	-	-	-	-	-	-	-	-	-
Apr-2002	11	8	5	7	5	11	-	-	-	-	-	-	-	-	-	-
Jul-2002	11	8	5	7	7	12	-	-	-	-	-	-	-	-	-	-
Oct-2002	13	7	4	7	8	13	-	-	-	-	-	-	-	-	-	-
Jan-2003	13	10	6	7	9	17	-	-	-	-	-	-	-	-	-	-
Apr-2003	11	5	4	6	6	16	-	-	-	-	-	-	-	-	-	-
Jul-2003	13	5	5	7	5	-	-	-	-	-	-	-	-	-	-	-
Oct-2003	14	6	7	7	7	17	-	-	-	-	-	-	-	-	-	-
Feb-2004	14.2	8.8	8	5.9	6.5	18.7	-	-	-	-	-	-	-	-	-	-
Apr-2004	14	8	6	5	9	19	-	-	-	-	-	-	-	-	-	-
Jul-2004	13	7	5	6	8	19	-	-	-	-	-	-	-	-	-	-
Oct-2004	12	7	6	5	8	18	-	-	-	-	-	-	-	-	-	-
Jan-2005	12	6	6	5	4	18	-	-	-	-	-	-	-	-	-	-
Apr-2005	11	6	6	5	6	18	-	-	-	-	-	-	-	-	-	-
Jul-2005	11	5	6	-	3	23	-	-	-	-	-	-	-	-	-	-
Oct-2005	10	5	2	11	5	19	-	-	-	-	-	-	-	-	-	-
Jan-2006	10	4	7	-	3	21	-	-	-	-	-	-	-	-	-	-
Apr-2006	10	7	7	8	2	18	-	-	-	-	-	-	-	-	-	-
Jul-2006	7	6	11	-	2	20	-	-	-	-	-	-	-	-	-	-
Nov-2006	7	7	4	-	4	21	-	-	-	-	-	-	-	-	-	-
Mar-2007	5	6	5	-	5	24	-	-	-	-	-	-	-	-	-	-
May-2007	8	5	5	6	5	23	5	8	15	10	-	-	-	-	-	-
Sep-2007	11	40	-	-	28	-	4.5	27	25	18	-	-	-	-	-	-
Jan-2008	8.6	-	-	-	3.6	12	-	11	12	6.5	-	-	-	-	-	-
Apr-2008	6	-	5.6	-	7	-	4.5	10	-	12	-	-	-	-	-	-
Jul-2008	5.6	-	-	-	2.9	-	5.2	10	12	8.8	-	-	-	-	-	-
Oct-2008	7.2	-	4.7	6	7.9	15	5.1	9.6	12	9.1	-	-	-	-	-	-
Dec-2008	5	-	8	-	5	-	5	7	10	5	-	-	-	-	-	-
Jun-2009	6	-	-	11	4	-	3	10	11	10	-	-	-	-	-	-
Sep-2009	5	-	6	-	-	-	2	10	12	8	-	-	-	-	-	-
Mar-2010	-	-	6	-	5	11	5	8	-	5	-	-	-	-	-	-
Sep-2010	5	4	9	5	-	12	2	8	-	5	-	-	-	-	-	-
Mar-2011	5	7	11	10	4	-	2	8	10	10	-	-	-	-	-	-
Sep-2011	6	6	9	4	8	-	2	7	8	6	-	-	-	-	-	-
Apr-2012	5	6	8	12	10	6	5	10	11	7	-	-	-	-	-	-
Sep-2012	5	5	6	5	6	7	2	7	8	6	-	-	-	-	-	-
Apr-2013	7	6	6	5	7	12	2	8	8	7	-	-	-	-	-	-
Sep-2013	8	5	6	5	6	10	4	7	8	9	-	-	-	-	-	-
Mar-2014	8	6	6	5	8	10	4	8	11	7	-	-	-	-	-	-
Oct-2014	8	3	6	4	6	10	3	6	8	6	-	-	-	-	-	-
Mar-2015	7	5	8	5	6	7	4	9	9	11	-	-	-	-	-	-
Sep-2015	9	4	9	4	6	7	3	6	8	6	-	-	-	-	-	-
Mar-2016	9	4	12	5	6	8	4	8	8	7	-	-	-	-	-	-
Sep-2016	7.3	5.5	6.8	4.8	9	6.7	4.7	8.6	9.7	9	-	-	-	-	-	-
Apr-2017	7.7	8.1	5.9	6.1	11	6.4	5.9	9.7	10	7.7	-	-	-	-	-	-
Sep-2017	7.5	5.1	8.1	4	7.1	4.4	4.8	7.2	7.9	7.3	-	-	-	-	-	-
Mar-2018	8	4.5	6.4	4.5	8.9	8.5	4.9	9.3	9.4	7.7	-	-	-	-	-	-
Sep-2018	9	4	7	4	6	12	4	7	8	6	-	-	-	-	-	-
Jun-2019	10	4	7	3	7	12	4	8	8	6	-	-	-	-	-	-
Dec-2019	14	3	8	4	6	9	6	8	9	7	-	-	-	-	-	-
May-2020	-	-	-	-	-	-	-	-	-	-	5	1	38	8	2	6
Jun-2020	20	10	7	4	7	5	3	8	9	-	4	0.5	39	5	1	3
Jul-2020	-	-	-	-	-	-	-	-	-	-	4	1	41	4	0.5	4
Aug-2020	-	-	-	-	-	-	-	-	-	-	4	1	43	4	0.5	4
Aug-2020	-	-	-	-	-	-	-	-	-	-	4	0.5	45	4	0.5	4
Sep-2020	-	-	-	-	-	-	-	-	-	-	4	0.5	41	4	0.5	3
Sep-2020	-	-	-	-	-	-	-	-	-	-	4	0.5	43	4	0.5	3
Oct-2020	-	-	-	-	-	-	-	-	-	-	4	1	45	4	0.5	3
Median	9	6	6	5	6	12	4	8	9	7	4	1	42	4	1	4
Mean	9	7	7	6	7	13	4	9	10	8	4	1	42	5	1	4
Min	5	3	2	3	2	4	2	6	8	5	4	1	38	4	1	3
Max	20	40	12	12	28	24	6	27	25	18	5	1	45	8	2	6
80th percentile	12	8	8	7	8	19	5	10	12	9	4	1	44	5	1	4
20th percentile	6	5	5	4	5	7	3	7	8	6	4	1	40	4	1	3

Project TSP, Cudgen, NSW <LOR
Parameter: Mg D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Deep bores													
Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	61.0	288.0	91.0	—	—	—	—	—	—	—	—	—	—
Jan-2002	71.0	363.0	94.0	—	—	—	—	—	—	—	—	—	—
Apr-2002	56.0	179.0	89.0	—	—	—	—	—	—	—	—	—	—
Jul-2002	60.0	358.0	90.0	—	—	—	—	—	—	—	—	—	—
Oct-2002	75.0	329.0	78.0	—	—	—	—	—	—	—	—	—	—
Jan-2003	105.0	345.0	91.0	—	—	—	—	—	—	—	—	—	—
Apr-2003	103.0	356.0	83.0	—	—	—	—	—	—	—	—	—	—
Jul-2003	107.0	402.0	91.0	—	—	—	—	—	—	—	—	—	—
Oct-2003	D	392.0	95.0	—	—	—	—	—	—	—	—	—	—
Feb-2004	D	373.0	88.1	—	—	—	—	—	—	—	—	—	—
Apr-2004	D	416.0	86.0	—	—	—	—	—	—	—	—	—	—
Jul-2004	D	414.0	88.0	—	—	—	—	—	—	—	—	—	—
Oct-2004	D	420.0	88.0	—	—	—	—	—	—	—	—	—	—
Jan-2005	D	409.0	83.0	—	—	—	—	—	—	—	—	—	—
Apr-2005	D	407.0	81.0	—	—	—	—	—	—	—	—	—	—
Jul-2005	D	394.0	74.0	—	—	—	—	—	—	—	—	—	—
Oct-2005	D	426.0	75.0	—	—	—	—	—	—	—	—	—	—
Jan-2006	D	377.0	73.0	—	—	—	—	—	—	—	—	—	—
Apr-2006	D	412.0	86.0	—	—	—	—	—	—	—	—	—	—
Jul-2006	D	184.0	72.0	—	—	—	—	—	—	—	—	—	—
Nov-2006	D	150.0	74.0	—	—	—	—	—	—	—	—	—	—
Mar-2007	D	165.0	67.0	—	—	—	—	—	—	—	—	—	—
May-2007	D	232.0	63.0	909.0	—	644.0	768.0	—	—	—	—	—	—
Sep-2007	D	180.0	95.0	870.0	—	500.0	820.0	—	—	—	—	—	—
Jan-2008	D	170.0	61.0	—	—	380.0	750.0	—	—	—	—	—	—
Apr-2008	D	6.3	68.0	970.0	—	480.0	860.0	—	—	—	—	—	—
Jul-2008	D	5.7	62.0	800.0	—	370.0	780.0	—	—	—	—	—	—
Oct-2008	D	—	59.0	860.0	—	370.0	720.0	—	—	—	—	—	—
Dec-2008	D	—	66.0	615.0	—	311.0	540.0	—	—	—	—	—	—
Jun-2009	D	—	63.0	809.0	—	174.0	699.0	—	—	—	—	—	—
Sep-2009	D	—	65.0	896.0	—	338.0	770.0	—	—	—	—	—	—
Mar-2010	D	—	50.0	499.0	—	—	448.0	—	—	—	—	—	—
Sep-2010	D	—	62.0	975.0	82.0	262.0	798.0	—	—	—	—	—	—
Mar-2011	D	3.0	30.0	958.0	—	303.0	801.0	—	—	—	—	—	—
Sep-2011	D	3.0	63.0	972.0	22.0	238.0	786.0	—	—	—	—	—	—
Apr-2012	D	4.7	72.0	849.0	19.0	239.0	764.0	—	—	—	—	—	—
Sep-2012	D	4.0	62.0	943.0	45.0	243.0	808.0	—	—	—	—	—	—
Apr-2013	D	11.0	73.0	904.0	855.0	568.0	839.0	—	—	—	—	—	—
Sep-2013	D	511.0	71.0	806.0	728.0	514.0	720.0	—	—	—	—	—	—
Mar-2014	D	527.0	72.0	900.0	—	536.0	787.0	—	—	—	—	—	—
Oct-2014	D	538.0	75.0	846.0	—	534.0	779.0	—	—	—	—	—	—
Mar-2015	D	—	70.0	—	—	501.0	710.0	—	—	—	—	—	—
Sep-2015	D	443.0	61.0	677.0	—	466.0	668.0	—	—	—	—	—	—
Mar-2016	D	495.0	66.0	801.0	—	511.0	760.0	—	—	—	—	—	—
Sep-2016	D	540.0	57.0	520.0	—	400.0	500.0	—	—	—	—	—	—
Apr-2017	D	490.0	66.0	910.0	—	570.0	820.0	—	—	—	—	—	—
Sep-2017	D	480.0	64.0	780.0	—	520.0	730.0	—	—	—	—	—	—
Mar-2018	D	530.0	67.0	820.0	—	540.0	760.0	—	—	—	—	—	—
Sep-2018	D	470.0	66.0	776.0	—	421.0	676.0	—	—	—	—	—	—
Jun-2019	D	516.0	69.0	848.0	—	393.0	791.0	—	—	—	—	—	—
Dec-2019	D	466.0	61.0	957.0	—	339.0	670.0	—	—	—	—	—	—
May-2020	D	—	—	—	—	—	—	700.0	717.0	823.0	650.0	364.0	504.0
Jun-2020	D	496.0	69.0	825.0	—	371.0	—	704.0	696.0	833.0	726.0	354.0	468.0
Jul-2020	D	—	—	—	—	—	—	774.0	735.0	763.0	789.0	372.0	480.0
Aug-2020	D	—	—	—	—	—	—	808.0	653.0	720.0	660.0	355.0	457.0
Aug-2020	D	—	—	—	—	—	—	756.0	820.0	959.0	863.0	379.0	505.0
Sep-2020	D	—	—	—	—	—	—	756.0	698.0	845.0	775.0	383.0	508.0
Sep-2020	D	—	—	—	—	—	—	735.0	776.0	884.0	785.0	379.0	502.0
Oct-2020	D	—	—	—	—	—	—	717.0	719.0	879.0	811.0	377.0	522.0
Median	73.0	392.0	71.5	848.5	63.5	400.0	764.0	745.5	718.0	839.0	780.0	374.5	503.0
Mean	82.4	327.1	72.4	832.0	291.8	415.0	735.2	743.8	726.8	838.3	757.4	370.4	493.3
Min	56.0	3.0	30.0	499.0	19.0	174.0	448.0	700.0	653.0	720.0	650.0	354.0	457.0
Max	107.0	540.0	95.0	975.0	855.0	644.0	860.0	808.0	820.0	959.0	863.0	383.0	522.0
80th percentile	104.2	482.0	87.6	929.8	728.0	525.6	799.2	766.8	759.6	882.0	802.2	379.0	506.8
20th percentile	60.4	169.0	63.0	788.0	22.0	307.8	689.8	709.2	696.8	787.0	686.4	358.6	472.8

Project TSP, Cudgen, NSW <LOR
Parameter: Mg D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Shallow bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	18.0	19.0	20.0	51.0	27.0	0.5	—	—	—	—	—	—	—	—	—	—
Jan-2002	18.0	8.0	15.0	69.0	22.0	0.5	—	—	—	—	—	—	—	—	—	—
Apr-2002	17.0	6.0	15.0	60.0	24.0	1.0	—	—	—	—	—	—	—	—	—	—
Jul-2002	19.0	5.0	22.0	55.0	29.0	0.5	—	—	—	—	—	—	—	—	—	—
Oct-2002	20.0	4.0	18.0	44.0	23.0	0.5	—	—	—	—	—	—	—	—	—	—
Jan-2003	22.0	3.0	26.0	44.0	27.0	0.5	—	—	—	—	—	—	—	—	—	—
Apr-2003	18.0	2.0	14.0	42.0	36.0	0.5	—	—	—	—	—	—	—	—	—	—
Jul-2003	23.0	2.0	25.0	59.0	27.0	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	23.0	2.0	25.0	38.0	30.0	0.5	—	—	—	—	—	—	—	—	—	—
Feb-2004	20.5	3.4	15.8	28.5	20.8	0.5	—	—	—	—	—	—	—	—	—	—
Apr-2004	22.0	4.0	18.0	26.0	29.0	0.5	—	—	—	—	—	—	—	—	—	—
Jul-2004	22.0	4.0	16.0	32.0	30.0	0.5	—	—	—	—	—	—	—	—	—	—
Oct-2004	23.0	4.0	19.0	28.0	31.0	0.5	—	—	—	—	—	—	—	—	—	—
Jan-2005	25.0	3.0	14.0	24.0	31.0	0.5	—	—	—	—	—	—	—	—	—	—
Apr-2005	22.0	3.0	13.0	29.0	33.0	0.5	—	—	—	—	—	—	—	—	—	—
Jul-2005	22.0	4.0	9.0	—	20.0	0.5	—	—	—	—	—	—	—	—	—	—
Oct-2005	22.0	3.0	5.0	55.0	32.0	0.5	—	—	—	—	—	—	—	—	—	—
Jan-2006	20.0	3.0	12.0	—	14.0	0.5	—	—	—	—	—	—	—	—	—	—
Apr-2006	19.0	4.0	8.0	28.0	15.0	0.5	—	—	—	—	—	—	—	—	—	—
Jul-2006	11.0	3.0	12.0	—	16.0	0.5	—	—	—	—	—	—	—	—	—	—
Nov-2006	12.0	4.0	7.0	—	21.0	4.0	—	—	—	—	—	—	—	—	—	—
Mar-2007	11.0	2.7	6.6	—	18.0	0.7	—	—	—	—	—	—	—	—	—	—
May-2007	14.0	3.0	4.6	26.0	15.0	0.4	29.0	31.0	34.0	48.0	—	—	—	—	—	—
Sep-2007	27.0	130.0	—	—	32.0	—	30.0	34.0	84.0	89.0	—	—	—	—	—	—
Jan-2008	17.0	—	—	—	32.0	0.5	—	—	26.0	27.0	—	—	—	—	—	—
Apr-2008	8.0	—	8.7	—	34.0	—	46.0	36.0	—	66.0	—	—	—	—	—	—
Jul-2008	7.5	—	—	—	30.0	—	38.0	37.0	30.0	60.0	—	—	—	—	—	—
Oct-2008	13.0	—	11.0	35.0	29.0	2.7	34.0	34.0	31.0	54.0	—	—	—	—	—	—
Dec-2008	8.6	—	14.2	—	30.1	—	32.0	37.0	32.0	46.0	—	—	—	—	—	—
Jun-2009	12.0	—	—	25.0	26.0	—	27.0	32.0	24.0	61.0	—	—	—	—	—	—
Sep-2009	9.0	—	22.0	—	—	—	24.0	35.0	24.0	65.0	—	—	—	—	—	—
Mar-2010	—	—	10.0	—	40.0	0.6	20.0	24.0	—	26.0	—	—	—	—	—	—
Sep-2010	9.0	4.0	12.0	35.0	—	0.5	26.0	32.0	—	39.0	—	—	—	—	—	—
Mar-2011	6.0	3.0	3.0	7.0	26.0	—	20.0	27.0	16.0	51.0	—	—	—	—	—	—
Sep-2011	9.0	4.0	12.0	30.0	35.0	—	20.0	26.0	15.0	55.0	—	—	—	—	—	—
Apr-2012	5.9	4.2	6.5	6.4	41.0	1.5	22.0	27.0	15.0	45.0	—	—	—	—	—	—
Sep-2012	10.0	4.0	18.0	36.0	31.0	0.5	19.0	26.0	16	62.0	—	—	—	—	—	—
Apr-2013	14.0	3.0	16.0	27.0	50.0	3.0	19.0	26.0	14.0	59.0	—	—	—	—	—	—
Sep-2013	14.0	4.0	15.0	29.0	36.0	2.0	44.0	23.0	13.0	67.0	—	—	—	—	—	—
Mar-2014	15.0	5.0	17.0	32.0	32.0	2.0	40.0	25.0	19.0	59.0	—	—	—	—	—	—
Oct-2014	16.0	3.0	15.0	32.0	51.0	0.5	37.0	25.0	17.0	52.0	—	—	—	—	—	—
Mar-2015	11.0	3.0	11.0	28.0	39.0	0.5	38.0	24.0	14.0	77.0	—	—	—	—	—	—
Sep-2015	16.0	3.0	15.0	24.0	32.0	0.5	46.0	23.0	14.0	54.0	—	—	—	—	—	—
Mar-2016	17.0	3.0	21.0	29.0	39.0	0.5	46.0	27.0	15.0	57.0	—	—	—	—	—	—
Sep-2016	13.0	3.6	15.0	22.0	44.0	1.6	30.0	24.0	20.0	61.0	—	—	—	—	—	—
Apr-2017	12.0	4.5	12.0	29.0	72.0	0.7	19.0	23.0	18.0	52.0	—	—	—	—	—	—
Sep-2017	12.0	3.9	15.0	24.0	39.0	0.9	38.0	24.0	17.0	70.0	—	—	—	—	—	—
Mar-2018	16.0	3.3	17.0	28.0	56.0	7.9	41.0	26.0	19.0	53.0	—	—	—	—	—	—
Sep-2018	14.0	3.0	18.0	29.0	53.0	8.0	36.0	25.0	20.0	50.0	—	—	—	—	—	—
Jun-2019	17.0	3.0	21.0	19.0	46.0	6.0	40.0	28.0	22.0	55.0	—	—	—	—	—	—
Dec-2019	16.0	2.0	25.0	23.0	43.0	3.0	43.0	28.0	18.0	57.0	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	10.0	6.0	109.0	18.0	6.0	12.0
Jun-2020	17.0	4.0	24.0	23.0	54.0	2.0	29.0	29.0	18.0	—	9.0	5.0	105.0	11.0	4.0	6.0
Jul-2020	—	—	—	—	—	—	—	—	—	—	9.0	6.0	121.0	11.0	5.0	7.0
Aug-2020	—	—	—	—	—	—	—	—	—	—	10.0	7.0	123.0	12.0	4.0	6.0
Aug-2020	—	—	—	—	—	—	—	—	—	—	9.0	7.0	134.0	11.0	4.0	6.0
Sep-2020	—	—	—	—	—	—	—	—	—	—	9.0	7.0	130.0	11.0	4.0	6.0
Sep-2020	—	—	—	—	—	—	—	—	—	—	9.0	7.0	134.0	10.0	4.0	6.0
Oct-2020	—	—	—	—	—	—	—	—	—	—	9.0	8.0	138.0	11.0	4.0	6.0
Median	16.0	3.5	15.0	29.0	31.0	0.5	32.0	27.0	18.5	55.0	9.0	7.0	126.5	11.0	4.0	6.0
Mean	15.8	6.8	14.9	32.8	32.9	1.4	32.2	28.3	22.7	55.8	9.3	6.6	124.3	11.9	4.4	6.9
Min	5.9	2.0	3.0	6.4	14.0	0.4	19.0	23.0	13.0	26.0	9.0	5.0	105.0	10.0	4.0	6.0
Max	27.0	130.0	26.0	69.0	72.0	8.0	46.0	37.0	84.0	89.0	10.0	8.0	138.0	18.0	6.0	12.0
80th percentile	22.0	4.0	18.8	39.6	40.4	2.0	40.4	32.4	26.0	63.2	9.6	7.0	134.0	11.6	4.6	6.6
20th percentile	11.0	3.0	10.2	24.0	23.6	0.5	21.2	24.0	15.0	49.2	9.0	6.0	113.8	11.0	4.0	6.0

Project TSP, Cudgen, NSW <LOR
Parameter: Na D Destroyed
Units: mg/L — Not monitored or inaccessible
Data Collected by: G+S

Deep Bores													
Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	358	1740	570	—	—	—	—	—	—	—	—	—	—
Jan-2002	312	1950	461	—	—	—	—	—	—	—	—	—	—
Apr-2002	128	915	490	—	—	—	—	—	—	—	—	—	—
Jul-2002	196	2080	444	—	—	—	—	—	—	—	—	—	—
Oct-2002	448	1890	508	—	—	—	—	—	—	—	—	—	—
Jan-2003	517	2430	458	—	—	—	—	—	—	—	—	—	—
Apr-2003	597	2300	491	—	—	—	—	—	—	—	—	—	—
Jul-2003	542	2480	420	—	—	—	—	—	—	—	—	—	—
Oct-2003	D	2060	418	—	—	—	—	—	—	—	—	—	—
Feb-2004	D	2200	408	—	—	—	—	—	—	—	—	—	—
Apr-2004	D	2370	364	—	—	—	—	—	—	—	—	—	—
Jul-2004	D	2350	389	—	—	—	—	—	—	—	—	—	—
Oct-2004	D	2440	405	—	—	—	—	—	—	—	—	—	—
Jan-2005	D	2290	367	—	—	—	—	—	—	—	—	—	—
Apr-2005	D	2340	394	—	—	—	—	—	—	—	—	—	—
Jul-2005	D	2290	348	—	—	—	—	—	—	—	—	—	—
Oct-2005	D	2470	349	—	—	—	—	—	—	—	—	—	—
Jan-2006	D	2180	339	—	—	—	—	—	—	—	—	—	—
Apr-2006	D	2370	357	—	—	—	—	—	—	—	—	—	—
Jul-2006	D	983	331	—	—	—	—	—	—	—	—	—	—
Nov-2006	D	663	333	—	—	—	—	—	—	—	—	—	—
Mar-2007	D	546	270	—	—	—	—	—	—	—	—	—	—
May-2007	D	666	278	4940	—	2160	5230	—	—	—	—	—	—
Sep-2007	D	880	420	4500	—	2200	5600	—	—	—	—	—	—
Jan-2008	D	890	300	—	—	1600	4700	—	—	—	—	—	—
Apr-2008	D	30	300	5300	—	2100	5600	—	—	—	—	—	—
Jul-2008	D	16	290	4500	—	1700	5400	—	—	—	—	—	—
Oct-2008	D	—	340	5000	—	1800	5900	—	—	—	—	—	—
Dec-2008	D	—	320	3480	—	1377	3569	—	—	—	—	—	—
Jun-2009	D	—	331	3680	—	733	4240	—	—	—	—	—	—
Sep-2009	D	—	330	4440	—	1520	4560	—	—	—	—	—	—
Mar-2010	D	—	267	5008	—	—	5362	—	—	—	—	—	—
Sep-2010	D	—	434	4820	675	1130	5110	—	—	—	—	—	—
Mar-2011	D	8	423	2000	—	1290	5020	—	—	—	—	—	—
Sep-2011	D	13	416	4980	76	1080	4880	—	—	—	—	—	—
Apr-2012	D	9.4	385	2717	103	916	2787	—	—	—	—	—	—
Sep-2012	D	11	319	4410	272	1000	4780	—	—	—	—	—	—
Apr-2013	D	81	319	5010	4720	2470	5180	—	—	—	—	—	—
Sep-2013	D	3170	314	4500	4300	2560	4560	—	—	—	—	—	—
Mar-2014	D	3220	324	4990	—	2520	4920	—	—	—	—	—	—
Oct-2014	D	3060	282	5160	—	2360	4670	—	—	—	—	—	—
Mar-2015	D	—	240	—	—	2490	5160	—	—	—	—	—	—
Sep-2015	D	2990	249	5230	—	2380	4830	—	—	—	—	—	—
Mar-2016	D	3470	252	5960	—	2500	5310	—	—	—	—	—	—
Sep-2016	D	3150	240	5330	—	2400	4840	—	—	—	—	—	—
Apr-2017	D	2640	310	4990	—	2390	4460	—	—	—	—	—	—
Sep-2017	D	3160	290	6030	—	2580	5300	—	—	—	—	—	—
Mar-2018	D	3280	400	5940	—	2660	4890	—	—	—	—	—	—
Sep-2018	D	3170	426	5950	—	2770	5050	—	—	—	—	—	—
Jun-2019	D	3310	429	6180	—	3150	5540	—	—	—	—	—	—
Dec-19	D	3110	395	7080	—	2870	4900	—	—	—	—	—	—
May-2020	D	—	—	—	—	—	—	4860	6210	4580	4350	2260	2620
Jun-2020	D	3290	433	6090	—	3190	—	5200	6660	4580	4810	2180	2420
Jul-2020	D	—	—	—	—	—	—	5600	6960	4110	5170	2300	2540
Aug-2020	D	—	—	—	—	—	—	5950	6150	3980	4230	2190	2380
Aug-2020	D	—	—	—	—	—	—	5890	8170	5450	5770	2350	2620
Sep-2020	D	—	—	—	—	—	—	5660	6800	4380	4890	2380	2620
Sep-2020	D	—	—	—	—	—	—	5250	7430	4450	4610	2260	2500
Oct-2020	D	—	—	—	—	—	—	5450	6700	4840	5130	2380	2710
Median	403	2290	353	4995	474	2360	4920	5525	6750	4515	4850	2280	2580
Mean	391	1937	361	4936	1691	2065	4909	5483	6885	4546	4870	2288	2551
Min	128	8	240	2000	76	733	2787	4860	6150	3980	4230	2180	2380
Max	597	3470	570	7080	4720	3190	5900	5950	8170	5450	5770	2380	2710
80th percentile	532	3118	425	5946	4300	2568	5331	5798	7242	4736	5154	2368	2620
20th percentile	242	665	300	4464	103	1342	4626	5220	6390	4218	4454	2218	2452

Project TSP, Cudgen, NSW <LOR
Parameter: Na D Destroyed
Units: mg/L — Not monitored or inaccessible
Data Collected b G+S

Shallow bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	16	124	35	201	90	15	—	—	—	—	—	—	—	—	—	—
Jan-2002	20	40	30	242	86	16	—	—	—	—	—	—	—	—	—	—
Apr-2002	35	52	35	225	100	32	—	—	—	—	—	—	—	—	—	—
Jul-2002	22	46	33	211	116	17	—	—	—	—	—	—	—	—	—	—
Oct-2002	50	36	55	229	139	16	—	—	—	—	—	—	—	—	—	—
Jan-2003	32	39	42	171	107	20	—	—	—	—	—	—	—	—	—	—
Apr-2003	36	20	40	152	139	22	—	—	—	—	—	—	—	—	—	—
Jul-2003	24	30	49	199	136	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	26	16	52	154	143	20	—	—	—	—	—	—	—	—	—	—
Feb-2004	26	20	46	71	147	19	—	—	—	—	—	—	—	—	—	—
Apr-2004	31	16	52	62	198	21	—	—	—	—	—	—	—	—	—	—
Jul-2004	27	16	47	78	206	22	—	—	—	—	—	—	—	—	—	—
Oct-2004	26	22	47	64	218	22	—	—	—	—	—	—	—	—	—	—
Jan-2005	26	25	50	60	131	18	—	—	—	—	—	—	—	—	—	—
Apr-2005	23	25	50	74	155	15	—	—	—	—	—	—	—	—	—	—
Jul-2005	30	24	58	—	123	26	—	—	—	—	—	—	—	—	—	—
Oct-2005	23	25	30	98	138	20	—	—	—	—	—	—	—	—	—	—
Jan-2006	22	21	55	—	104	20	—	—	—	—	—	—	—	—	—	—
Apr-2006	23	33	50	69	74	13	—	—	—	—	—	—	—	—	—	—
Jul-2006	19	9	64	—	50	18	—	—	—	—	—	—	—	—	—	—
Nov-2006	16	20	42	—	96	55	—	—	—	—	—	—	—	—	—	—
Mar-2007	18	19	46	—	92	20	—	—	—	—	—	—	—	—	—	—
May-2007	20	23	34	85	85	21	60	131	236	184	—	—	—	—	—	—
Sep-2007	110	630	—	—	120	—	77	190	240	210	—	—	—	—	—	—
Jan-2008	33	—	—	—	96	15	—	140	190	92	—	—	—	—	—	—
Apr-2008	31	—	66	—	170	—	110	190	—	170	—	—	—	—	—	—
Jul-2008	16	—	—	—	92	—	100	180	190	170	—	—	—	—	—	—
Oct-2008	25	—	47	89	130	25	93	200	200	140	—	—	—	—	—	—
Dec-2008	17	—	63	—	81	—	68	200	204	136	—	—	—	—	—	—
Jun-2009	53	—	—	66	103	—	69	179	174	182	—	—	—	—	—	—
Sep-2009	25	—	90	—	—	—	44	226	190	136	—	—	—	—	—	—
Mar-2010	—	—	49	—	136	12	51	153	—	86	—	—	—	—	—	—
Sep-2010	17	12	40	114	—	13	62	154	—	104	—	—	—	—	—	—
Mar-2011	13	8	19	90	72	—	49	151	136	170	—	—	—	—	—	—
Sep-2011	13	14	23	86	149	—	41	174	127	120	—	—	—	—	—	—
Apr-2012	7	12	20	17	160	9	42	27	15	45	—	—	—	—	—	—
Sep-2012	11	15	25	103	98	9	34	162	114	131	—	—	—	—	—	—
Apr-2013	16	12	26	79	180	37	33	140	102	128	—	—	—	—	—	—
Sep-2013	28	14	24	93	134	25	92	141	108	177	—	—	—	—	—	—
Mar-2014	22	16	26	117	91	19	113	162	130	128	—	—	—	—	—	—
Oct-2014	73	20	27	108	285	12	103	158	124	138	—	—	—	—	—	—
Mar-2015	16	10	24	112	212	13	140	152	107	279	—	—	—	—	—	—
Sep-2015	19	15	23	82	138	12	226	135	101	132	—	—	—	—	—	—
Mar-2016	19	16	30	105	199	12	269	155	98	147	—	—	—	—	—	—
Sep-2016	14	14	19	74	190	10	240	140	99	140	—	—	—	—	—	—
Apr-2017	17	21	21	94	310	10	120	140	89	130	—	—	—	—	—	—
Sep-2017	20	17	29	75	230	11	300	150	95	150	—	—	—	—	—	—
Mar-2018	15	15	21	61	200	100	280	150	100	140	—	—	—	—	—	—
Sep-2018	20	18	28	76	231	130	300	152	109	140	—	—	—	—	—	—
Jun-2019	25	18	38	42	193	93	278	160	110	161	—	—	—	—	—	—
Dec-2019	34	18	40	55	179	45	274	156	106	155	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	39	25	506	85	53	57
Jun-2020	69	17	36	58	272	20	375	148	106	—	21	22	454	47	25	20
Jul-2020	—	—	—	—	—	—	—	—	—	—	20	22	496	38	23	18
Aug-2020	—	—	—	—	—	—	—	—	—	—	19	22	506	37	21	17
Aug-2020	—	—	—	—	—	—	—	—	—	—	18	21	567	42	18	16
Sep-2020	—	—	—	—	—	—	—	—	—	—	16	19	549	38	18	14
Sep-2020	—	—	—	—	—	—	—	—	—	—	18	21	547	35	19	16
Oct-2020	—	—	—	—	—	—	—	—	—	—	18	24	580	38	20	15
Median	23	19	39	88	137	19	100	154	110	140	19	22	527	38	21	17
Mean	27	37	39	106	146	26	139	157	133	146	21	22	526	45	25	22
Min	7	8	19	17	50	9	33	27	15	45	16	19	454	35	18	14
Max	110	630	90	242	310	130	375	226	240	279	39	25	580	85	53	57
80th percentile	31	27	50	152	198	25	271	179	190	170	21	23	560	45	24	19
20th percentile	16	15	25	66	95	12	50	140	100	128	18	21	500	37	18	15

Project TSP, Cudgen, NSW <LOR
Parameter: NH3 D Destroyed
Units: mg/L — Not monitored
Data Collected by: G+S

Deep Bores													
Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
May-2007	D	1.99	0.6	6.47	—	1.36	4.59	—	—	—	—	—	—
Sep-2007	D	0.19	0.06	4.8	—	0.033	0.058	—	—	—	—	—	—
Jan-2008	D	2.3	0.57	—	—	0.11	3	—	—	—	—	—	—
Apr-2008	D	0.88	0.72	6.9	—	0.96	5.7	—	—	—	—	—	—
Jul-2008	D	24	0.32	18	—	0.29	2	—	—	—	—	—	—
Oct-2008	D	—	0.15	9.2	—	0.19	2.5	—	—	—	—	—	—
Dec-2008	D	—	0.37	10	—	0.51	5.46	—	—	—	—	—	—
Jun-2009	D	—	0.15	4.48	—	0.16	1.33	—	—	—	—	—	—
Sep-2009	D	—	0.9	3.81	—	2.99	1.01	—	—	—	—	—	—
Mar-2010	D	—	1.21	5.09	—	—	5.94	—	—	—	—	—	—
Sep-2010	D	—	0.03	0.2	40.7	4.38	0.84	—	—	—	—	—	—
Mar-2011	D	4.75	0.92	5.91	—	6.6	4.89	—	—	—	—	—	—
Sep-2011	D	12.8	0.12	2.07	0.07	0.13	1.19	—	—	—	—	—	—
Apr-2012	D	0.2	0.45	4.05	1.1	0.77	4.59	—	—	0.05	—	—	—
Sep-2012	D	0.23	0.06	0.77	0.84	0.12	0.54	—	—	—	—	—	—
Apr-2013	D	0.81	2.04	7.44	2.31	2.23	11.3	—	—	—	—	—	—
Sep-2013	D	16	1.23	6.31	1.97	1.86	9.88	—	—	—	—	—	—
Mar-2014	D	0.68	0.78	6.45	—	1.03	9.67	—	—	—	—	—	—
Oct-2014	D	13.8	0.92	5.18	—	0.79	8.04	—	—	—	—	—	—
Mar-2015	D	—	0.68	—	—	1.07	8.33	—	—	—	—	—	—
Sep-2015	D	26.7	0.9	4.62	—	1.12	8.61	—	—	—	—	—	—
Mar-2016	D	15.4	0.7	4.51	—	1.31	8.37	—	—	—	—	—	—
Sep-2016	D	15	0.69	5.1	—	1.5	0.65	—	—	—	—	—	—
Apr-2017	D	13	1	5.7	—	1.2	9.8	1	—	—	—	—	—
Sep-2017	D	14	0.8	5	—	1.3	9.7	—	—	—	—	—	—
Mar-2018	D	18	0.74	4.7	—	1.4	9.7	—	—	—	—	—	—
Sep-2018	D	13.7	0.7	4.2	—	1.26	8.01	—	—	—	—	—	—
Jun-2019	D	13.5	0.56	4.64	—	0.92	7.81	—	—	—	—	—	—
Dec-2019	D	12.6	0.55	3.56	—	0.83	7.35	—	—	—	—	—	—
May-2020	D	—	—	—	—	—	—	8.3	19.9	11.8	9.46	7.03	2.46
Jun-2020	D	—	—	—	—	—	—	8.91	21.9	12.9	16.6	7.76	2.85
Jul-2020	D	12.5	0.47	4.25	—	0.77	—	9.51	20.7	12.1	17.1	7.21	0.43
Aug-2020	D	—	—	—	—	—	—	8.73	23.4	12.7	16.8	7.2	2.73
Aug-2020	D	—	—	—	—	—	—	8.24	21.4	12.6	15.8	7.19	2.72
Sep-2020	D	—	—	—	—	—	—	8.37	20.3	12.1	15.8	7.52	2.91
Sep-2020	D	—	—	—	—	—	—	8.23	21	11.8	15.6	7.07	2.48
Oct-2020	D	—	—	—	—	—	—	7.97	21.6	12.6	15.4	6.99	2.58

Median	12.800	0.685	4.900	1.535	1.030	5.700	8.335	21.200	12.350	15.800	7.195	2.650
Mean	10.132	0.646	5.479	7.832	1.283	5.547	8.533	21.275	12.325	15.320	7.246	2.395
Min	0.190	0.030	0.200	0.070	0.033	0.058	7.970	19.900	11.800	9.460	6.990	0.430
Max	26.700	2.040	18.000	40.700	6.600	11.300	9.510	23.400	12.900	17.100	7.760	2.910
80th percentile	15.240	0.904	6.462	2.310	1.440	9.034	8.838	21.780	12.660	16.720	7.396	2.802
20th percentile	0.838	0.286	4.110	0.840	0.250	1.274	8.234	20.460	11.920	15.480	7.046	2.468

Project TSP, Cudgen, NSW **<LOR**
Parameter: NH3 **D** Destroyed
Units: mg/L **—** Not monitored
Data Collected by: G+S

Shallow bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
May-2007	1.18	1.33	1.86	0.66	2.07	0.61	1.31	1.22	3.51	0.23	—	—	—	—	—	—
Sep-2007	0.94	0.09	—	—	2.00	—	0.71	1.20	0.26	0.17	—	—	—	—	—	—
Jan-2008	1.10	—	—	—	1.40	0.57	—	2.70	5.60	0.17	—	—	—	—	—	—
Apr-2008	1.30	—	1.40	—	1.80	—	1.90	1.10	—	0.33	—	—	—	—	—	—
Jul-2008	1.30	—	—	—	1.10	—	0.69	0.34	4.20	0.42	—	—	—	—	—	—
Oct-2008	1.40	—	2.00	0.72	2.20	8.10	0.41	0.30	1.90	0.61	—	—	—	—	—	—
Dec-2008	0.63	—	2.79	—	29.20	—	0.34	2.43	1.84	0.12	—	—	—	—	—	—
Jun-2009	0.72	—	—	0.17	2.54	—	0.13	0.20	2.91	0.45	—	—	—	—	—	—
Sep-2009	0.69	—	2.46	—	—	—	0.12	0.19	3.11	1.66	—	—	—	—	—	—
Mar-2010	—	—	3.29	—	3.65	1.87	0.40	3.67	—	2.56	—	—	—	—	—	—
Sep-2010	0.42	0.45	2.96	0.98	—	0.60	0.06	2.30	—	0.32	—	—	—	—	—	—
Mar-2011	0.52	0.10	2.58	0.75	0.46	—	1.22	1.04	3.90	0.30	—	—	—	—	—	—
Sep-2011	0.66	0.70	3.53	1.22	2.45	—	0.24	0.30	0.83	0.45	—	—	—	—	—	—
Apr-2012	0.17	0.04	0.91	0.05	7.85	0.11	0.18	1.88	6.36	0.36	—	—	—	—	—	—
Sep-2012	0.37	0.24	3.65	0.77	2.29	0.28	0.30	0.23	5.69	0.46	—	—	—	—	—	—
Apr-2013	0.81	0.24	3.65	0.97	1.92	0.28	0.44	0.52	3.62	0.60	—	—	—	—	—	—
Sep-2013	0.60	0.34	3.01	0.95	1.62	0.25	0.42	0.36	1.49	0.54	—	—	—	—	—	—
Mar-2014	14.90	0.96	2.94	0.88	1.31	0.23	0.40	0.60	2.53	0.65	—	—	—	—	—	—
Oct-2014	0.57	0.95	1.98	0.64	0.92	0.55	0.88	0.50	1.60	0.33	—	—	—	—	—	—
Mar-2015	0.61	0.35	1.82	0.72	0.79	0.33	0.51	0.77	1.61	0.84	—	—	—	—	—	—
Sep-2015	0.48	0.59	1.44	0.63	0.70	0.35	0.46	0.36	0.97	0.52	—	—	—	—	—	—
Mar-2016	0.60	0.50	3.89	0.73	0.81	0.51	0.46	0.77	1.06	0.54	—	—	—	—	—	—
Sep-2016	0.17	1.30	2.40	0.09	1.20	9.60	0.48	0.45	1.30	0.54	—	—	—	—	—	—
Apr-2017	0.67	3.20	1.90	0.85	1.30	0.49	0.36	0.58	1.80	0.72	—	—	—	—	—	—
Sep-2017	0.57	1.50	1.10	0.61	1.10	0.28	0.37	0.28	1.40	0.51	—	—	—	—	—	—
Mar-2018	0.60	1.30	1.40	0.84	1.20	0.24	0.63	2.70	1.30	0.88	—	—	—	—	—	—
Sep-2018	0.52	1.20	1.81	1.01	0.66	0.47	0.35	1.31	0.80	0.55	—	—	—	—	—	—
Jun-2018	0.55	1.47	3.40	0.53	0.74	0.43	0.31	0.66	0.68	0.73	—	—	—	—	—	—
Dec-2019	0.70	0.99	3.41	0.54	0.27	0.28	0.34	0.42	0.80	0.46	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	0.35	0.47	1.33	0.44	0.35	0.26
Jun-2020	—	—	—	—	—	—	—	—	—	—	0.47	0.33	2.1	1.06	0.36	0.43
Jul-2020	0.73	0.44	3.98	0.69	0.83	0.27	0.31	0.32	0.75	—	0.4	0.36	1.98	2.81	0.29	0.94
Aug-2020	—	—	—	—	—	—	—	—	—	—	0.38	0.41	1.97	0.7	0.22	0.3
Aug-2020	—	—	—	—	—	—	—	—	—	—	0.4	0.38	1.95	0.66	0.24	0.31
Sep-2020	—	—	—	—	—	—	—	—	—	—	0.37	0.34	1.95	0.64	0.22	0.29
Sep-2020	—	—	—	—	—	—	—	—	—	—	0.39	0.37	1.92	0.61	0.25	0.3
Oct-2020	—	—	—	—	—	—	—	—	—	—	0.39	0.36	2.03	0.56	0.24	0.29

Median	0.630	0.645	2.520	0.720	1.305	0.390	0.400	0.590	1.610	0.510	0.390	0.365	1.960	0.650	0.245	0.300
Mean	1.189	0.831	2.522	0.695	2.656	1.214	0.508	0.990	2.290	0.587	0.394	0.378	1.904	0.935	0.271	0.390
Min	0.170	0.040	0.910	0.050	0.270	0.110	0.060	0.190	0.260	0.120	0.350	0.330	1.330	0.440	0.220	0.260
Max	14.900	3.200	3.980	1.220	29.200	9.600	1.900	3.670	6.360	2.560	0.470	0.470	2.100	2.810	0.360	0.940
80th percentile	1.004	1.300	3.410	0.922	2.254	0.594	0.654	1.424	3.598	0.678	0.400	0.398	2.010	0.916	0.326	0.382
20th percentile	0.520	0.260	1.810	0.568	0.798	0.272	0.306	0.316	0.858	0.326	0.374	0.348	1.932	0.580	0.228	0.290

Project TSP, Cudgen, NSW <LOR
Parameter: pH
Units: n/a — Not monitored or inaccessible
Data Collected by: G+S

	Deep Bores													
	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB12b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	7.6	7.21	7.19	—	—	—	—	—	—	—	—	—	—	—
Jan-2002	7.53	7.29	7.07	—	—	—	—	—	—	—	—	—	—	—
Apr-2002	6.95	6.83	6.9	—	—	—	—	—	—	—	—	—	—	—
Jul-2002	7.04	6.82	6.82	—	—	—	—	—	—	—	—	—	—	—
Oct-2002	7.51	7.28	7.54	—	—	—	—	—	—	—	—	—	—	—
Jan-2003	7.14	7.07	7.1	—	—	—	—	—	—	—	—	—	—	—
Apr-2003	7.57	7.3	7.1	—	—	—	—	—	—	—	—	—	—	—
Jul-2003	7.85	7.56	7.45	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	D	7.36	7.37	—	—	—	—	—	—	—	—	—	—	—
Feb-2004	D	6.45	7.17	—	—	—	—	—	—	—	—	—	—	—
Apr-2004	D	7.33	5.99	—	—	—	—	—	—	—	—	—	—	—
Jul-2004	D	6.99	7.16	—	—	—	—	—	—	—	—	—	—	—
Oct-2004	D	7.37	7.21	—	—	—	—	—	—	—	—	—	—	—
Jan-2005	D	7.08	6.83	—	—	—	—	—	—	—	—	—	—	—
Apr-2005	D	7.42	7.34	—	—	—	—	—	—	—	—	—	—	—
Jul-2005	D	7.06	6.72	6.98	7.51	7.34	6.89	6.89	—	—	—	—	—	—
Oct-2005	D	6.7	7.04	6.86	7.36	7.39	7.02	6.44	—	—	—	—	—	—
Dec-2005	D	—	—	6.873	6.22	6.42	6.64	3.33	—	—	—	—	—	—
Jan-2006	D	7.48	8.86	7.48	7.46	7.89	7.6	7.16	—	—	—	—	—	—
Apr-2006	D	7.74	7.57	7.57	7.29	7.41	7.73	7.55	—	—	—	—	—	—
Jul-2006	D	7.51	6.64	7.28	—	—	—	7.78	—	—	—	—	—	—
Nov-2006	D	7.48	7.82	7.47	7.13	8.03	7.39	7.05	—	—	—	—	—	—
Mar-2007	D	6.77	7.14	6.94	6.49	6.97	—	7.07	—	—	—	—	—	—
May-2007	D	7.17	7.76	7.15	—	6.72	6.94	6.91	—	—	—	—	—	—
Sep-2007	D	7	7.49	7.14	—	7.08	6.92	7.05	—	—	—	—	—	—
Jan-2008	D	7.45	7.41	—	—	7.06	7.18	D	—	—	—	—	—	—
Apr-2008	D	6.1	7.72	6.11	—	6.77	6.66	D	—	—	—	—	—	—
Jul-2008	D	5.38	5.29	6.54	—	6.54	6.34	D	—	—	—	—	—	—
Oct-2008	D	—	7.59	7.39	—	7.05	7.11	D	—	—	—	—	—	—
Dec-2008	D	—	7.94	7.01	—	7.83	8.27	D	—	—	—	—	—	—
Jun-2009	D	—	7.65	6.56	—	8.09	7.7	D	—	—	—	—	—	—
Sep-2009	D	—	7.49	7.45	—	7.02	7.2	D	—	—	—	—	—	—
Mar-2010	D	—	7.07	6.87	—	—	6.28	D	—	—	—	—	—	—
Sep-2010	D	—	7.32	7.14	7.35	6.74	7.02	D	—	—	—	—	—	—
Mar-2011	D	6.9	6.97	6.92	—	7.57	7	D	—	—	—	—	—	—
Sep-2011	D	7.33	7.23	7.03	6.82	7.43	7.07	D	—	—	—	—	—	—
Apr-2012	D	6.74	6.79	6.72	6.9	7.04	6.89	D	—	—	—	—	—	—
Sep-2012	D	8.59	8.49	8.7	8.73	8.76	8.57	D	—	—	—	—	—	—
Apr-2013	D	7.09	7.61	7.37	6.97	7.14	7.38	D	—	—	—	—	—	—
Sep-2013	D	7.54	7.14	7.17	7.01	6.99	7.29	D	—	—	—	—	—	—
Mar-2014	D	7.63	7.52	7.41	—	6.9	7.16	D	—	—	—	—	—	—
Oct-2014	D	7.26	7.27	7.1	—	6.97	7.19	D	—	—	—	—	—	—
Mar-2015	D	—	7.16	6.53	—	7.14	6.81	D	—	—	—	—	—	—
Sep-2015	D	6.75	7.23	6.94	—	6.7	7.09	D	—	—	—	—	—	—
Mar-2016	D	7.06	8.11	7.93	—	7.72	8.05	D	—	—	—	—	—	—
Sep-2016	D	7.14	7.12	6.62	—	6.54	6.82	D	—	—	—	—	—	—
Apr-2017	D	7.69	7.62	7.37	—	7	7.26	D	—	—	—	—	—	—
Sep-2017	D	7.33	7.4	6.97	—	6.73	6.99	D	—	—	—	—	—	—
Mar-2018	D	7.16	7.34	6.76	—	6.53	6.77	D	—	—	—	—	—	—
Sep-2018	D	7.62	7.69	7.31	—	6.96	7.34	D	—	—	—	—	—	—
Jun-2019	D	7.43	7.37	7.04	—	6.66	7.1	D	—	—	—	—	—	—
Dec-2019	D	7.48	7.46	8.69	—	6.79	7.18	D	—	—	—	—	—	—
Mar-2020	D	—	—	—	—	—	—	D	—	—	—	—	—	—
May-2020	D	—	—	—	—	—	—	D	7.53	7.42	7.69	7.33	7.85	7.47
Jun-2020	D	7.28	7.42	6.91	—	6.71	—	D	7.73	7.6	7.89	7.98	8.03	7.65
Jul-2020	D	—	—	—	—	—	—	D	7.38	7.24	7.64	7.71	7.76	7.27
Aug-2020	D	—	—	—	—	—	—	D	7.38	7.22	7.63	7.69	7.8	7.31
Aug-2020	D	—	—	—	—	—	—	D	7.31	7.11	7.6	7.68	7.7	7.21
Sep-2020	D	—	—	—	—	—	—	D	7.21	7.01	7.49	7.56	7.63	7.16
Sep-2020	D	—	—	—	—	—	—	D	—	—	—	—	—	—
Sep-2020	D	—	—	—	—	—	—	D	7.47	7.3	7.7	7.81	7.91	7.42
Oct-2020	D	—	—	—	—	—	—	D	7.24	7.09	7.58	7.69	7.73	7.28
Median	7.52	7.28	7.33	7.04	7.13	7.01	7.10	7.05	7.38	7.23	7.64	7.69	7.78	7.30
Mean	7.40	7.18	7.30	7.14	7.17	7.13	7.17	6.72	7.41	7.25	7.65	7.68	7.80	7.35
Min	6.95	5.38	5.29	6.11	6.22	6.42	6.28	3.33	7.21	7.01	7.49	7.33	7.63	7.16
Max	7.85	8.59	8.86	8.70	8.73	8.76	8.57	7.78	7.73	7.60	7.89	7.98	8.03	7.65
80th percentile	7.59	7.48	7.61	7.41	7.42	7.43	7.38	7.24	7.51	7.37	7.70	7.77	7.89	7.45
20th percentile	7.08	6.89	7.07	6.86	6.85	6.72	6.88	6.80	7.27	7.10	7.59	7.61	7.71	7.23

Project TSP, Cudgen, NSW <LOR
Parameter: pH
Units: n/a — Not monitored or inaccessible
Data Collected by G+S

	Shallow Bores																
	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB12a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	6.65	5.63	6.65	6.72	6.61	5.19	—	—	—	—	—	—	—	—	—	—	—
Jan-2002	6.73	6.01	6.62	6.62	6.46	5.66	—	—	—	—	—	—	—	—	—	—	—
Apr-2002	6.06	5.48	5.99	6.50	6.25	5.28	—	—	—	—	—	—	—	—	—	—	—
Jul-2002	6.17	5.57	6.21	6.85	6.34	5.77	—	—	—	—	—	—	—	—	—	—	—
Oct-2002	6.60	5.62	6.61	6.84	6.75	6.46	—	—	—	—	—	—	—	—	—	—	—
Jan-2003	6.65	6.30	6.55	6.41	6.87	6.66	—	—	—	—	—	—	—	—	—	—	—
Apr-2003	7.52	5.94	6.64	6.85	6.49	6.02	—	—	—	—	—	—	—	—	—	—	—
Jul-2003	6.83	6.39	6.59	6.95	6.72	6.53	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	6.65	5.83	6.34	6.95	6.72	6.66	—	—	—	—	—	—	—	—	—	—	—
Feb-2004	5.13	5.15	6.01	6.82	6.58	5.80	—	—	—	—	—	—	—	—	—	—	—
Apr-2004	6.61	6.21	5.05	6.94	6.58	5.94	—	—	—	—	—	—	—	—	—	—	—
Jul-2004	6.45	6.63	6.54	6.89	6.63	6.31	—	—	—	—	—	—	—	—	—	—	—
Oct-2004	6.89	6.21	6.44	7.10	6.57	6.22	—	—	—	—	—	—	—	—	—	—	—
Jan-2005	6.65	5.94	6.22	6.8	6.55	6.02	—	—	—	—	—	—	—	—	—	—	—
Apr-2005	6.62	6.13	6.24	6.69	6.6	6.21	—	—	—	—	—	—	—	—	—	—	—
Jul-2005	6.55	6.61	6.7	—	6.77	7.51	7.53	7.32	—	6.49	6.5	—	—	—	—	—	—
Oct-2005	7.17	6.86	7.45	7.82	7.28	8.42	7.55	7.65	7.45	7.3	6.66	—	—	—	—	—	—
Dec-2005	—	—	—	—	—	—	3.6	7.05	6.53	6.61	5.14	—	—	—	—	—	—
Jan-2006	9.12	8.55	8.56	—	9.33	9.51	8.47	8.95	8.52	9.26	8.12	—	—	—	—	—	—
Apr-2006	7.11	6.51	6.91	7.1	7.17	7.03	7.8	7.54	7.14	7.12	6.67	—	—	—	—	—	—
Jul-2006	7.16	7.71	6.74	—	6.81	6.43	6.64	—	—	—	6.96	—	—	—	—	—	—
Nov-2006	7.49	8.08	7.94	—	8.33	7.79	7.97	7.29	—	7.94	7.01	—	—	—	—	—	—
Mar-2007	6.59	6.75	7.22	—	6.75	7.60	6.77	6.75	7.41	—	6.26	—	—	—	—	—	—
May-2007	7.05	6.23	6.52	7.71	7.35	7.19	7.26	6.95	6.83	7.25	6.38	—	—	—	—	—	—
Sep-2007	7.18	7.46	—	—	7.47	—	7.95	7.99	7.48	7.24	6.81	—	—	—	—	—	—
Jan-2008	6.66	—	—	—	6.61	5.75	—	6.86	6.73	6.66	D	—	—	—	—	—	—
Apr-2008	5.61	—	6.21	—	7.15	—	6.46	7.4	—	7.11	D	—	—	—	—	—	—
Jul-2008	3.66	—	—	—	5.23	—	6.3	6.22	5.84	6.14	D	—	—	—	—	—	—
Oct-2008	7.04	—	6.98	7	7.15	8.15	6.91	7.29	6.79	6.9	D	—	—	—	—	—	—
Dec-2008	6.85	—	7.57	—	7.82	—	7.01	8.72	8.05	8.32	D	—	—	—	—	—	—
Jun-2009	6.41	—	—	7.63	7.91	—	7.23	7.5	7.23	6.97	D	—	—	—	—	—	—
Sep-2009	6.09	—	7.06	—	—	—	7.27	6.95	6.99	7.03	D	—	—	—	—	—	—
Mar-2010	—	5.8	5.63	—	6.04	—	7.23	7.18	—	6.12	D	—	—	—	—	—	—
Sep-2010	6.12	6.52	6.47	6.73	—	6.14	6.57	6.77	—	6.55	D	—	—	—	—	—	—
Mar-2011	6.42	6.59	6.45	6.85	6.7	—	6.76	6.99	7	6.49	D	—	—	—	—	—	—
Sep-2011	6.60	6.77	6.83	7.02	6.83	—	6.88	6.92	7.16	6.66	D	—	—	—	—	—	—
Apr-2012	6.04	6.65	6.61	6.85	6.63	5.84	6.60	6.85	7.04	6.44	D	—	—	—	—	—	—
Sep-2012	8.44	8.43	8.64	8.62	8.57	8.47	8.63	8.9	8.82	8.48	D	—	—	—	—	—	—
Apr-2013	6.86	7.02	6.97	7.15	6.95	6.36	7.02	7.13	7.21	7.02	D	—	—	—	—	—	—
Sep-2013	7.68	6.37	6.77	6.95	6.79	6.37	6.95	7.1	7.09	7.21	D	—	—	—	—	—	—
Mar-2014	6.97	6.19	6.93	7.12	6.79	6.16	7.04	7.12	7.28	7.12	D	—	—	—	—	—	—
Oct-2014	6.66	6.45	6.79	6.83	6.90	5.84	7.44	7.05	7.02	6.64	D	—	—	—	—	—	—
Mar-2015	5.72	5.35	6.02	6.08	6.70	5.99	6.04	—	6.75	6.12	D	—	—	—	—	—	—
Sep-2015	7.3	7	6.38	6.88	6.84	6.8	6.5	6.95	6.79	7.35	D	—	—	—	—	—	—
Mar-2016	7.58	8.13	6.91	7.78	7.73	6.39	7.34	7.78	7.37	7.42	D	—	—	—	—	—	—
Sep-2016	6.59	6.47	6.17	6.72	6.81	5.83	6.43	6.97	6.75	6.78	D	—	—	—	—	—	—
Apr-2017	6.84	6.45	6.92	7.09	6.92	5.57	7.15	7.21	6.88	7.01	D	—	—	—	—	—	—
Sep-2017	6.79	6.33	6.32	6.74	6.98	5.53	6.56	7.18	6.85	6.97	D	—	—	—	—	—	—
Mar-2018	6.55	6.09	6.39	6.75	6.26	5.22	6.73	6.84	6.61	6.65	D	—	—	—	—	—	—
Sep-2018	7.03	6.32	6.68	7.01	6.71	5.49	7.08	7.24	6.74	7.62	D	—	—	—	—	—	—
Jun-2019	6.84	6.1	6.42	6.74	6.63	5.97	6.97	7	6.59	6.72	D	—	—	—	—	—	—
Dec-2019	6.83	6.08	8.15	7.48	6.78	6.03	7.51	7.22	6.7	6.9	D	—	—	—	—	—	—
Mar-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	D	7.67	7.66	7.6	7.31	7.75	7.54
Jun-2020	6.82	6.31	6.35	6.95	6.67	5.81	6.85	7.25	6.88	—	D	7.89	7.84	7.93	7.69	8.05	7.84
Jul-2020	—	—	—	—	—	—	—	—	—	—	D	7.53	7.56	7.65	7.44	7.8	7.48
Aug-2020	—	—	—	—	—	—	—	—	—	—	D	7.59	7.55	7.66	7.51	7.84	7.49
Aug-2020	—	—	—	—	—	—	—	—	—	—	D	7.53	7.58	7.58	7.37	7.75	7.47
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	7.41	7.4	7.48	7.31	7.68	7.37
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	7.64	7.6	7.72	7.61	7.79	7.55
Oct-2020	—	—	—	—	—	—	—	—	—	—	D	7.4	7.37	7.58	7.43	7.69	7.43
Median	6.66	6.33	6.61	6.89	6.76	6.16	7.01	7.16	7.00	6.97	6.67	7.56	7.57	7.63	7.44	7.77	7.49
Mean	6.72	6.47	6.70	6.99	6.90	6.42	7.00	7.28	7.08	7.05	6.65	7.58	7.57	7.65	7.46	7.79	7.52
Min	3.66	5.15	5.05	6.08	5.23	5.19	3.60	6.22	5.84	6.12	5.14	7.40	7.37	7.48	7.31	7.68	7.37
Max	9.12	8.55	8.64	8.62	9.33	9.51	8.63	8.95	8.82	9.26	8.12	7.89	7.84	7.93	7.69	8.05	7.84
80th percentile	7.11	6.79	6.95	7.10	7.15	6.94	7.50	7.50	7.35	7.31	6.97	7.66	7.64	7.70	7.57	7.82	7.55
20th percentile	6.42	5.94	6.27	6.74	6.58	5.78	6.58	6.95	6.74	6.60	6.36	7.46	7.46	7.58	7.33	7.71	7.45

Project TSP, Cudgen, NSW

Parameter: SO4

Units: mg/L

Data Collec G+S

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D Destroyed
— ot monitored

Date	Deep bores												
	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	419	983	672	—	—	—	—	—	—	—	—	—	—
Jan-2002	408	963	645	—	—	—	—	—	—	—	—	—	—
Apr-2002	351	812	583	—	—	—	—	—	—	—	—	—	—
Jul-2002	329	996	603	—	—	—	—	—	—	—	—	—	—
Oct-2002	321	876	563	—	—	—	—	—	—	—	—	—	—
Jan-2003	413	888	655	—	—	—	—	—	—	—	—	—	—
Apr-2003	389	871	643	—	—	—	—	—	—	—	—	—	—
Jul-2003	351	906	710	—	—	—	—	—	—	—	—	—	—
Oct-2003	—	937	699	—	—	—	—	—	—	—	—	—	—
Feb-2004	—	994	680	—	—	—	—	—	—	—	—	—	—
Apr-2004	—	1020	658	—	—	—	—	—	—	—	—	—	—
Jul-2004	—	998	630	—	—	—	—	—	—	—	—	—	—
Oct-2004	—	1020	685	—	—	—	—	—	—	—	—	—	—
Jan-2005	—	962	614	—	—	—	—	—	—	—	—	—	—
Apr-2005	—	1010	601	—	—	—	—	—	—	—	—	—	—
Jul-2005	—	946	603	—	—	—	—	—	—	—	—	—	—
Oct-2005	—	1100	611	—	—	—	—	—	—	—	—	—	—
Jan-2006	—	941	579	—	—	—	—	—	—	—	—	—	—
Apr-2006	—	897	681	—	—	—	—	—	—	—	—	—	—
Jul-2006	—	590	575	—	—	—	—	—	—	—	—	—	—
Nov-2006	—	563	549	—	—	—	—	—	—	—	—	—	—
Mar-2007	—	546	270	—	—	—	—	—	—	—	—	—	—
May-2007	—	812	434	2760	—	2300	1620	—	—	—	—	—	—
Sep-2007	—	610	470	2600	—	2000	1700	—	—	—	—	—	—
Jan-2008	—	630	470	—	—	1600	1600	—	—	—	—	—	—
Apr-2008	—	12	450	2300	—	1700	1400	—	—	—	—	—	—
Jul-2008	—	13	480	2400	—	1300	1500	—	—	—	—	—	—
Oct-2008	—	—	550	2400	—	1400	1400	—	—	—	—	—	—
Dec-2008	—	—	476	2360	—	1247	1442	—	—	—	—	—	—
Jun-2009	—	—	452	2600	—	651	1620	—	—	—	—	—	—
Sep-2009	—	—	485	3110	—	1360	1780	—	—	—	—	—	—
Mar-2010	—	—	364	2945	—	—	1721	—	—	—	—	—	—
Sep-2010	—	—	457	3210	312	976	1880	—	—	—	—	—	—
Mar-2011	—	8	423	5000	—	1290	5020	—	—	—	—	—	—
Sep-2011	—	9	451	2990	61	890	1810	—	—	—	—	—	—
Apr-2012	—	15	427	1678	50	672	1138	—	—	—	—	—	—
Sep-2012	—	11	305	1660	105	795	974	—	—	—	—	—	—
Apr-2013	—	25	469	2510	2290	2150	1690	—	—	—	—	—	—
Sep-2013	—	747	409	2470	2170	2170	1650	—	—	—	—	—	—
Mar-2014	—	913	438	2440	—	2110	1670	—	—	—	—	—	—
Oct-2014	—	887	446	2010	—	2140	1620	—	—	—	—	—	—
Mar-2015	—	—	401	—	—	2020	1580	—	—	—	—	—	—
Sep-2015	—	721	560	2060	—	2360	1800	—	—	—	—	—	—
Mar-2016	—	892	467	2030	—	2290	1650	—	—	—	—	—	—
Sep-2016	—	1050	479	1950	—	2190	1650	—	—	—	—	—	—
Apr-2017	—	839	449	1890	—	1980	1680	—	—	—	—	—	—
Sep-2017	—	869	419	1920	—	2040	1650	—	—	—	—	—	—
Mar-2018	—	959	330	1890	—	1560	1530	—	—	—	—	—	—
Sep-2018	—	868	313	2000	—	1160	1580	—	—	—	—	—	—
Jun-2019	—	870	314	1920	—	969	1590	—	—	—	—	—	—
Dec-2019	—	866	283	1910	—	884	1580	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	1330	1870	2080	701	583	1690
Jun-2020	—	842	302	2030	—	924	—	1330	1830	2030	672	534	1580
Jul-2020	—	—	—	—	—	—	—	1460	1900	2110	756	546	1680
Aug-2020	—	—	—	—	—	—	—	1490	2000	2210	1000	590	1730
Aug-2020	—	—	—	—	—	—	—	1450	1940	2100	915	521	1680
Sep-2020	—	—	—	—	—	—	—	1380	1840	1940	890	523	1620
Sep-2020	—	—	—	—	—	—	—	1510	2020	2150	1140	576	1850
Oct-2020	—	—	—	—	—	—	—	1370	1900	2050	1050	572	1570
Median	370	871	478	2330	209	1560	1620	1415	1900	2090	903	559	1680
Mean	373	740	505	2394	831	1556	1708	1415	1913	2084	891	556	1675
Min	321	8	270	1660	50	651	974	1330	1830	1940	672	521	1570
Max	419	1100	710	5000	2290	2360	5020	1510	2020	2210	1140	590	1850
0th percentil	411	967	627	2696	2170	2144	1708	1478	1976	2134	1030	580	1714
0th percentil	338	585	420	1920	61	951	1518	1346	1852	2038	723	527	1596

Project TSP, Cudgen, NSW
Parameter: SO4
Units: mg/L
Data Collected by: G+S

<LOR
 D Destroyed
 — Not monitored

Shallow bores																
Date	MB1b	MB2b	MB3	MB4	MB5b	MB7	MB8a	MB9a	MB10a	MB11a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	149	109	523	478	472	14	—	—	—	—	—	—	—	—	—	—
Jan-2002	150	7	423	647	411	16	—	—	—	—	—	—	—	—	—	—
Apr-2002	153	27	394	566	377	26	—	—	—	—	—	—	—	—	—	—
Jul-2002	169	35	514	508	525	15	—	—	—	—	—	—	—	—	—	—
Oct-2002	169	28	458	412	476	14	—	—	—	—	—	—	—	—	—	—
Jan-2003	204	17	640	408	557	16	—	—	—	—	—	—	—	—	—	—
Apr-2003	241	7	394	391	643	14	—	—	—	—	—	—	—	—	—	—
Jul-2003	321	13	774	558	405	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	331	35	755	312	436	17	—	—	—	—	—	—	—	—	—	—
Feb-2004	287	36	524	223	295	13.3	—	—	—	—	—	—	—	—	—	—
Apr-2004	293	35	591	205	503	19	—	—	—	—	—	—	—	—	—	—
Jul-2004	276	34	502	243	474	23	—	—	—	—	—	—	—	—	—	—
Oct-2004	305	34	612	226	549	27	—	—	—	—	—	—	—	—	—	—
Jan-2005	262	10	676	204	393	14	—	—	—	—	—	—	—	—	—	—
Apr-2005	243	12	528	222	510	17	—	—	—	—	—	—	—	—	—	—
Jul-2005	250	24	349	—	225	14	—	—	—	—	—	—	—	—	—	—
Oct-2005	235	12	153	197	422	21	—	—	—	—	—	—	—	—	—	—
Jan-2006	199	8	537	—	102	16	—	—	—	—	—	—	—	—	—	—
Apr-2006	193	13	306	182	91	15	—	—	—	—	—	—	—	—	—	—
Jul-2006	72	10	261	—	83	14	—	—	—	—	—	—	—	—	—	—
Nov-2006	102	12	176	—	176	26	—	—	—	—	—	—	—	—	—	—
Mar-2007	18	19	46	—	92	20	—	—	—	—	—	—	—	—	—	—
May-2007	138	7.2	124	150	135	15	93	91	276	195	—	—	—	—	—	—
Sep-2007	150	510	—	—	310	—	130	85	340	190	—	—	—	—	—	—
Jan-2008	170	—	—	—	340	650	—	92	280	130	—	—	—	—	—	—
Apr-2008	39	—	160	—	94	—	110	89	—	240	—	—	—	—	—	—
Jul-2008	64	—	—	—	240	—	130	120	260	250	—	—	—	—	—	—
Oct-2008	26	—	310	310	330	8.1	83	90	230	340	—	—	—	—	—	—
Dec-2008	19	—	193	—	174	—	83	100	254	214	—	—	—	—	—	—
Jun-2009	32	—	—	171	163	—	75	102	197	338	—	—	—	—	—	—
Sep-2009	31	—	479	—	—	—	56	105	201	434	—	—	—	—	—	—
Mar-2010	—	—	275	—	347	4.6	52	50	—	128	—	—	—	—	—	—
Sep-2010	58	7	216	332	—	11	61	76	—	245	—	—	—	—	—	—
Mar-2011	13	8	19	90	72	—	49	151	136	170	—	—	—	—	—	—
Sep-2011	45	4	89	218	394	—	45	83	108	360	—	—	—	—	—	—
Apr-2012	13	18	39	29	314	8.5	48	50	62	285	—	—	—	—	—	—
Sep-2012	29	15	186	234	184	3	24	40	41	335	—	—	—	—	—	—
Apr-2013	82	9	161	173	211	20	25	66	72	402	—	—	—	—	—	—
Sep-2013	72	10	150	225	167	14	110	63	88	441	—	—	—	—	—	—
Mar-2014	94	6	152	256	115	6	113	57	120	427	—	—	—	—	—	—
Oct-2014	116	4	160	238	275	3	94	—	104	284	—	—	—	—	—	—
Mar-2015	66	9	99	219	267	6	110	55	91	502	—	—	—	—	—	—
Sep-2015	104	6	99	159	167	6	189	71	82	468	—	—	—	—	—	—
Mar-2016	100	10	56	181	226	1	197	65	77	436	—	—	—	—	—	—
Sep-2016	83.9	4	83.9	129	273	10.2	174	83.9	95.9	509	—	—	—	—	—	—
Apr-2017	65.9	9.9	83.9	144	479	3.9	83.9	71.9	62.9	389	—	—	—	—	—	—
Sep-2017	65.9	7.2	98.9	129	255	5.1	201	71.9	71.9	599	—	—	—	—	—	—
Mar-2018	89.9	8.4	102	102	719	89.9	189	50.9	77.9	362	—	—	—	—	—	—
Sep-2018	82	7	75	54	599	125	135	64	100	363	—	—	—	—	—	—
Jun-2019	82	5	46	64	367	95	136	77	97	368	—	—	—	—	—	—
Dec-2019	71	5	76	63	326	46	146	92	82	403	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	2	0.5	188	2.5	40	6
Jun-2020	76	11	48	68	558	11	85	106	78	—	4	0.5	258	0.5	5	0.5
Jul-2020	—	—	—	—	—	—	—	—	—	—	3	0.5	307	0.5	4	0.5
Aug-2020	—	—	—	—	—	—	—	—	—	—	3	0.5	360	1	4	0.5
Aug-2020	—	—	—	—	—	—	—	—	—	—	3	0.5	340	0.5	4	0.5
Sep-2020	—	—	—	—	—	—	—	—	—	—	3	0.5	343	0.5	3	0.5
Sep-2020	—	—	—	—	—	—	—	—	—	—	4	1	352	2	3	1
Oct-2020	—	—	—	—	—	—	—	—	—	—	3	0.5	372	2	4	0.5
Median	100.0	10.0	189.5	218.5	320.0	14.0	94.0	77.0	97.0	360.0	3.0	0.5	341.5	0.8	4.0	0.5
Mean	131.4	27.7	265.8	243.0	326.4	35.2	104.4	80.0	136.5	338.2	3.1	0.6	315.0	1.2	8.4	1.3
Min	13.0	4.0	19.0	29.0	72.0	1.0	24.0	40.0	41.0	128.0	2.0	0.5	188.0	0.5	3.0	0.5
Max	331.0	510.0	774.0	647.0	719.0	650.0	201.0	151.0	340.0	599.0	4.0	1.0	372.0	2.5	40.0	6.0
80th percentile	235.0	27.4	519.4	343.8	476.6	22.2	140.0	95.2	224.2	434.8	3.6	0.5	356.8	2.0	4.6	0.8
20th percentile	58.0	7.0	85.9	129.0	167.0	6.8	54.4	60.6	77.2	229.6	3.0	0.5	277.6	0.5	3.4	0.5

Project TSP, Cudgen, NSW — Not monitored
Parameter: Temp D Destroyed
Units: °C
Data Collected by: G+S

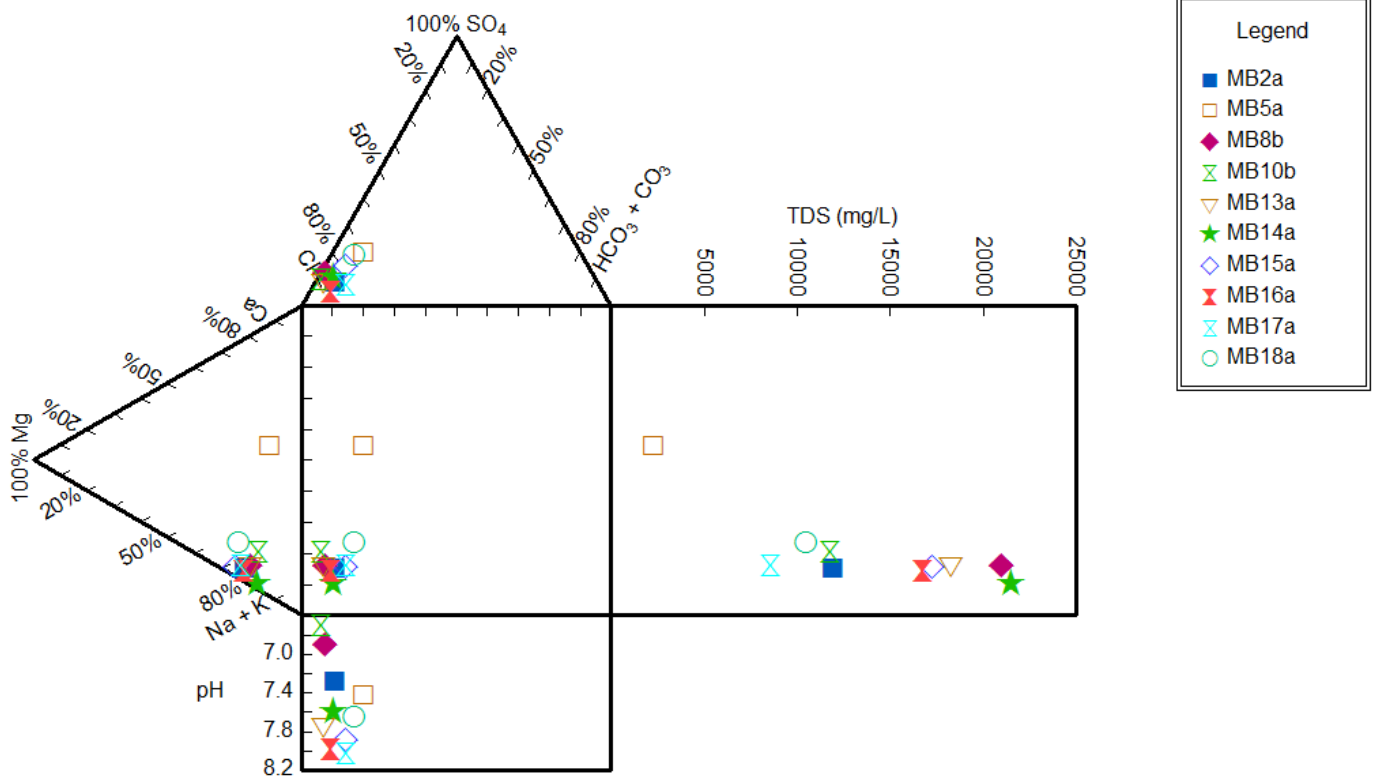
Deep bores														
Date	MB1A	MB2A	MB5A	MB8b	MB9b	MB10b	MB11b	MB12b	MB13a	MB14a	MB15a	MB16a	MB17a	MB18a
Oct-2001	24.4	24.1	23.7	—	—	—	—	—	—	—	—	—	—	—
Jan-2002	24.8	24.6	23.4	—	—	—	—	—	—	—	—	—	—	—
Apr-2002	23.7	24.0	22.9	—	—	—	—	—	—	—	—	—	—	—
Jul-2002	21.5	21.9	21.3	—	—	—	—	—	—	—	—	—	—	—
Oct-2002	25.1	23.1	24.8	—	—	—	—	—	—	—	—	—	—	—
Jan-2003	19.4	19.3	19.0	—	—	—	—	—	—	—	—	—	—	—
Apr-2003	21.4	23.6	22.1	—	—	—	—	—	—	—	—	—	—	—
Jul-2003	18.6	19.6	19.0	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	D	20.5	21.1	—	—	—	—	—	—	—	—	—	—	—
Feb-2004	D	22.3	22.6	—	—	—	—	—	—	—	—	—	—	—
Apr-2004	D	21.0	21.3	—	—	—	—	—	—	—	—	—	—	—
Jul-2004	D	17.9	18.4	—	—	—	—	—	—	—	—	—	—	—
Oct-2004	D	22.3	22.8	—	—	—	—	—	—	—	—	—	—	—
Jan-2005	D	23.0	22.7	—	—	—	—	—	—	—	—	—	—	—
Apr-2005	D	23.4	23.5	—	—	—	—	—	—	—	—	—	—	—
Jul-2005	D	21.9	21.6	22.4	21.6	22.6	19.7	21.9	—	—	—	—	—	—
Oct-2005	D	21.9	22.1	21.1	20.2	20.1	19.7	21.2	—	—	—	—	—	—
Dec-2005	D	—	—	26.7	24.7	22.8	23.7	24.8	—	—	—	—	—	—
Jan-2006	D	23.4	23.1	25.8	23.5	22.8	23.5	24	—	—	—	—	—	—
Apr-2006	D	—	—	—	—	—	—	—	—	—	—	—	—	—
Jul-2006	D	—	—	—	—	—	—	—	—	—	—	—	—	—
Nov-2006	D	—	—	—	—	—	—	—	—	—	—	—	—	—
Mar-2007	D	24.4	24.4	24.1	24.2	24.3	—	23.7	—	—	—	—	—	—
May-2007	D	24.2	23.0	24.2	—	23.8	23.8	24.1	—	—	—	—	—	—
Sep-2007	D	22.9	19.8	20	—	19.1	19.7	19.7	—	—	—	—	—	—
Jan-2008	D	24.4	23.8	—	—	24.4	24	D	—	—	—	—	—	—
Apr-2008	D	26.1	26.3	27.7	—	29.3	28.2	D	—	—	—	—	—	—
Jul-2008	D	20.9	19.5	20.9	—	19.3	18.4	D	—	—	—	—	—	—
Oct-2008	D	—	25.8	24.6	—	24.6	23.4	D	—	—	—	—	—	—
Dec-2008	D	—	28.7	27.3	—	26.4	28.5	D	—	—	—	—	—	—
Jun-2009	D	—	16.4	16.4	—	—	28	D	—	—	—	—	—	—
Sep-2011	D	19.8	21.1	20.7	20.4	18.8	19.6	D	—	—	—	—	—	—
Apr-2012	D	22.4	23.4	24.2	22.6	22.4	22.0	D	—	—	—	—	—	—
Sep-2012	D	21.0	20.5	20.9	20.0	20.3	20.6	D	—	—	—	—	—	—
Apr-2013	D	23.7	24.0	24.1	22.6	21.5	22.3	D	—	—	—	—	—	—
Sep-2013	D	23.17	23.53	23.98	21.23	21.11	21.64	D	—	—	—	—	—	—
Mar-2014	D	24.35	23.17	22.28	D	23.25	23.06	D	—	—	—	—	—	—
Oct-2014	D	22.26	20.88	22.36	D	21.53	21.64	D	—	—	—	—	—	—
Mar-2015	D	—	22.52	23.11	D	21.64	21.5	D	—	—	—	—	—	—
Sep-2015	D	22.32	20.81	20.83	D	20.88	21.38	D	—	—	—	—	—	—
Mar-2016	D	—	—	—	D	—	—	D	—	—	—	—	—	—
Sep-2016	D	21.51	21.08	22.03	D	21.73	21.05	D	—	—	—	—	—	—
Apr-2017	D	—	—	—	D	—	—	D	—	—	—	—	—	—
Sep-2017	D	22.07	22.05	21.9	D	21.78	21.56	D	—	—	—	—	—	—
Mar-2018	D	22.3	22.4	21.5	D	21.8	21.4	D	—	—	—	—	—	—
Sep-2018	D	22.76	22.52	22.01	D	21.23	20.94	D	—	—	—	—	—	—
Jun-2019	D	—	22.14	20.93	D	21.73	21.07	D	—	—	—	—	—	—
Dec-2019	D	22.71	22.66	21.72	D	22.17	21.69	D	—	—	—	—	—	—
Mar-2020	D	—	—	—	D	—	—	D	—	—	—	—	—	—
May-2020	D	—	—	—	D	—	—	D	21.1	21.63	21.13	22.19	20.52	20.4
Jun-2020	D	21.64	21.98	21.31	D	21.06	—	D	20.5	21.87	21.29	22.36	21.05	21.24
Jul-2020	D	—	—	—	D	—	—	D	20.47	20.21	20.49	21.34	20.94	20.88
Aug-2020	D	—	—	—	D	—	—	D	21.55	20.62	20.7	22.45	21.28	21.1
Aug-2020	D	—	—	—	D	—	—	D	21.18	20.57	21.01	22.03	21.33	21.07
Sep-2020	D	—	—	—	D	—	—	D	20.98	20.69	20.39	20.82	20.62	20.72
Sep-2020	D	—	—	—	D	—	—	D	—	—	—	—	—	—
Sep-2020	D	—	—	—	D	—	—	D	20.4	20.67	19.97	21.9	20.69	20.81
Oct-2020	D	—	—	—	D	—	—	D	20.69	20.69	19.92	21.9	21.27	20.23
Median	22.6	22.3	22.5	22.2	22.1	21.8	21.6	23.7	20.8	20.7	20.6	22.0	21.0	20.8
Mean	22.4	22.4	22.3	22.7	22.1	22.2	22.3	22.8	20.9	20.9	20.6	21.9	21.0	20.8
Min	18.6	17.9	16.4	16.4	20.0	18.8	18.4	19.7	20.4	20.2	19.9	20.8	20.5	20.2
Max	25.1	26.1	28.7	27.7	24.7	29.3	28.5	24.8	21.6	21.9	21.3	22.5	21.3	21.2
80th percentile	24.6	23.9	23.5	24.2	23.6	23.6	23.7	24.1	21.1	21.3	21.1	22.3	21.3	21.1
20th percentile	20.2	21.2	21.0	20.9	20.4	21.0	20.6	21.3	20.5	20.6	20.1	21.6	20.6	20.5

Project TSP, Cudgen, NSW
Parameter: Temp
Units: °C
Data Collected by: G+S

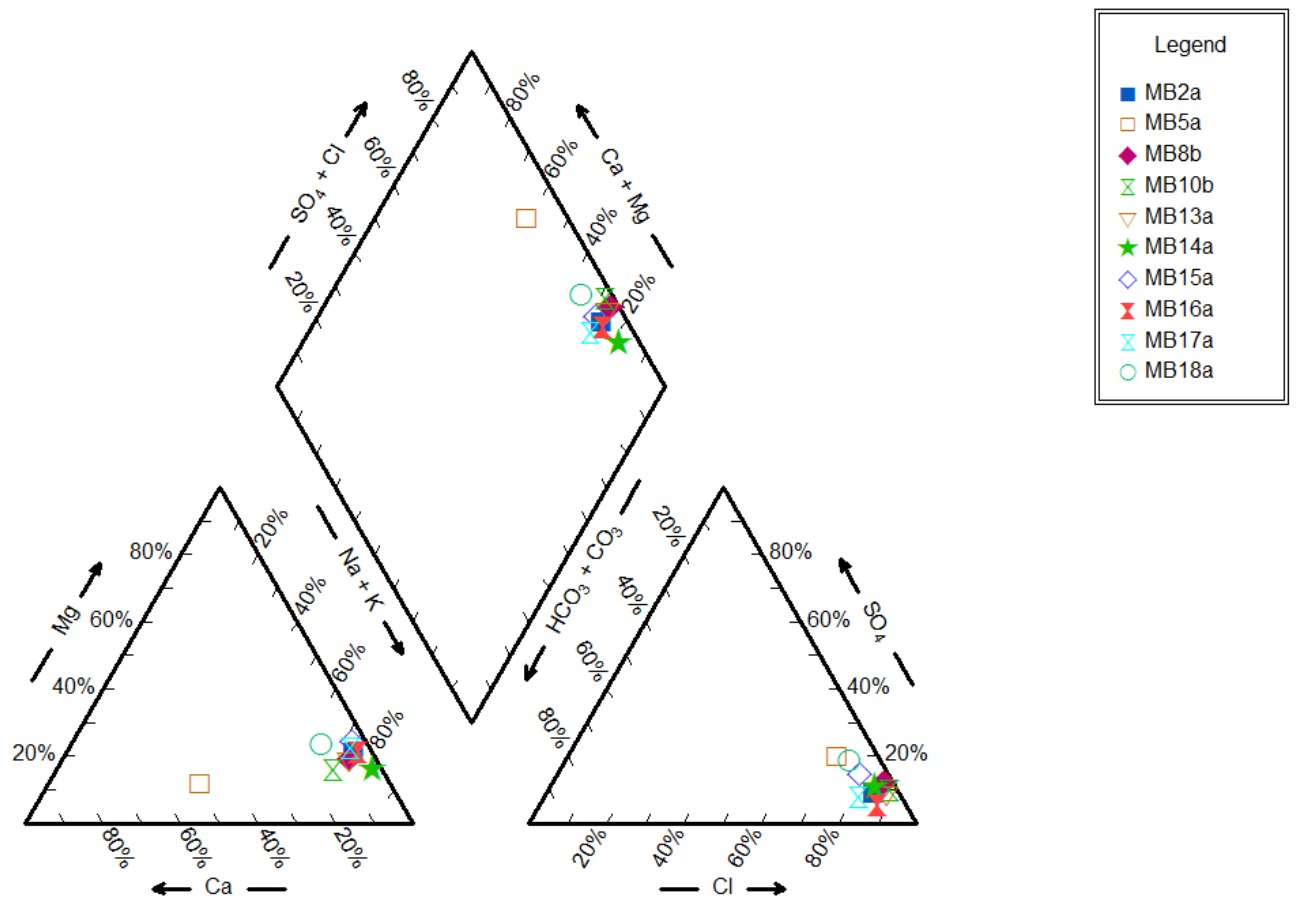
— Not monitored
D Destroyed

Shallow bores																	
Date	MB1B	MB2B	MB3	MB4	MB5B	MB7	MB9a	MB9a	MB10a	MB11a	MB12a	MB13b	MB14b	MB15b	MB16b	MB17b	MB18b
Oct-2001	24.2	23.2	23.8	24.3	22.4	24.0	—	—	—	—	—	—	—	—	—	—	—
Jan-2002	25.8	26.3	26.0	23.7	25.0	25.4	—	—	—	—	—	—	—	—	—	—	—
Apr-2002	23.0	25.5	24.5	23.5	23.8	25.4	—	—	—	—	—	—	—	—	—	—	—
Jul-2002	21.7	21.3	20.6	20.7	20.1	20.7	—	—	—	—	—	—	—	—	—	—	—
Oct-2002	25.2	24.7	24.1	22.7	22.0	24.1	—	—	—	—	—	—	—	—	—	—	—
Jan-2003	19.1	20.4	19.4	18.7	19.5	19.9	—	—	—	—	—	—	—	—	—	—	—
Apr-2003	23.1	26.5	24.0	23.5	22.3	24.0	—	—	—	—	—	—	—	—	—	—	—
Jul-2003	18.0	19.8	18.0	19.5	16.0	17.9	—	—	—	—	—	—	—	—	—	—	—
Oct-2003	20.6	21.6	20.0	20.1	19.8	19.5	—	—	—	—	—	—	—	—	—	—	—
Feb-2004	22.6	24.9	21.3	20.1	22.3	21.5	—	—	—	—	—	—	—	—	—	—	—
Apr-2004	22.8	22.2	21.7	21.5	21.4	22.3	—	—	—	—	—	—	—	—	—	—	—
Jul-2004	18.7	18.2	18.4	19.1	18.3	18.4	—	—	—	—	—	—	—	—	—	—	—
Oct-2004	21.9	21.8	21.2	21.0	17.3	20.9	—	—	—	—	—	—	—	—	—	—	—
Jan-2005	23.5	24.7	23.7	23.5	24.0	25.3	—	—	—	—	—	—	—	—	—	—	—
Apr-2005	24.6	27.8	24.9	23.3	24.6	24.3	—	—	—	—	—	—	—	—	—	—	—
Jul-2005	21.7	20.8	20.9	—	19.4	19.9	20.9	19.8	—	18.8	20.8	—	—	—	—	—	—
Oct-2005	21.2	21.4	22.0	21.7	20.8	21.1	21.8	19.7	20.2	20.7	21.6	—	—	—	—	—	—
Dec-2005	—	—	—	—	—	—	25	23.3	23.3	23.3	24.8	—	—	—	—	—	—
Jan-2006	25.1	25.0	24.4	—	27.6	24.9	27.1	26.6	26.1	25.5	25.9	—	—	—	—	—	—
Apr-2006	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jul-2006	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nov-2006	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mar-2007	24.7	27.1	24.8	—	25.3	26.2	27.1	25.3	26.4	—	26.2	—	—	—	—	—	—
May-2007	23.9	24.5	23.8	23.8	23.6	23.6	24.7	25	23.8	24.5	24.4	—	—	—	—	—	—
Sep-2007	22.5	21.9	—	—	19.6	—	19.5	19.2	19.4	19.2	20.1	—	—	—	—	—	—
Jan-2008	24.7	—	—	—	23.8	25.8	—	24.7	24.9	24.4	D	—	—	—	—	—	—
Apr-2008	26.1	—	29.3	—	27.5	—	29.2	27.7	26.7	D	—	—	—	—	—	—	—
Jul-2008	21.2	—	—	—	18.8	—	20.5	19.4	18.9	18.9	D	—	—	—	—	—	—
Oct-2008	25.4	—	25.5	24.5	27.5	25.6	24.4	23.7	23.8	25	D	—	—	—	—	—	—
Dec-2008	27.4	—	28.8	—	25.9	—	29.7	31.6	27.9	26.5	D	—	—	—	—	—	—
Jun-2009	—	26.0	26.6	15.9	15.6	28.8	16.5	15.8	—	26.6	D	—	—	—	—	—	—
Sep-2011	20.3	18.8	19.8	20.5	20.3	—	20.3	19.5	19.4	20.0	D	—	—	—	—	—	—
Apr-2012	22.8	22.8	23.5	22.7	22.5	23.7	26.1	23.5	23.3	22.8	D	—	—	—	—	—	—
Sep-2012	21.8	26.2	19.8	20.5	19.7	20.1	21.3	19.9	20.4	20.4	D	—	—	—	—	—	—
Apr-2013	24.3	24.2	24.5	23.8	23.6	26.0	25.5	22.7	21.7	23.0	D	—	—	—	—	—	—
Sep-2013	21.3	22.39	21.63	22.03	20.95	20.87	21.89	20.2	20.14	20.28	D	—	—	—	—	—	—
Mar-2014	23.62	31.84	23.43	22.41	24.55	24.33	25.06	24.82	25.12	25.09	D	—	—	—	—	—	—
Oct-2014	21.42	21.04	20.51	20.54	20.11	20.71	21.38	20.11	20.1	19.83	D	—	—	—	—	—	—
Mar-2015	23.26	23.75	23.41	22.57	22.61	23.91	25.17	—	24.51	23.87	D	—	—	—	—	—	—
Sep-2015	22.22	21.18	21.95	21.82	20.58	21.1	19.47	19.88	19.41	19.97	D	—	—	—	—	—	—
Mar-2016	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
Sep-2016	21.62	20.53	22.59	22.23	19.63	20.1	20.99	19.92	19.75	19.52	D	—	—	—	—	—	—
Apr-2017	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
Sep-2017	22.09	20.94	22.73	22.26	20.64	20.56	20.69	19.95	19.97	19.03	D	—	—	—	—	—	—
Mar-2018	23.3	23.6	23.4	22.4	23.8	24	24	23.8	24	23.5	D	—	—	—	—	—	—
Sep-2018	22.87	20.13	22.15	22.15	19.97	19.92	19.65	19.07	18.81	18.15	D	—	—	—	—	—	—
Jun-2019	23.18	22.37	23.35	22.28	22.02	21.47	20.7	20.79	20.5	19.82	D	—	—	—	—	—	—
Dec-2019	23.49	21.96	22.37	22.06	21.81	21.86	21.85	22.07	22.91	22.71	D	—	—	—	—	—	—
Mar-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
May-2020	—	—	—	—	—	—	—	—	—	—	D	22.1	22.31	21.81	21.56	21.56	21.8
Jun-2020	22.54	21.63	23.24	22.16	21.47	21.77	20.46	20.08	20	—	D	20.44	21.07	21.71	21.19	21.24	21.17
Jul-2020	—	—	—	—	—	—	—	—	—	—	D	19.77	19.74	20.35	20.14	20.26	20.24
Aug-2020	—	—	—	—	—	—	—	—	—	—	D	20.42	19.78	20.29	20.08	20.12	20.08
Aug-2020	—	—	—	—	—	—	—	—	—	—	D	19.7	19.68	20.07	20.01	19.83	19.67
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	19.89	19.63	19.71	19.85	19.65	19.45
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	—	—	—	—	—	—
Sep-2020	—	—	—	—	—	—	—	—	—	—	D	18.92	19.5	18.94	19.16	18.94	18.85
Oct-2020	—	—	—	—	—	—	—	—	—	—	D	19.03	18.87	18.85	18.99	19.85	18.94
Median	22.9	22.4	23.3	22.2	21.8	22.1	21.8	20.5	21.1	22.7	24.4	19.8	19.7	20.2	20.0	20.0	19.9
Mean	22.8	23.1	22.9	21.8	21.8	22.6	22.9	22.1	22.1	22.2	23.4	20.0	20.1	20.2	20.1	20.2	20.0
Min	18.0	18.2	18.0	15.9	15.6	17.9	16.5	15.8	18.8	18.2	20.1	18.9	18.9	18.9	19.0	18.9	18.9
Max	27.4	31.8	29.3	24.5	27.6	28.8	29.7	31.6	27.9	26.7	26.2	22.1	22.3	21.8	21.6	21.6	21.8
80th percentile	24.5	25.3	24.5	23.5	23.9	25.1	25.4	24.8	24.5	24.9	25.7	20.4	20.6	21.2	20.8	20.8	20.8
20th percentile	21.5	21.0	20.8	20.5	19.7	20.3	20.5	19.7	19.8	19.6	21.0	19.3	19.6	19.2	19.4	19.7	19.1

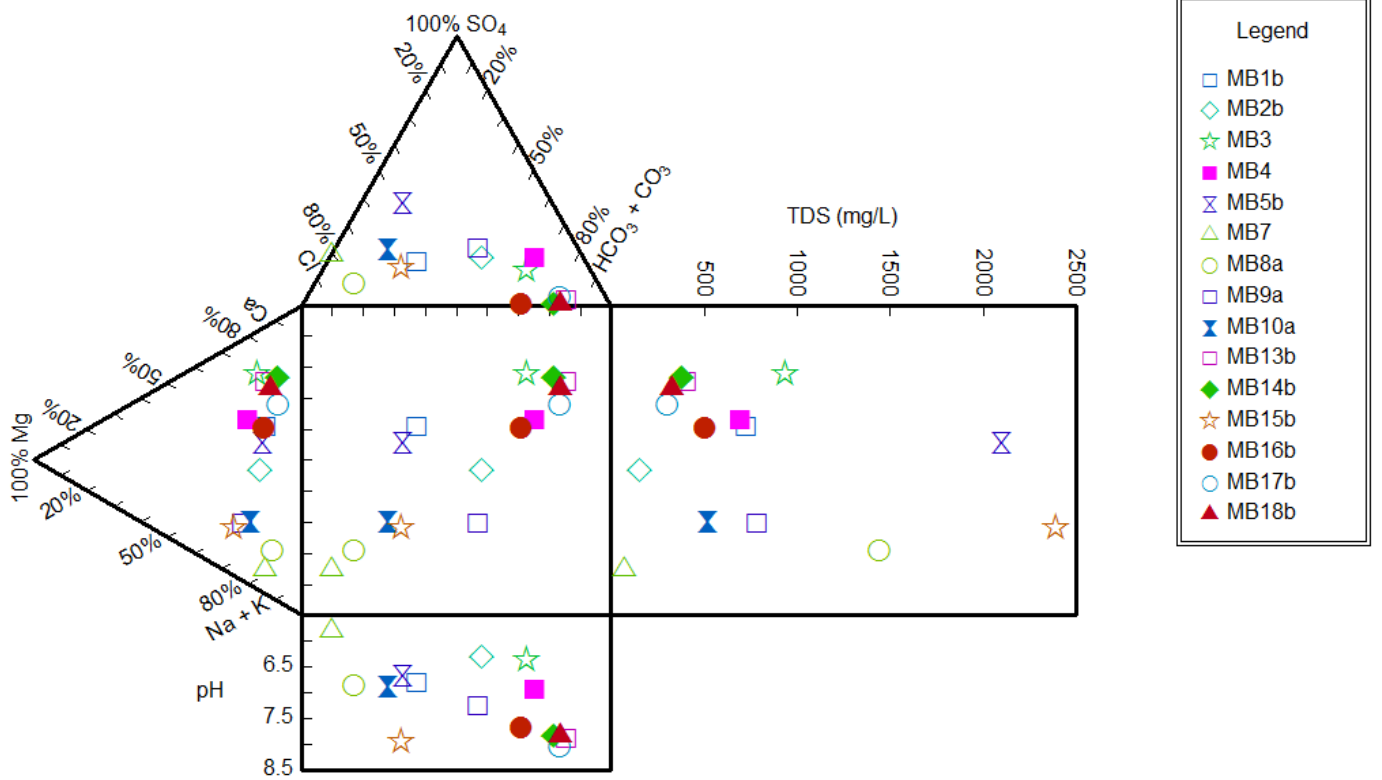
June 2020 Deep Bores - Durov Diagram



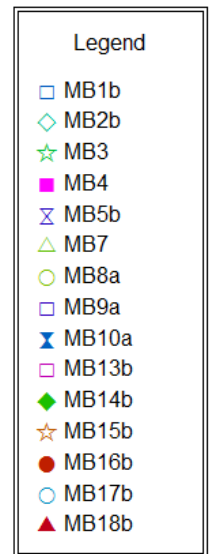
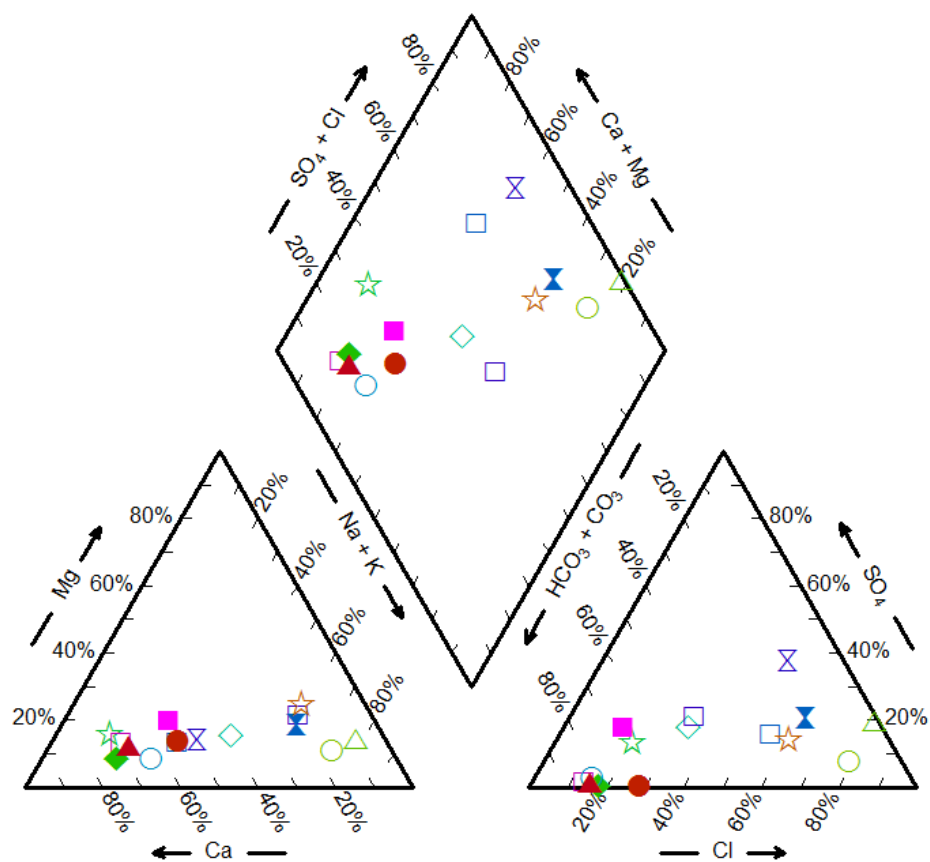
June 2020 Deep Bores - Piper Diagram



June 2020 Shallow Bores - Durov Diagram



June 2020 Shallow Bores - Piper Diagram



12 Appendix 4 – Potentiometric surface drawings (m AHD)



ORIENTATION

SCALE

0

125

250

375

500

625

metres

ROBINA

PO Box 4115 Robina QLD4230

07 5578 9944

Email robina@access.gs

www.access.gs

- LEGEND
- Groundwater bores

Groundwater flow direction

Groundwater level major contour (0.1 m interval) (mAHd)

Groundwater level minor contour (0.025 m interval) (mAHd)

SOURCES

Image: Nearmap image dated 1 June 2020.

PROJECT

TWEED SAND PLANT
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CLIENT

HANSON
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MATERIALS PTY LTD

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GROUNDWATER CONTOURS & FLOW
DIRECTIONS 6 MAY 2020

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07 5578 9944
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LEGEND

Groundwater bores

Groundwater flow direction

Groundwater level major contour (0.1 m interval) (mAHD)

Groundwater level minor contour (0.025 m interval) (mAHD)

SOURCES

Image: Nearmap image dated 1 June 2020.

PROJECT

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ORIENTATION

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LEGEND

Groundwater bores

Groundwater flow direction

Groundwater level major contour (0.1 m interval) (mAHd)

Groundwater level minor contour (0.025 m interval) (mAHd)

SOURCES

Image: Nearmap image dated 1 June 2020.

PROJECT

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LEGEND

Groundwater bores

Groundwater flow direction

Groundwater level major contour (0.1 m interval) (mAHd)

Groundwater level minor contour (0.025 m interval) (mAHd)

SOURCES

Image: Nearmap image dated 1 June 2020.

PROJECT

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GROUNDWATER CONTOURS & FLOW
DIRECTIONS 26 AUGUST 2020

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- LEGEND
- Groundwater bores

Groundwater flow direction

Groundwater level major contour (0.1 m interval) (mAHD)

Groundwater level minor contour (0.025 m interval) (mAHD)

SOURCES

Image: Nearmap image dated 1 June 2020.

PROJECT

TWEED SAND PLANT
EXPANSION

CLIENT

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MATERIALS PTY LTD

DRAWING

GROUNDWATER CONTOURS & FLOW
DIRECTIONS 9 SEPTEMBER 2020

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LEGEND

Groundwater bores

Groundwater flow direction

Groundwater level major contour (0.1 m interval) (mAHd)

Groundwater level minor contour (0.025 m interval) (mAHd)

SOURCES

Image: Nearmap image dated 1 June 2020.

PROJECT

TWEED SAND PLANT
EXPANSION

CLIENT

HANSON
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MATERIALS PTY LTD

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GROUNDWATER CONTOURS & FLOW
DIRECTIONS 22 SEPTEMBER 2020

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3/12/2020

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REVISION





ORIENTATION

SCALE

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metres

ROBINA

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07 5578 9944
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LEGEND

Groundwater bores

Groundwater flow direction

Groundwater level major contour (0.1 m interval) (mAHD)

Groundwater level minor contour (0.025 m interval) (mAHD)

SOURCES

Image: Nearmap image dated 1 June 2020.

PROJECT

TWEED SAND PLANT
EXPANSION

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DRAWING

GROUNDWATER CONTOURS & FLOW
DIRECTIONS 7 OCTOBER 2020

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3/12/2020

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REVISION





ORIENTATION

SCALE

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metres

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LEGEND

Groundwater bores

Groundwater flow direction

Groundwater level major contour (0.1 m interval) (mAHD)

Groundwater level minor contour (0.025 m interval) (mAHD)

SOURCES

Image: Nearmap image dated 1 June 2020.

PROJECT

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DRAWING

GROUNDWATER CONTOURS & FLOW
DIRECTIONS 7 OCTOBER 2020

SCALE

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3/12/2020

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PROJECT

12035

DRAWING

509

REVISION

13 Appendix 5 – Certificates of analysis

CERTIFICATE OF ANALYSIS

Work Order : **EB2012355**
Client : **GILBERT & SUTHERLAND PTY LTD**
Contact : MS ERIN HOLTON
Address : P O BOX 4115
 ROBINA QLD, AUSTRALIA 4230
Telephone : +61 07 38523999
Project : 12035
Order number : ----
C-O-C number : ----
Sampler : MIAH CLAYTON
Site : ----
Quote number : EN/222
No. of samples received : 19
No. of samples analysed : 19

Page : 1 of 10
Laboratory : Environmental Division Brisbane
Contact : Carsten Emrich
Address : 2 Byth Street Stafford QLD Australia 4053

Telephone : +61 7 3552 8616
Date Samples Received : 08-May-2020 15:40
Date Analysis Commenced : 08-May-2020
Issue Date : 15-May-2020 16:55



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

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Luke Evans	Microbiologist	Brisbane Microbiological, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- EG020F (Dissolved Metals by ICP-MS): Limit of reporting raised for some samples due to matrix interference.
- EK061G (Total Kjeldahl Nitrogen as N) / EK067G (Total Phosphorus as P): Some samples were diluted due to matrix interference. LOR adjusted accordingly.
- ED041G (Sulfate as SO₄ 2-) Sample EB2012355_008 (MB16b) was diluted due to matrix interference. LOR adjusted accordingly.
- MF = membrane filtration
- CFU = colony forming unit
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- Microbiological Comment: Membrane filtration result for EB2012355-01,-02 and -03 is reported <100 CFU/100mL where the filtered sample at 10mL were overgrown and therefore the presumptive colonies were confirmed at 1mL sample filtered and confirmation of suspected organisms were not detected.
- Microbiological Comment: Membrane filtration result for EB2012355-06,-08,-10 and -12 is reported <1000 CFU/100mL where the filtered sample at 10 and 1mL were overgrown and therefore the presumptive colonies were confirmed at 0.1mL sample filtered and confirmation of suspected organisms were not detected.
- Microbiological Comment: Membrane filtration result is reported <10 CFU/100mL where 10mL sample was filtered because the sample was turbid, insufficient for filtration at higher volume and there were no target organisms confirmed.
- Microbiological Comment: Membrane filtration result for EB2012355-04 and -07 is reported <10000 CFU/100mL where the filtered sample at 10, 1 and 0.1mL were overgrown and therefore the presumptive colonies were confirmed at 0.01mL sample filtered and confirmation of suspected organisms were not detected.
- MW006 is ALS's internal code and is equivalent to AS4276.7.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID		MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time				07-May-2020 00:00		07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00
Compound	CAS Number	LOR	Unit	EB2012355-001	EB2012355-002	EB2012355-003	EB2012355-004	EB2012355-005		
				Result	Result	Result	Result	Result		
EA005P: pH by PC Titrator										
pH Value	----	0.01	pH Unit	7.53	7.67	7.42	7.66	7.69		
EA010P: Conductivity by PC Titrator										
Electrical Conductivity @ 25°C	----	1	µS/cm	27100	626	31400	530	25300		
ED037P: Alkalinity by PC Titrator										
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1		
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1		
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	465	261	1020	216	1060		
Total Alkalinity as CaCO3	----	1	mg/L	465	261	1020	216	1060		
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA										
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1330	2	1870	<1	2080		
ED045G: Chloride by Discrete Analyser										
Chloride	16887-00-6	1	mg/L	9630	35	11200	36	8080		
ED093F: Dissolved Major Cations										
Calcium	7440-70-2	1	mg/L	437	81	164	80	193		
Magnesium	7439-95-4	1	mg/L	700	10	717	6	823		
Sodium	7440-23-5	1	mg/L	4860	39	6210	25	4580		
Potassium	7440-09-7	1	mg/L	142	5	148	1	164		
ED093F: SAR and Hardness Calculations										
Total Hardness as CaCO3	----	1	mg/L	3970	243	3360	224	3870		
^ Sodium Adsorption Ratio	----	0.01	-	33.5	1.09	46.6	0.72	32.0		
EG020F: Dissolved Metals by ICP-MS										
Aluminium	7429-90-5	0.01	mg/L	<0.05	<0.01	<0.05	<0.01	<0.01		
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.001	<0.005	<0.001	<0.001		
Iron	7439-89-6	0.05	mg/L	9.28	3.59	7.38	5.17	0.96		
EK040P: Fluoride by PC Titrator										
Fluoride	16984-48-8	0.1	mg/L	0.3	0.7	0.5	0.2	0.4		
EK055G: Ammonia as N by Discrete Analyser										
Ammonia as N	7664-41-7	0.01	mg/L	8.30	0.35	19.9	0.47	11.8		
EK057G: Nitrite as N by Discrete Analyser										
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01		
EK058G: Nitrate as N by Discrete Analyser										
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	0.08	<0.01	<0.01		
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser										



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time					07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00
Compound	CAS Number	LOR	Unit		EB2012355-001	EB2012355-002	EB2012355-003	EB2012355-004	EB2012355-005
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	0.08	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		9.8	0.9	24.0	1.8	13.6
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		9.8	0.9	24.1	1.8	13.6
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.51	0.35	0.33	0.38	0.59
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	0.04	<0.01	<0.01	0.34
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		309	6.24	375	5.33	292
∅ Total Cations	----	0.01	meq/L		294	6.69	341	5.60	281
∅ Ionic Balance	----	0.01	%		2.35	3.44	4.77	2.45	2.03
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		~3700	8100	1100	270000	61000
<i>Escherichia coli</i>	----	1	CFU/100mL		<100	<100	<100	<10000	<1000

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time				07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2012355-006	EB2012355-007	EB2012355-008	EB2012355-009	EB2012355-010	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.60	7.33	7.31	7.85	7.75	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	3710	23900	955	13400	510	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	572	1210	283	763	175	
Total Alkalinity as CaCO3	----	1	mg/L	572	1210	283	763	175	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	188	701	<5	583	40	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	812	8090	122	4310	24	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	132	222	96	124	53	
Magnesium	7439-95-4	1	mg/L	109	650	18	364	6	
Sodium	7440-23-5	1	mg/L	506	4350	85	2260	53	
Potassium	7440-09-7	1	mg/L	38	144	8	83	2	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	778	3230	314	1810	157	
^ Sodium Adsorption Ratio	----	0.01	-	7.89	33.3	2.09	23.1	1.84	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
Arsenic	7440-38-2	0.001	mg/L	<0.001	0.002	<0.001	<0.001	<0.001	
Iron	7439-89-6	0.05	mg/L	4.60	0.29	16.1	1.11	3.25	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.6	0.4	0.6	0.5	0.2	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	1.33	9.46	0.44	7.03	0.35	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	0.04	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time					07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00	07-May-2020 00:00
Compound	CAS Number	LOR	Unit		EB2012355-006	EB2012355-007	EB2012355-008	EB2012355-009	EB2012355-010
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		0.04	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		2.7	13.6	1.2	8.2	0.9
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		2.7	13.6	1.2	8.2	0.9
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.42	0.92	0.80	0.50	0.18
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	0.63	0.06	0.24	0.02
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		38.2	267	9.10	149	5.01
∅ Total Cations	----	0.01	meq/L		38.5	257	10.2	136	5.50
∅ Ionic Balance	----	0.01	%		0.38	1.81	5.59	4.34	4.65
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		48000	430000	12000	24000	~120000
<i>Escherichia coli</i>	----	1	CFU/100mL		<1000	<10000	<1000	<1000	<1000

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID		MB18a	MB18b	L1	L2	L3	
Client sampling date / time				07-May-2020 00:00		07-May-2020 00:00		06-May-2020 00:00		06-May-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2012355-011		EB2012355-012		EB2012355-013		EB2012355-014	
				Result		Result		Result		Result	
EA005P: pH by PC Titrator											
pH Value		----	0.01	pH Unit	7.47	7.54	7.85	7.84	7.62		
EA010P: Conductivity by PC Titrator											
Electrical Conductivity @ 25°C		----	1	µS/cm	15600	693	42700	41700	608		
ED037P: Alkalinity by PC Titrator											
Hydroxide Alkalinity as CaCO3		DMO-210-001	1	mg/L	<1	<1	<1	<1	<1		
Carbonate Alkalinity as CaCO3		3812-32-6	1	mg/L	<1	<1	<1	<1	<1		
Bicarbonate Alkalinity as CaCO3		71-52-3	1	mg/L	710	246	99	98	113		
Total Alkalinity as CaCO3		----	1	mg/L	710	246	99	98	113		
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA											
Sulfate as SO4 - Turbidimetric		14808-79-8	1	mg/L	1690	6	2280	2240	17		
ED045G: Chloride by Discrete Analyser											
Chloride		16887-00-6	1	mg/L	4890	64	16600	16100	114		
ED093F: Dissolved Major Cations											
Calcium		7440-70-2	1	mg/L	341	72	346	342	25		
Magnesium		7439-95-4	1	mg/L	504	12	1010	990	14		
Sodium		7440-23-5	1	mg/L	2620	57	7850	7740	70		
Potassium		7440-09-7	1	mg/L	86	6	300	303	4		
ED093F: SAR and Hardness Calculations											
Total Hardness as CaCO3		----	1	mg/L	2930	229	5020	4930	120		
^ Sodium Adsorption Ratio		----	0.01	-	21.1	1.64	48.2	48.0	2.78		
EG020F: Dissolved Metals by ICP-MS											
Aluminium		7429-90-5	0.01	mg/L	<0.01	<0.01	<0.05	<0.05	<0.01		
Arsenic		7440-38-2	0.001	mg/L	<0.001	<0.001	<0.005	<0.005	<0.001		
Iron		7439-89-6	0.05	mg/L	15.4	9.31	<0.05	<0.05	0.57		
EK040P: Fluoride by PC Titrator											
Fluoride		16984-48-8	0.1	mg/L	0.5	0.3	0.7	0.8	0.2		
EK055G: Ammonia as N by Discrete Analyser											
Ammonia as N		7664-41-7	0.01	mg/L	2.46	0.26	0.08	0.08	0.03		
EK057G: Nitrite as N by Discrete Analyser											
Nitrite as N		14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01		
EK058G: Nitrate as N by Discrete Analyser											
Nitrate as N		14797-55-8	0.01	mg/L	<0.01	<0.01	0.01	<0.01	0.08		
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser											



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB18a	MB18b	L1	L2	L3
Client sampling date / time					07-May-2020 00:00	07-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00
Compound	CAS Number	LOR	Unit		EB2012355-011	EB2012355-012	EB2012355-013	EB2012355-014	EB2012355-015
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	0.01	<0.01	0.08
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		3.6	1.4	<0.5	1.5	0.6
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		3.6	1.4	<0.5	1.5	0.7
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.32	0.36	0.05	0.06	0.06
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		187	6.84	518	503	5.83
∅ Total Cations	----	0.01	meq/L		175	7.21	450	443	5.55
∅ Ionic Balance	----	0.01	%		3.50	2.62	7.05	6.32	2.47
EP008: Chlorophyll a & Pheophytin a									
Chlorophyll a	----	1	mg/m ³		----	----	2	1	3
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		~60	57000	24	54	120
<i>Escherichia coli</i>	----	1	CFU/100mL		<10	<1000	17	54	110

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	L4	L5	L6	L7	----
Client sampling date / time				06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	----	
Compound	CAS Number	LOR	Unit	EB2012355-016	EB2012355-017	EB2012355-018	EB2012355-019	-----	
				Result	Result	Result	Result	----	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.65	8.16	7.64	7.72	----	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	37000	2620	28100	39900	----	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	103	141	100	96	----	
Total Alkalinity as CaCO3	----	1	mg/L	103	141	100	96	----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1930	169	1410	2100	----	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	14200	682	9990	15400	----	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	327	66	294	358	----	
Magnesium	7439-95-4	1	mg/L	917	59	855	1060	----	
Sodium	7440-23-5	1	mg/L	7730	364	6690	8770	----	
Potassium	7440-09-7	1	mg/L	272	17	259	303	----	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	4590	408	4260	5260	----	
^ Sodium Adsorption Ratio	----	0.01	-	49.6	7.84	44.6	52.6	----	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.05	<0.01	<0.05	<0.05	----	
Arsenic	7440-38-2	0.001	mg/L	<0.005	0.002	<0.005	<0.005	----	
Iron	7439-89-6	0.05	mg/L	0.14	<0.05	<0.05	0.40	----	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.8	0.4	0.5	0.7	----	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	0.23	0.06	0.04	0.29	----	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	0.04	0.04	<0.01	0.09	----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	L4	L5	L6	L7	----
Client sampling date / time					06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	06-May-2020 00:00	----
Compound	CAS Number	LOR	Unit		EB2012355-016	EB2012355-017	EB2012355-018	EB2012355-019	-----
				Result	Result	Result	Result	Result	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		0.04	0.04	<0.01	0.09	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		1.0	0.4	<0.5	0.5	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		1.0	0.4	<0.5	0.6	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.20	0.02	<0.05	<0.05	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		443	25.6	313	480	----
∅ Total Cations	----	0.01	meq/L		435	24.4	383	494	----
∅ Ionic Balance	----	0.01	%		0.89	2.31	9.99	1.46	----
EP008: Chlorophyll a & Pheophytin a									
Chlorophyll a	----	1	mg/m ³		26	2	2	1	----
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		12	~2	120	320	----
<i>Escherichia coli</i>	----	1	CFU/100mL		12	<1	90	320	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2016243**
Client : **GILBERT & SUTHERLAND PTY LTD**
Contact : MS ERIN HOLTON
Address : P O BOX 4115
 ROBINA QLD, AUSTRALIA 4230
Telephone : +61 07 38523999
Project : 10026
Order number : ----
C-O-C number : ----
Sampler : MIAH CLAYTON
Site : ----
Quote number : EN/222
No. of samples received : 17
No. of samples analysed : 17

Page : 1 of 10
Laboratory : Environmental Division Brisbane
Contact : Carsten Emrich
Address : 2 Byth Street Stafford QLD Australia 4053

Telephone : +61 7 3552 8616
Date Samples Received : 18-Jun-2020 15:40
Date Analysis Commenced : 18-Jun-2020
Issue Date : 26-Jun-2020 15:03



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

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Luke Evans	Microbiologist	Brisbane Microbiological, Stafford, QLD
Santusha Pandra	Senior Chemist	Brisbane Inorganics, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- MF = membrane filtration
- CFU = colony forming unit
- It has been noted that EK071G (Reactive Phosphorus as P) is greater than EK067G (Total Phosphorus as P) for sample EB2016243_012 (MB15a), however this difference is within the limits of experimental variation.
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- Microbiological Comment: Accordance with ALS work instruction, membrane filtration result for EB2016243-13, -16 & -17 is estimated, where there are overgrown non-typical colonies on the filtered membrane that may have inhibited the growth of the target organisms. It may be informative to record this fact.
- Microbiological Comment: Membrane filtration result is reported <2 CFU/100mL where 50mL sample was filtered because the sample was turbid, insufficient for filtration at higher volume and there were no target organisms confirmed.
- Microbiological Comment: Membrane filtration result is reported <10 CFU/100mL where 10mL sample was filtered because the sample was turbid, insufficient for filtration at higher volume and there were no target organisms confirmed.
- EG020-F (Dissolved Metals by ICP-MS): Limit of reporting raised for some samples due to matrix interference.
- MW006 is ALS's internal code and is equivalent to AS4276.7.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW1	SW2	SW4	SW6	SW7
Client sampling date / time				17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2016243-001	EB2016243-002	EB2016243-004	EB2016243-006	EB2016243-007	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.81	7.77	7.49	7.79	7.87	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	19800	20400	28400	12100	5560	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	146	144	141	146	205	
Total Alkalinity as CaCO3	----	1	mg/L	146	144	141	146	205	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	833	867	1290	551	190	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	6890	7070	9880	3970	1530	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	176	174	236	128	73	
Magnesium	7439-95-4	1	mg/L	464	462	656	267	93	
Sodium	7440-23-5	1	mg/L	3790	3790	5530	2170	731	
Potassium	7440-09-7	1	mg/L	147	146	204	89	33	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	2350	2340	3290	1420	565	
^ Sodium Adsorption Ratio	----	0.01	-	34.0	34.1	41.9	25.1	13.4	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	0.01	<0.05	<0.01	<0.01	
Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	<0.005	0.001	<0.001	
Iron	7439-89-6	0.05	mg/L	<0.05	0.17	0.07	0.14	0.29	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.7	0.7	0.7	0.6	0.6	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	0.24	0.23	0.32	0.23	0.25	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	0.02	0.03	<0.01	0.02	0.05	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW1	SW2	SW4	SW6	SW7
Client sampling date / time					17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016243-001	EB2016243-002	EB2016243-004	EB2016243-006	EB2016243-007
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		0.02	0.03	<0.01	0.02	0.05
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		0.7	0.6	2.0	0.7	0.9
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		0.7	0.6	2.0	0.7	1.0
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.07	0.07	0.37	0.14	0.17
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		0.03	0.04	0.10	0.07	0.05
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		215	220	308	126	51.2
∅ Total Cations	----	0.01	meq/L		216	215	312	125	43.9
∅ Ionic Balance	----	0.01	%		0.22	1.16	0.51	0.54	7.64
EP008: Chlorophyll a & Pheophytin a									
Chlorophyll a	----	1	mg/m³		<1	<1	81	<1	2
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		110	160	54	~31	64
Escherichia coli	----	1	CFU/100mL		110	160	50	~25	49

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time				17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2016243-008	EB2016243-009	EB2016243-010	EB2016243-011	EB2016243-012	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.73	7.89	7.60	7.84	7.89	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	28300	532	32300	517	24900	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	479	222	970	208	1050	
Total Alkalinity as CaCO3	----	1	mg/L	479	222	970	208	1050	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1330	4	1830	<1	2030	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	9760	24	10600	32	8040	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	426	77	163	72	196	
Magnesium	7439-95-4	1	mg/L	704	9	696	5	833	
Sodium	7440-23-5	1	mg/L	5200	21	6660	22	4580	
Potassium	7440-09-7	1	mg/L	148	4	152	<1	168	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	3960	229	3270	200	3920	
^ Sodium Adsorption Ratio	----	0.01	-	35.9	0.60	50.6	0.68	31.8	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.05	<0.01	<0.05	<0.01	<0.05	
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.001	<0.005	<0.001	<0.005	
Iron	7439-89-6	0.05	mg/L	10.4	5.64	<0.05	<0.05	<0.05	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.3	0.8	0.5	0.2	0.4	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	8.91	0.47	21.9	0.33	12.9	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time					17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016243-008	EB2016243-009	EB2016243-010	EB2016243-011	EB2016243-012
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		9.5	0.8	22.7	0.6	13.4
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		9.5	0.8	22.7	0.6	13.4
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.55	0.43	0.30	0.16	0.61
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	0.65
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		312	5.20	356	5.06	290
∅ Total Cations	----	0.01	meq/L		309	5.60	359	4.96	282
∅ Ionic Balance	----	0.01	%		0.55	3.73	0.35	0.97	1.43
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<2	<2	<2	~5	~3
Escherichia coli	----	1	CFU/100mL		<2	<2	<2	<1	<1

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID		MB15b	MB16a	MB16b	MB17a	MB17b	
Client sampling date / time				17-Jun-2020 00:00		17-Jun-2020 00:00		17-Jun-2020 00:00		17-Jun-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2016243-013	EB2016243-014	EB2016243-015	EB2016243-016	EB2016243-017			
				Result	Result	Result	Result	Result			
EA005P: pH by PC Titrator											
pH Value	----	0.01	pH Unit	7.93	7.98	7.69	8.03	8.05			
EA010P: Conductivity by PC Titrator											
Electrical Conductivity @ 25°C	----	1	µS/cm	3700	25800	695	13600	408			
ED037P: Alkalinity by PC Titrator											
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1			
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1			
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	497	1030	254	808	165			
Total Alkalinity as CaCO3	----	1	mg/L	497	1030	254	808	165			
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA											
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	258	672	<1	534	5			
ED045G: Chloride by Discrete Analyser											
Chloride	16887-00-6	1	mg/L	822	8860	69	4280	21			
ED093F: Dissolved Major Cations											
Calcium	7440-70-2	1	mg/L	113	198	71	130	50			
Magnesium	7439-95-4	1	mg/L	105	726	11	354	4			
Sodium	7440-23-5	1	mg/L	454	4810	47	2180	25			
Potassium	7440-09-7	1	mg/L	39	158	5	87	1			
ED093F: SAR and Hardness Calculations											
Total Hardness as CaCO3	----	1	mg/L	714	3480	222	1780	141			
^ Sodium Adsorption Ratio	----	0.01	-	7.39	35.4	1.37	22.5	0.91			
EG020F: Dissolved Metals by ICP-MS											
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.05	<0.01	<0.01	<0.01			
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.005	<0.001	<0.001	<0.001			
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.50	<0.05	0.38			
EK040P: Fluoride by PC Titrator											
Fluoride	16984-48-8	0.1	mg/L	0.6	0.4	0.7	0.5	0.2			
EK055G: Ammonia as N by Discrete Analyser											
Ammonia as N	7664-41-7	0.01	mg/L	2.10	16.6	1.06	7.76	0.36			
EK057G: Nitrite as N by Discrete Analyser											
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01			
EK058G: Nitrate as N by Discrete Analyser											
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01			
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser											



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time					17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00	17-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016243-013	EB2016243-014	EB2016243-015	EB2016243-016	EB2016243-017
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		2.8	19.8	1.8	8.8	0.6
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		2.8	19.8	1.8	8.8	0.6
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.52	1.92	0.96	0.56	0.15
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		0.16	0.87	<0.01	0.38	0.02
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		38.5	284	7.02	148	3.99
∅ Total Cations	----	0.01	meq/L		35.0	283	6.62	133	3.94
∅ Ionic Balance	----	0.01	%		4.71	0.28	2.94	5.46	0.70
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		15	~20	<10	~2	~2
<i>Escherichia coli</i>	----	1	CFU/100mL		5	<10	<10	<1	~1

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB18a	MB18b	----	----	----
Client sampling date / time				17-Jun-2020 00:00	17-Jun-2020 00:00	----	----	----	
Compound	CAS Number	LOR	Unit	EB2016243-018	EB2016243-019	-----	-----	-----	
				Result	Result	----	----	----	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.65	7.84	----	----	----	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	15400	464	----	----	----	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	736	184	----	----	----	
Total Alkalinity as CaCO3	----	1	mg/L	736	184	----	----	----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1580	<1	----	----	----	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	4650	24	----	----	----	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	391	60	----	----	----	
Magnesium	7439-95-4	1	mg/L	468	6	----	----	----	
Sodium	7440-23-5	1	mg/L	2420	20	----	----	----	
Potassium	7440-09-7	1	mg/L	88	3	----	----	----	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	2900	174	----	----	----	
^ Sodium Adsorption Ratio	----	0.01	-	19.5	0.66	----	----	----	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	----	----	----	
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----	
Iron	7439-89-6	0.05	mg/L	0.06	0.06	----	----	----	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.6	0.3	----	----	----	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	2.85	0.43	----	----	----	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	----	----	----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB18a	MB18b	----	----	----
Client sampling date / time					17-Jun-2020 00:00	17-Jun-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EB2016243-018	EB2016243-019	-----	-----	-----
				Result	Result		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		4.1	0.9	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		4.1	0.9	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.38	0.23	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	----	----	----
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		179	4.35	----	----	----
∅ Total Cations	----	0.01	meq/L		166	4.43	----	----	----
∅ Ionic Balance	----	0.01	%		3.84	0.92	----	----	----
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<10	~2	----	----	----
<i>Escherichia coli</i>	----	1	CFU/100mL		<10	~2	----	----	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2016334**
Client : **GILBERT & SUTHERLAND PTY LTD**
Contact : MS ERIN HOLTON
Address : P O BOX 4115
 ROBINA QLD, AUSTRALIA 4230
Telephone : +61 07 38523999
Project : 10026
Order number : ----
C-O-C number : ----
Sampler : MIAH CLAYTON
Site : ----
Quote number : EN/222
No. of samples received : 17
No. of samples analysed : 17

Page : 1 of 10
Laboratory : Environmental Division Brisbane
Contact : Carsten Emrich
Address : 2 Byth Street Stafford QLD Australia 4053

Telephone : +61 7 3552 8616
Date Samples Received : 19-Jun-2020 13:50
Date Analysis Commenced : 19-Jun-2020
Issue Date : 29-Jun-2020 08:15



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

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	Position	Accreditation Category
Anuththara Jayasuriya	Microbiologist	Brisbane Microbiological, Stafford, QLD
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EK067G (Total Phosphorus as P): Sample EB2016334_016 (MB8b) was diluted due to matrix interference. LOR adjusted accordingly.
- MF = membrane filtration
- CFU = colony forming unit
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- Microbiological Comment: Membrane filtration result is reported <10 CFU/100mL where 10mL sample was filtered because the sample was turbid, insufficient for filtration at higher volume and there were no target organisms confirmed.
- MW023 is ALS's internal code and is equivalent to AS4276.9.
- MW006 is ALS's internal code and is equivalent to AS4276.7.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- EG093: Samples containing high levels of sulfate may precipitate barium under the acidic conditions of this method and may therefore bias results low.



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW1	SW2	SW3	MB1b	MB2b
Client sampling date / time					18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016334-001	EB2016334-002	EB2016334-003	EB2016334-004	EB2016334-005
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		8.25	8.27	8.24	7.14	6.66
EA006: Sodium Adsorption Ratio (SAR)									
^ Sodium Adsorption Ratio	----	0.01	-		7.96	8.27	8.25	1.58	0.96
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		2700	2700	2700	1100	249
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	----	1	mg/L		1760	1760	1760	715	162
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		409	429	429	360	59
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		143	142	144	196	69
Total Alkalinity as CaCO3	----	1	mg/L		143	142	144	196	69
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		163	188	162	76	11
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		717	605	695	194	15
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		65	68	68	116	17
Magnesium	7439-95-4	1	mg/L		60	63	63	17	4
Sodium	7440-23-5	1	mg/L		370	394	393	69	17
Potassium	7440-09-7	1	mg/L		17	18	19	20	10
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		187	128	131	7	108
Arsenic	7440-38-2	0.2	µg/L		1.6	1.4	1.3	14.8	5.2
Iron	7439-89-6	2	µg/L		148	124	115	11200	4520
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		0.5	0.5	0.5	0.4	<0.1
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		0.02	<0.01	0.02	0.73	0.44
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	0.01	0.02	<0.01	<0.01



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	SW1	SW2	SW3	MB1b	MB2b
Client sampling date / time					18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016334-001	EB2016334-002	EB2016334-003	EB2016334-004	EB2016334-005
					Result	Result	Result	Result	Result
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		0.13	0.12	0.11	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		0.13	0.13	0.13	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		0.3	0.3	0.4	1.5	1.6
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		0.4	0.4	0.5	1.5	1.6
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.01	<0.01	0.01	0.40	0.56
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	0.04
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		26.5	23.8	25.8	11.0	2.03
∅ Total Cations	----	0.01	meq/L		24.7	26.2	26.2	10.7	2.17
∅ Ionic Balance	----	0.01	%		3.45	4.72	0.58	1.25	----
EP008: Chlorophyll a & Pheophytin a									
Chlorophyll a	----	1	mg/m³		2	1	3	----	----
MW006: Faecal Coliforms & E.coli by MF									
<i>Escherichia coli</i>	----	1	CFU/100mL		~7	19	9	<10	6
MW023: Enterococci by Membrane Filtration									
<i>Enterococci</i>	----	1	CFU/100mL		13	8	10	<10	6



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB3	MB4	MB5b	MB7	MB8a
Client sampling date / time					18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016334-006	EB2016334-007	EB2016334-008	EB2016334-009	EB2016334-010
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		6.66	7.30	6.93	5.25	7.30
EA006: Sodium Adsorption Ratio (SAR)									
^ Sodium Adsorption Ratio	----	0.01	-		0.68	1.35	3.73	2.39	9.55
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		1180	888	2960	159	2420
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	----	1	mg/L		767	577	1920	103	1570
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		536	349	1000	13	292
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		491	331	309	3	200
Total Alkalinity as CaCO3	----	1	mg/L		491	331	309	3	200
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		48	68	558	11	85
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		54	44	527	35	646
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		175	102	313	2	69
Magnesium	7439-95-4	1	mg/L		24	23	54	2	29
Sodium	7440-23-5	1	mg/L		36	58	272	20	375
Potassium	7440-09-7	1	mg/L		7	4	7	5	3
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	<5	<5	2390	6
Arsenic	7440-38-2	0.2	µg/L		13.9	0.2	17.5	73.4	7.2
Iron	7439-89-6	2	µg/L		63700	23400	28800	7170	7050
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		0.2	0.7	0.4	<0.1	0.5
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		3.98	0.69	0.83	0.27	0.31
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB3	MB4	MB5b	MB7	MB8a
Client sampling date / time					18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016334-006	EB2016334-007	EB2016334-008	EB2016334-009	EB2016334-010
					Result	Result	Result	Result	Result
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	0.02	0.01	<0.01	0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	0.02	0.01	<0.01	0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		5.7	1.3	2.4	2.0	1.2
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		5.7	1.3	2.4	2.0	1.2
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.23	0.21	0.23	0.20	0.12
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		12.3	9.27	32.6	1.28	24.0
∅ Total Cations	----	0.01	meq/L		12.4	9.61	32.1	1.26	22.2
∅ Ionic Balance	----	0.01	%		0.48	1.79	0.90	----	3.83
MW006: Faecal Coliforms & E.coli by MF									
Escherichia coli	----	1	CFU/100mL		<10	<10	<10	<10	<10
MW023: Enterococci by Membrane Filtration									
Enterococci	----	1	CFU/100mL		<10	<10	<10	<10	~20



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB9a	MB10a	MB2a	MB5a	MB8b
Client sampling date / time					18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016334-011	EB2016334-012	EB2016334-014	EB2016334-015	EB2016334-016
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		7.57	7.08	7.91	7.91	7.62
EA006: Sodium Adsorption Ratio (SAR)									
^ Sodium Adsorption Ratio	----	0.01	-		4.30	3.68	28.5	7.85	39.0
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		1130	876	18700	3170	31600
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	----	1	mg/L		734	569	12200	2060	20500
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		224	156	2520	576	4600
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		275	91	733	181	403
Total Alkalinity as CaCO3	----	1	mg/L		275	91	733	181	403
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		106	78	842	302	2030
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		120	171	6090	791	10700
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		42	33	190	117	483
Magnesium	7439-95-4	1	mg/L		29	18	496	69	825
Sodium	7440-23-5	1	mg/L		148	106	3290	433	6090
Potassium	7440-09-7	1	mg/L		8	9	124	23	184
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		----	----	<5	----	<5
Arsenic	7440-38-2	0.5	µg/L		----	----	1.3	----	<0.5
Iron	7439-89-6	5	µg/L		----	----	808	----	2420
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	<5	----	<5	----
Arsenic	7440-38-2	0.2	µg/L		0.2	0.4	----	0.2	----
Iron	7439-89-6	2	µg/L		6300	8720	----	1780	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		1.3	0.7	0.4	0.4	0.4



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB9a	MB10a	MB2a	MB5a	MB8b
Client sampling date / time					18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00	18-Jun-2020 00:00
Compound	CAS Number	LOR	Unit		EB2016334-011	EB2016334-012	EB2016334-014	EB2016334-015	EB2016334-016
					Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		0.32	0.75	12.5	0.47	4.25
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	0.02	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	0.02	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		0.8	1.4	14.0	0.6	4.7
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		0.8	1.4	14.0	0.6	4.7
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.45	0.36	0.78	0.23	<0.05
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	0.17	0.71	<0.01	<0.01
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		11.1	8.26	204	32.2	352
∅ Total Cations	----	0.01	meq/L		11.1	7.97	196	30.9	362
∅ Ionic Balance	----	0.01	%		0.17	1.83	1.84	2.02	1.32
MW006: Faecal Coliforms & E.coli by MF									
Escherichia coli	----	1	CFU/100mL		~20	~10	<1	<1	<1
MW023: Enterococci by Membrane Filtration									
Enterococci	----	1	CFU/100mL		<10	~10	<1	<1	5



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB10b	MB7	----	----	----
Client sampling date / time					18-Jun-2020 00:00	18-Jun-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EB2016334-017	EB2016334-019	-----	-----	-----
					Result	Result	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		7.17	----	----	----	----
EA006: Sodium Adsorption Ratio (SAR)									
^ Sodium Adsorption Ratio	----	0.01	-		26.4	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		18900	----	----	----	----
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	----	1	mg/L		12300	----	----	----	----
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		2770	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		286	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		286	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		924	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		6380	----	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		498	----	----	----	----
Magnesium	7439-95-4	1	mg/L		371	----	----	----	----
Sodium	7440-23-5	1	mg/L		3190	----	----	----	----
Potassium	7440-09-7	1	mg/L		82	----	----	----	----
EG093F: Dissolved Metals in Saline Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		<5	----	----	----	----
Arsenic	7440-38-2	0.5	µg/L		29.3	----	----	----	----
Iron	7439-89-6	5	µg/L		31100	----	----	----	----
EG094F: Dissolved Metals in Fresh Water by ORC-ICPMS									
Aluminium	7429-90-5	5	µg/L		----	361	----	----	----
Arsenic	7440-38-2	0.2	µg/L		----	66.6	----	----	----
Iron	7439-89-6	2	µg/L		----	6020	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		0.4	----	----	----	----



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB10b	MB7	----	----	----
Client sampling date / time					18-Jun-2020 00:00	18-Jun-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EB2016334-017	EB2016334-019	-----	-----	-----
				Result	Result		----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		0.77	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		1.2	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		1.2	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.07	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		205	----	----	----	----
∅ Total Cations	----	0.01	meq/L		196	----	----	----	----
∅ Ionic Balance	----	0.01	%		2.16	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF									
<i>Escherichia coli</i>	----	1	CFU/100mL		<10	----	----	----	----
MW023: Enterococci by Membrane Filtration									
<i>Enterococci</i>	----	1	CFU/100mL		<10	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2021333**
Client : **GILBERT & SUTHERLAND PTY LTD**
Contact : MS ERIN HOLTON
Address : P O BOX 4115
 ROBINA QLD, AUSTRALIA 4230
Telephone : +61 07 38523999
Project : 12035
Order number : ----
C-O-C number : ----
Sampler : MIAH CLAYTON
Site : ----
Quote number : EN/222
No. of samples received : 12
No. of samples analysed : 12

Page : 1 of 8
Laboratory : Environmental Division Brisbane
Contact : Carsten Emrich
Address : 2 Byth Street Stafford QLD Australia 4053

Telephone : +61 7 3552 8616
Date Samples Received : 13-Aug-2020 13:40
Date Analysis Commenced : 13-Aug-2020
Issue Date : 21-Aug-2020 14:39



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

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Luke Evans	Microbiologist	Brisbane Microbiological, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- EG020F (Dissolved Metals by ICP-MS): Limit of reporting raised for sample MB14a (EB2021333-003) due to matrix interference.
- EK057G (Nitrite as N) / EK071G (Reactive Phosphorus as P): Sample EB2021333_011 (MB18a) was diluted due to matrix interference. LOR adjusted accordingly.
- MF = membrane filtration
- CFU = colony forming unit
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- Ionic Balance out of acceptable limits for some samples due to analytes not quantified in this report.
- Microbiological Comment: Membrane filtration result is reported <2 CFU/100mL where 50mL sample was filtered because the sample was turbid, insufficient for filtration at higher volume and there were no target organisms confirmed.
- Microbiological Comment: Membrane filtration result is reported <10 CFU/100mL where 10mL sample was filtered because the sample was turbid, insufficient for filtration at higher volume and there were no target organisms confirmed.
- Microbiological Comment: Accordance with ALS work instruction, membrane filtration result for EB2021333-05 is estimated ~<1 where the sample was filtered at 100mL and the confirmed organisms are not detected but there are overgrown non-typical colonies on the filtered membrane that may have inhibited the growth of the target organisms. It may be informative to record this fact.
- Microbiological Comment: Accordance with ALS work instruction, membrane filtration result for EB2021333-07 is estimated ~<1 where the sample was filtered at 100mL and the target organisms are not detected but there are overgrown non-typical colonies on the filtered membrane that may have inhibited the growth of the target organisms. It may be informative to record this fact.
- EG020-F (Dissolved Metals by ICP-MS): Limit of reporting raised for sample MB13a (EB2021333-001) due to matrix interference.
- MW006 is ALS's internal code and is equivalent to AS4276.7.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time				12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2021333-001	EB2021333-002	EB2021333-003	EB2021333-004	EB2021333-005	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.38	7.59	7.22	7.55	7.63	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	28000	501	31800	510	24200	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	421	217	1070	207	1120	
Total Alkalinity as CaCO3	----	1	mg/L	421	217	1070	207	1120	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1490	3	2000	<1	2210	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	9960	23	10800	35	7930	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	468	83	184	83	197	
Magnesium	7439-95-4	1	mg/L	808	10	653	7	720	
Sodium	7440-23-5	1	mg/L	5950	19	6150	22	3980	
Potassium	7440-09-7	1	mg/L	171	4	162	1	159	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	4500	248	3150	236	3460	
^ Sodium Adsorption Ratio	----	0.01	-	38.6	0.52	47.7	0.62	29.4	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.05	<0.01	<0.05	<0.01	<0.01	
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.001	<0.005	<0.001	<0.001	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.4	0.8	0.6	0.1	0.4	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	8.73	0.38	23.4	0.41	12.7	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	0.05	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time					12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00
Compound	CAS Number	LOR	Unit		EB2021333-001	EB2021333-002	EB2021333-003	EB2021333-004	EB2021333-005
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	0.05	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		10.4	0.7	26.0	0.8	15.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		10.4	0.7	26.0	0.8	15.1
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.56	0.46	0.35	0.12	0.68
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	0.64
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		320	5.05	368	5.12	292
∅ Total Cations	----	0.01	meq/L		353	5.89	334	5.70	246
∅ Ionic Balance	----	0.01	%		4.85	7.74	4.71	5.33	8.51
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<2	<2	~22	<2	<1
<i>Escherichia coli</i>	----	1	CFU/100mL		<2	<2	<2	<2	<1

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time				12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2021333-006	EB2021333-007	EB2021333-008	EB2021333-009	EB2021333-010	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.66	7.69	7.51	7.80	7.84	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	3860	25000	592	13200	373	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	448	1100	219	824	171	
Total Alkalinity as CaCO3	----	1	mg/L	448	1100	219	824	171	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	360	1000	1	590	4	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	873	8550	50	4140	17	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	130	176	80	150	63	
Magnesium	7439-95-4	1	mg/L	123	660	12	355	4	
Sodium	7440-23-5	1	mg/L	506	4230	37	2190	21	
Potassium	7440-09-7	1	mg/L	43	154	4	92	<1	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	831	3160	249	1840	174	
^ Sodium Adsorption Ratio	----	0.01	-	7.64	32.8	1.02	22.2	0.69	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.7	0.4	0.7	0.6	0.2	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	1.97	16.8	0.70	7.20	0.22	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	0.01	<0.01	0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time					12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00	12-Aug-2020 00:00
Compound	CAS Number	LOR	Unit		EB2021333-006	EB2021333-007	EB2021333-008	EB2021333-009	EB2021333-010
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	0.01	<0.01	0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		3.1	20.1	1.1	8.9	0.4
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		3.1	20.1	1.1	8.9	0.4
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.63	1.66	1.06	0.56	0.13
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		0.22	1.42	<0.01	0.36	<0.01
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		41.1	284	5.81	146	3.98
∅ Total Cations	----	0.01	meq/L		39.7	251	6.69	134	4.39
∅ Ionic Balance	----	0.01	%		1.67	6.16	7.08	4.01	4.86
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<1	<1	<2	<1	<1
Escherichia coli	----	1	CFU/100mL		<1	<1	<2	<1	<1

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB18a	MB18b	----	----	----
Client sampling date / time				12-Aug-2020 00:00	12-Aug-2020 00:00	----	----	----	
Compound	CAS Number	LOR	Unit	EB2021333-011	EB2021333-012	-----	-----	-----	
				Result	Result	----	----	----	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.31	7.49	----	----	----	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	15000	424	----	----	----	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	755	193	----	----	----	
Total Alkalinity as CaCO3	----	1	mg/L	755	193	----	----	----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1730	<1	----	----	----	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	4600	23	----	----	----	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	414	68	----	----	----	
Magnesium	7439-95-4	1	mg/L	457	6	----	----	----	
Sodium	7440-23-5	1	mg/L	2380	17	----	----	----	
Potassium	7440-09-7	1	mg/L	91	4	----	----	----	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	2920	194	----	----	----	
^ Sodium Adsorption Ratio	----	0.01	-	19.2	0.53	----	----	----	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	----	----	----	
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.6	0.3	----	----	----	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	2.73	0.30	----	----	----	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.05	<0.01	----	----	----	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.05	<0.01	----	----	----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB18a	MB18b	----	----	----
Client sampling date / time					12-Aug-2020 00:00	12-Aug-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EB2021333-011	EB2021333-012	-----	-----	-----
				Result	Result		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		4.1	0.7	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		4.1	0.7	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.40	0.21	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.02	<0.01	----	----	----
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		181	4.50	----	----	----
∅ Total Cations	----	0.01	meq/L		164	4.73	----	----	----
∅ Ionic Balance	----	0.01	%		4.85	2.42	----	----	----
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<10	<2	----	----	----
<i>Escherichia coli</i>	----	1	CFU/100mL		<10	<2	----	----	----

CERTIFICATE OF ANALYSIS

Work Order : **EB2022705**
Client : **GILBERT & SUTHERLAND PTY LTD**
Contact : MS ERIN HOLTON
Address : P O BOX 4115
 ROBINA QLD, AUSTRALIA 4230
Telephone : +61 07 38523999
Project : 12035
Order number : ----
C-O-C number : ----
Sampler : MIAH CLAYTON
Site : ----
Quote number : EN/222
No. of samples received : 12
No. of samples analysed : 12

Page : 1 of 8
Laboratory : Environmental Division Brisbane
Contact : Carsten Emrich
Address : 2 Byth Street Stafford QLD Australia 4053

Telephone : +61 7 3552 8616
Date Samples Received : 28-Aug-2020 14:10
Date Analysis Commenced : 28-Aug-2020
Issue Date : 04-Sep-2020 18:07



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

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Anuththara Jayasuriya	Microbiologist	Brisbane Microbiological, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Santusha Pandra	Senior Chemist	Brisbane Inorganics, Stafford, QLD



General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- MF = membrane filtration
- CFU = colony forming unit
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- EG020-F (Dissolved Metals by ICP-MS): Limit of reporting raised for some samples due to matrix interference.
- MW006 is ALS's internal code and is equivalent to AS4276.7.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time				27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2022705-001	EB2022705-002	EB2022705-003	EB2022705-004	EB2022705-005	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.31	7.53	7.11	7.58	7.60	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	29500	490	31900	507	24000	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	423	231	1060	199	1140	
Total Alkalinity as CaCO3	----	1	mg/L	423	231	1060	199	1140	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1450	3	1940	<1	2100	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	10200	21	10900	34	8320	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	435	81	178	84	219	
Magnesium	7439-95-4	1	mg/L	756	9	820	7	959	
Sodium	7440-23-5	1	mg/L	5890	18	8170	21	5450	
Potassium	7440-09-7	1	mg/L	159	4	177	<1	192	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	4200	239	3820	238	4500	
^ Sodium Adsorption Ratio	----	0.01	-	39.5	0.51	57.5	0.59	35.4	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.05	<0.01	<0.05	<0.01	<0.05	
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.001	<0.005	<0.001	<0.005	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.06	<0.05	<0.05	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.3	0.8	0.5	0.1	0.4	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	8.24	0.40	21.4	0.38	12.6	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time					27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00
Compound	CAS Number	LOR	Unit		EB2022705-001	EB2022705-002	EB2022705-003	EB2022705-004	EB2022705-005
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		9.2	0.7	22.9	0.6	12.8
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		9.2	0.7	22.9	0.6	12.8
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.58	0.48	0.37	0.11	0.66
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	0.65
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		326	5.27	369	4.94	301
∅ Total Cations	----	0.01	meq/L		344	5.67	436	5.68	332
∅ Ionic Balance	----	0.01	%		2.66	3.64	8.35	7.03	4.84
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<1	<1	<1	<1	<1
<i>Escherichia coli</i>	----	1	CFU/100mL		<1	<1	<1	<1	<1

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time				27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2022705-006	EB2022705-007	EB2022705-008	EB2022705-009	EB2022705-010	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.58	7.68	7.37	7.70	7.75	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	3970	24200	615	12500	359	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	515	995	250	813	168	
Total Alkalinity as CaCO3	----	1	mg/L	515	995	250	813	168	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	340	915	<1	521	4	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	910	8860	55	4340	19	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	135	196	87	142	49	
Magnesium	7439-95-4	1	mg/L	134	863	11	379	4	
Sodium	7440-23-5	1	mg/L	567	5770	42	2350	18	
Potassium	7440-09-7	1	mg/L	45	186	4	90	<1	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	889	4040	262	1920	139	
^ Sodium Adsorption Ratio	----	0.01	-	8.27	39.5	1.13	23.4	0.66	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.05	<0.01	<0.01	<0.01	
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.005	<0.001	<0.001	<0.001	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.6	0.4	0.7	0.6	0.2	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	1.95	15.8	0.66	7.19	0.24	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time					27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00	27-Aug-2020 00:00
Compound	CAS Number	LOR	Unit		EB2022705-006	EB2022705-007	EB2022705-008	EB2022705-009	EB2022705-010
				Result	Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		2.5	17.4	0.8	7.6	0.4
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		2.5	17.4	0.8	7.6	0.4
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.58	1.35	1.06	0.56	0.13
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		0.19	1.18	<0.01	0.36	<0.01
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		43.0	289	6.55	150	3.98
∅ Total Cations	----	0.01	meq/L		43.6	336	7.18	143	3.56
∅ Ionic Balance	----	0.01	%		0.62	7.62	4.59	2.30	5.56
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<1	<1	<1	<1	<1
<i>Escherichia coli</i>	----	1	CFU/100mL		<1	<1	<1	<1	<1

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID		MB18a		MB18b		----		----		----		
Client sampling date / time				27-Aug-2020 00:00		27-Aug-2020 00:00		----		----		----		----		
Compound		CAS Number	LOR	Unit	EB2022705-011		EB2022705-012		-----		-----		-----		-----	
					Result		Result		----		----		----		----	
EA005P: pH by PC Titrator																
pH Value		----	0.01	pH Unit	7.21		7.47		----		----		----		----	
EA010P: Conductivity by PC Titrator																
Electrical Conductivity @ 25°C		----	1	µS/cm	14500		426		----		----		----		----	
ED037P: Alkalinity by PC Titrator																
Hydroxide Alkalinity as CaCO3		DMO-210-001	1	mg/L	<1		<1		----		----		----		----	
Carbonate Alkalinity as CaCO3		3812-32-6	1	mg/L	<1		<1		----		----		----		----	
Bicarbonate Alkalinity as CaCO3		71-52-3	1	mg/L	752		197		----		----		----		----	
Total Alkalinity as CaCO3		----	1	mg/L	752		197		----		----		----		----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA																
Sulfate as SO4 - Turbidimetric		14808-79-8	1	mg/L	1680		<1		----		----		----		----	
ED045G: Chloride by Discrete Analyser																
Chloride		16887-00-6	1	mg/L	4780		21		----		----		----		----	
ED093F: Dissolved Major Cations																
Calcium		7440-70-2	1	mg/L	415		71		----		----		----		----	
Magnesium		7439-95-4	1	mg/L	505		6		----		----		----		----	
Sodium		7440-23-5	1	mg/L	2620		16		----		----		----		----	
Potassium		7440-09-7	1	mg/L	90		4		----		----		----		----	
ED093F: SAR and Hardness Calculations																
Total Hardness as CaCO3		----	1	mg/L	3120		202		----		----		----		----	
^ Sodium Adsorption Ratio		----	0.01	-	20.4		0.49		----		----		----		----	
EG020F: Dissolved Metals by ICP-MS																
Aluminium		7429-90-5	0.01	mg/L	<0.01		<0.01		----		----		----		----	
Arsenic		7440-38-2	0.001	mg/L	<0.001		<0.001		----		----		----		----	
Iron		7439-89-6	0.05	mg/L	<0.05		<0.05		----		----		----		----	
EK040P: Fluoride by PC Titrator																
Fluoride		16984-48-8	0.1	mg/L	0.6		0.3		----		----		----		----	
EK055G: Ammonia as N by Discrete Analyser																
Ammonia as N		7664-41-7	0.01	mg/L	2.72		0.31		----		----		----		----	
EK057G: Nitrite as N by Discrete Analyser																
Nitrite as N		14797-65-0	0.01	mg/L	<0.01		<0.01		----		----		----		----	
EK058G: Nitrate as N by Discrete Analyser																
Nitrate as N		14797-55-8	0.01	mg/L	<0.01		<0.01		----		----		----		----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser																

CERTIFICATE OF ANALYSIS

Work Order : **EB2024052**
Client : **GILBERT & SUTHERLAND PTY LTD**
Contact : MS ERIN HOLTON
Address : P O BOX 4115
 ROBINA QLD, AUSTRALIA 4230
Telephone : +61 07 38523999
Project : 12035
Order number : ----
C-O-C number : ----
Sampler : MIAH CLAYTON
Site : ----
Quote number : EN/222
No. of samples received : 12
No. of samples analysed : 12

Page : 1 of 8
Laboratory : Environmental Division Brisbane
Contact : Carsten Emrich
Address : 2 Byth Street Stafford QLD Australia 4053

Telephone : +61 7 3552 8616
Date Samples Received : 11-Sep-2020 14:00
Date Analysis Commenced : 11-Sep-2020
Issue Date : 18-Sep-2020 16:16



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

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Luke Evans	Microbiologist	Brisbane Microbiological, Stafford, QLD



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The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

Ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- MF = membrane filtration
- CFU = colony forming unit
- Microbiological Comment: In accordance with ALS work instruction QWI-MIC/04, membrane filtration result is reported an approximate (~) when the count of colonies on the filtered membrane is outside the range of 10 - 100cfu.
- Microbiological Comment: Membrane filtration result is reported <2 CFU/100mL where 50mL sample was filtered because the sample was turbid, insufficient for filtration at higher volume and there were no target organisms confirmed.
- Microbiological Comment: Membrane filtration result is reported <10 CFU/100mL where 10mL sample was filtered because the sample was turbid, insufficient for filtration at higher volume and there were no target organisms confirmed.
- EG020-F (Dissolved Metals by ICP-MS): Limit of reporting raised for samples MB13a (EB2024052-001) and MB14a (EB2024052-003) due to matrix interference.
- MW006 is ALS's internal code and is equivalent to AS4276.7.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time				10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2024052-001	EB2024052-002	EB2024052-003	EB2024052-004	EB2024052-005	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.21	7.41	7.01	7.40	7.49	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	29300	471	32200	504	24800	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	431	227	977	209	1110	
Total Alkalinity as CaCO3	----	1	mg/L	431	227	977	209	1110	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1380	3	1840	<1	1940	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	10200	21	10800	35	7940	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	436	72	158	75	210	
Magnesium	7439-95-4	1	mg/L	756	9	698	7	845	
Sodium	7440-23-5	1	mg/L	5660	16	6800	19	4380	
Potassium	7440-09-7	1	mg/L	152	4	150	<1	161	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	4200	217	3270	216	4000	
^ Sodium Adsorption Ratio	----	0.01	-	38.0	0.47	51.7	0.56	30.1	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.05	<0.01	<0.05	<0.01	<0.01	
Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.001	<0.005	<0.001	<0.001	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.3	0.8	0.5	0.1	0.4	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	8.37	0.37	20.3	0.34	12.1	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB13a	MB13b	MB14a	MB14b	MB15a
Client sampling date / time					10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00
Compound	CAS Number	LOR	Unit		EB2024052-001	EB2024052-002	EB2024052-003	EB2024052-004	EB2024052-005
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		9.3	0.7	23.5	0.6	13.0
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		9.3	0.7	23.5	0.6	13.0
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.51	0.43	0.32	0.11	0.62
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	0.62
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		325	5.19	362	5.16	286
∅ Total Cations	----	0.01	meq/L		334	5.13	365	5.14	275
∅ Ionic Balance	----	0.01	%		1.36	0.57	0.34	0.17	2.12
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<2	<2	<2	<2	<1
<i>Escherichia coli</i>	----	1	CFU/100mL		<2	<2	<2	<2	<1

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time				10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	
Compound	CAS Number	LOR	Unit	EB2024052-006	EB2024052-007	EB2024052-008	EB2024052-009	EB2024052-010	
				Result	Result	Result	Result	Result	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.48	7.56	7.31	7.63	7.68	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	4100	25900	636	13300	357	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	493	1070	244	794	162	
Total Alkalinity as CaCO3	----	1	mg/L	493	1070	244	794	162	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	343	890	<1	523	3	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	922	8820	58	4180	18	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	124	189	75	136	51	
Magnesium	7439-95-4	1	mg/L	130	775	11	383	4	
Sodium	7440-23-5	1	mg/L	549	4890	38	2380	18	
Potassium	7440-09-7	1	mg/L	41	160	4	88	<1	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	845	3660	232	1920	144	
^ Sodium Adsorption Ratio	----	0.01	-	8.22	35.2	1.08	23.6	0.65	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	0.001	<0.001	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.7	0.4	0.7	0.6	0.1	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	1.95	15.8	0.64	7.52	0.22	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB15b	MB16a	MB16b	MB17a	MB17b
Client sampling date / time					10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00	10-Sep-2020 00:00
Compound	CAS Number	LOR	Unit		EB2024052-006	EB2024052-007	EB2024052-008	EB2024052-009	EB2024052-010
					Result	Result	Result	Result	Result
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		2.5	17.3	0.9	8.3	0.3
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		2.5	17.3	0.9	8.3	0.3
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.56	1.31	0.97	0.56	0.13
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		0.18	1.17	<0.01	0.35	<0.01
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		43.0	289	6.51	145	3.81
∅ Total Cations	----	0.01	meq/L		41.8	290	6.40	144	3.66
∅ Ionic Balance	----	0.01	%		1.40	0.22	0.84	0.20	2.01
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<1	<1	<1	<1	<1
<i>Escherichia coli</i>	----	1	CFU/100mL		<1	<1	<1	<1	<1

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB18a	MB18b	----	----	----
Client sampling date / time				10-Sep-2020 00:00	10-Sep-2020 00:00	----	----	----	
Compound	CAS Number	LOR	Unit	EB2024052-011	EB2024052-012	-----	-----	-----	
				Result	Result	----	----	----	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	7.16	7.37	----	----	----	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	15500	412	----	----	----	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	734	192	----	----	----	
Total Alkalinity as CaCO3	----	1	mg/L	734	192	----	----	----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	1620	<1	----	----	----	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	4670	20	----	----	----	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	402	62	----	----	----	
Magnesium	7439-95-4	1	mg/L	508	6	----	----	----	
Sodium	7440-23-5	1	mg/L	2620	14	----	----	----	
Potassium	7440-09-7	1	mg/L	87	3	----	----	----	
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L	3100	180	----	----	----	
^ Sodium Adsorption Ratio	----	0.01	-	20.5	0.45	----	----	----	
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	----	----	----	
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----	
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	0.6	0.3	----	----	----	
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L	2.91	0.29	----	----	----	
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----	
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	----	----	----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB18a	MB18b	----	----	----
Client sampling date / time					10-Sep-2020 00:00	10-Sep-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EB2024052-011	EB2024052-012	-----	-----	-----
				Result	Result		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		3.8	0.7	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		3.8	0.7	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.46	0.22	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	----	----	----
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		180	4.40	----	----	----
∅ Total Cations	----	0.01	meq/L		178	4.27	----	----	----
∅ Ionic Balance	----	0.01	%		0.58	1.46	----	----	----
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<10	<10	----	----	----
<i>Escherichia coli</i>	----	1	CFU/100mL		<10	<10	----	----	----



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	MB18a	MB18b	----	----	----
Client sampling date / time					27-Aug-2020 00:00	27-Aug-2020 00:00	----	----	----
Compound	CAS Number	LOR	Unit		EB2022705-011	EB2022705-012	-----	-----	-----
				Result	Result		----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		3.6	0.8	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		3.6	0.8	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		0.41	0.22	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	----	----	----
EN055: Ionic Balance									
∅ Total Anions	----	0.01	meq/L		185	4.53	----	----	----
∅ Total Cations	----	0.01	meq/L		178	4.83	----	----	----
∅ Ionic Balance	----	0.01	%		1.73	3.27	----	----	----
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<1	<1	----	----	----
<i>Escherichia coli</i>	----	1	CFU/100mL		<1	<1	----	----	----

14 Appendix 6 – Cook's Method

Cook's method²⁷ is based on the chloride balance between the rainfall and the groundwater. The proportion of groundwater recharge in excess of the landscape environmental requirements is reflected by the ratio between the rainfall chloride concentration and the ground water chloride concentration. The general formula is:

$$G = (P \cdot C_p) - (R \cdot C_p) \quad C_g$$

Where:

G = ground water recharge (mm)

P = precipitation (mm)

R = run-off (mm)

C_p = Chloride conc. of rainfall (mg L⁻¹)

C_g = Chloride conc. of groundwater (mg L⁻¹)

Within the site, spatial variability of the Chloride concentrations may have impact on the distribution of recharge on the site (Cook 1989 and de Silva 2004).

The associations between the Chloride concentration of the groundwater was assessed by paired comparisons of the bore data using Mann-Whitney U-test²⁸ for small sample populations. The degree of association between the bore data was identified and the recharge calculated separately for each spatial association.

The estimate of rainfall Cl⁻ concentration was determined from three sources. First was data from sampling of a rainfall event at Robina. The sample site was within 5km of the ocean and 25km from the site. The rain was collected and sent to a laboratory for analysis of major anions and cations.

The second estimate was based on the work by Biggs 2004²⁹ who measured the chloride concentrations in rainfall at various locations throughout southern Queensland. Biggs developed a mathematical description based on a Power function ($y = ax^c$) of the relationship between rainfall chloride load and distance from the sea. Whilst noting that these types of equations are extremely unreliable, a quadratic equation³⁰ was developed to describe expected rainfall Cl⁻ concentration using the inputs of mean data from Biggs work and distance from the sea. The intercept of this equation was 5.28 mg Cl⁻ L⁻¹ (95% confidence interval + 0.95 mg Cl⁻ L⁻¹).

Although the derivation of the quadratic mathematical description from this data set was not the intent of the original researcher, in the absence of any other data it is reasonable to use this information to inform the estimate of the expected rainfall Chloride concentration.

²⁷ Cook P. G., Walker, G. R. and Jolly, I. D., (1989). Spatial Variability of Groundwater Recharge in a Semi-Arid Region. *Journal of Hydrology*, 111: 195-212, de Silva R.P. 2004 Spatial Variability of Groundwater Recharge - I. Is it really variable? *Journal of Spatial Hydrology* Vol.4, No.1 Fall 2004.

²⁸ Runyon R.P. and Haber A 1984 Fundamentals of behavioural statistics. Newbery Awards Records, inc. New York USA. pp376-380 Table I4 page 434.

²⁹ Biggs A.J.W. 2004 Rainfall salt loads in southern Queensland, Australia Proceedings ISCO 2004 - 13th International Soil Conservation Organisation Conference – Brisbane, July 2004. Conserving Soil and Water for Society: Sharing Solutions Paper No. 680.

³⁰ $Y = 2 \times 10^{-5} X^2 - 0.0171X + 5.28$ ($R^2 = 0.5666$, standard error of the estimate = 0.8) where Y = expected rainfall Cl⁻ concentration mg L⁻¹ and X = distance from mean high water in kilometres.

The final source of the rainfall Chloride concentration estimate was derived from laboratory analysis of water quality from a freshwater spear pump bore in the frontal dune at Burleigh Heads, Queensland.

The water analysis indicated the Cl^- concentration of the freshwater lens (above the salt water table) was $7.1 \text{ mg Cl}^- \text{ L}^{-1}$. The only source of recharge is rainfall and this chloride concentration suggests that the rainfall concentration is some number less than 7.1 .

Based on these data the boundaries for analysis of potential recharge may be derived, in this case³¹ 3.01 to $6.0 \text{ mg Cl}^- \text{ L}^{-1}$.

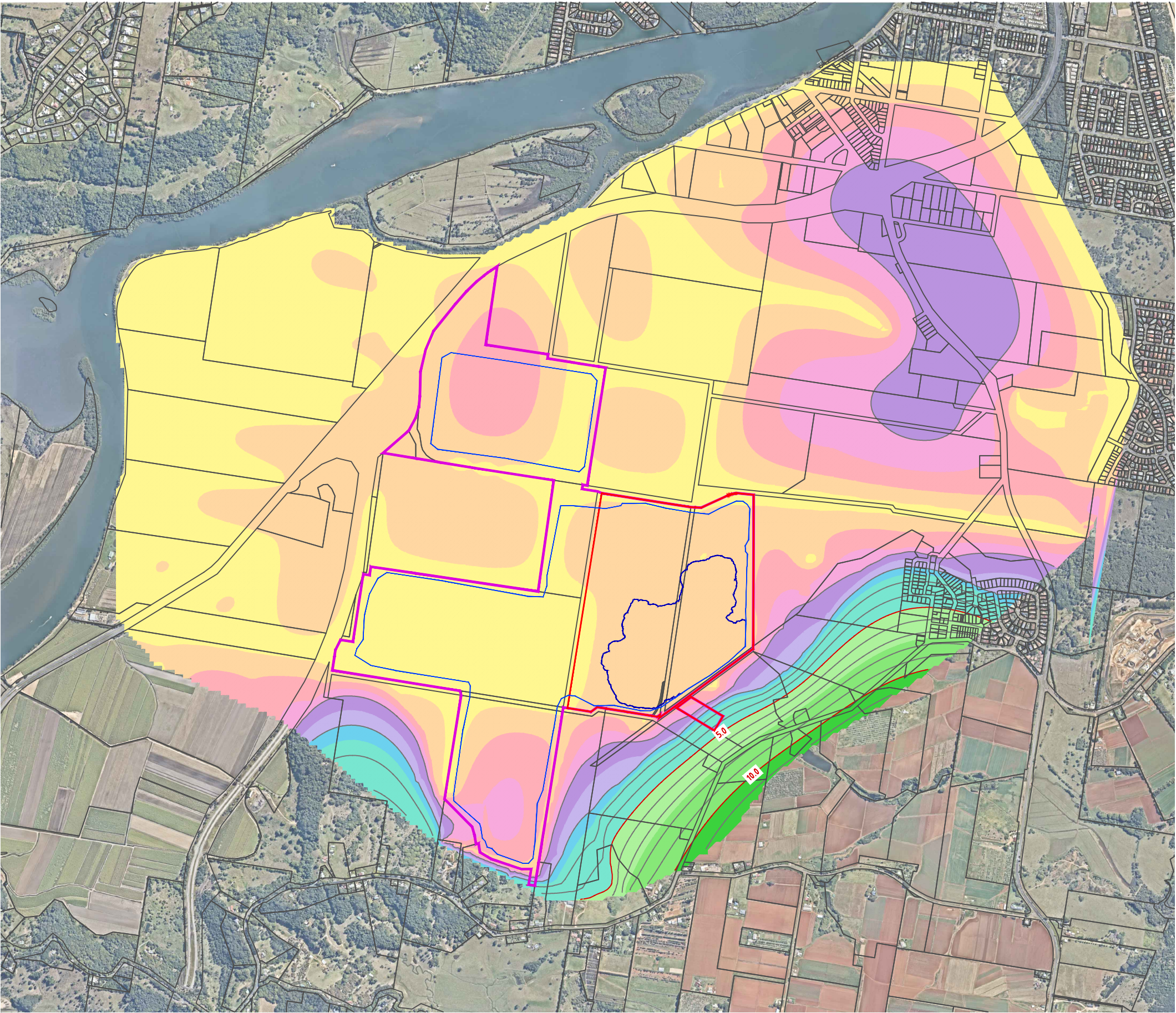
The run-off component of the recharge estimate equation was estimated at 0.1 based on the runoff yield estimates by Nelson (2000)³² and Burton and Freitz (1969)³³.¹⁷

³¹ This upper value corresponds to the estimate using Briggs data for a site 3 km from the sea (5.2) plus the standard error of 0.8 to give a maximum of $6.0 \text{ mg Cl}^- \text{ L}^{-1}$.

³² Nelson, K.D., 1985, *Design and Construction of Small Earth Dams*, Inkata Press, Melb, Vic, pp8-10.

³³ Burton, John R and Fietz, T. R. 1969 Water storage on the farm : a manual of design, construction and operation for Australian conditions. Bulletin (Water Research Foundation of Australia), no.9, Table 7.2.

15 Appendix 7 – Groundwater modelling results



Groundwater elevation		
Minimum Elevation (mAHD)	Maximum Elevation (mAHD)	Color
-1.000	0.000	
0.000	0.250	
0.250	0.500	
0.500	0.750	
0.750	1.000	
1.000	1.500	
1.500	2.000	
2.000	2.500	
2.500	5.000	
5.000	7.500	
7.500	10.000	
10.000	24.500	



ORIENTATION

SCALE

200 400 600 800 1000 metres

ROBINA

PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs www.access.gs

LEGEND

Cadastral boundaries

Site boundary - Existing

Site boundary - Expansion area

Lake boundary - Existing

Lake boundary - Ultimate expansion area

SOURCES

Image: Nearmap image dated 14 September 2020.
Cadastral: NSW Six Maps, sourced 23 November 2020.

PROJECT

TWEED SAND PLANT EXPANSION

CLIENT

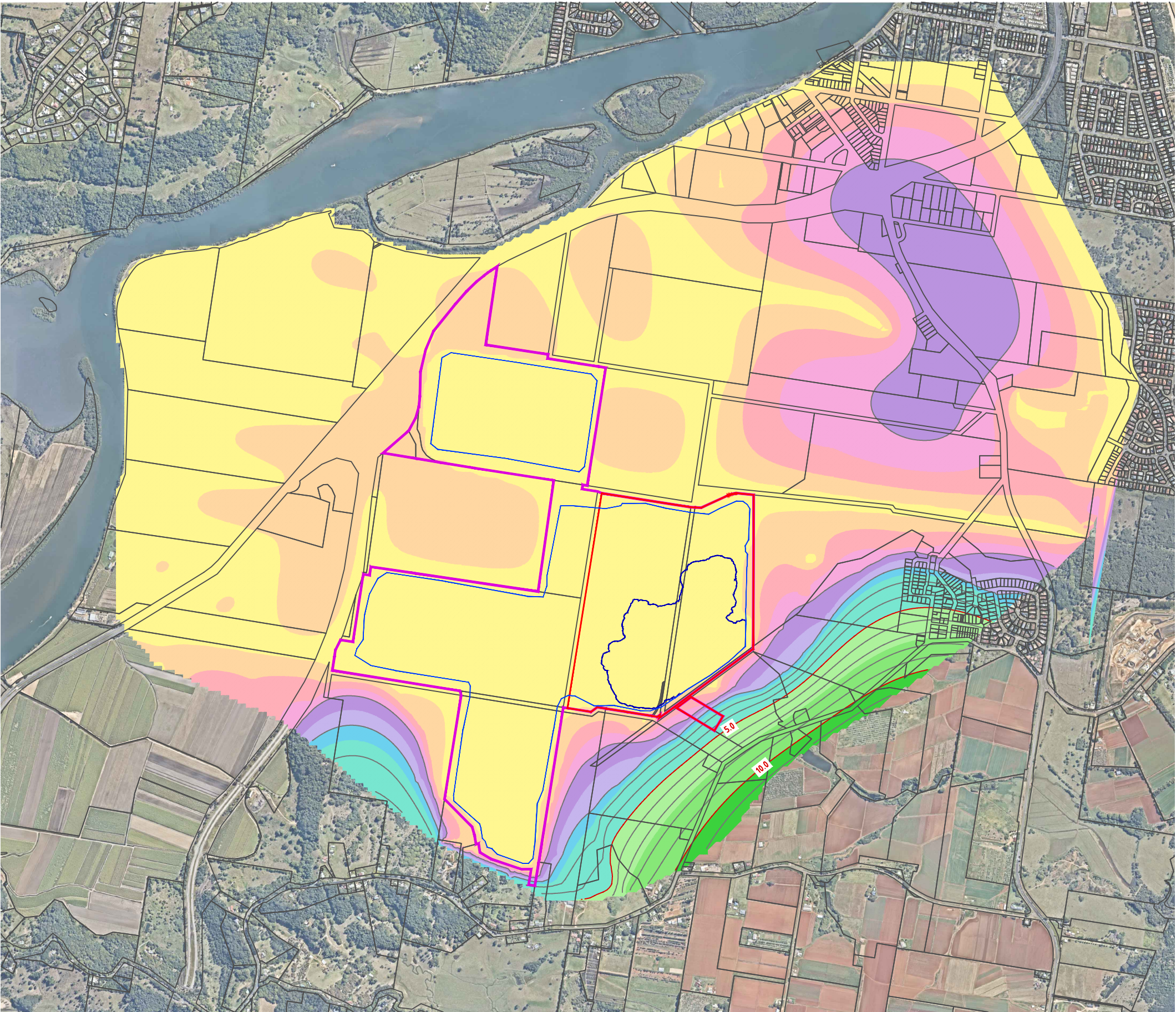
HANSON CONSTRUCTION MATERIALS

DRAWING

MODELLED EXISTING GROUNDWATER CONDITIONS

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:20 000@A3	15/12/2020	AJF	CMA	12035	510	-





Groundwater elevation		
Minimum Elevation (mAHD)	Maximum Elevation (mAHD)	Color
-1.000	0.000	
0.000	0.250	
0.250	0.500	
0.500	0.750	
0.750	1.000	
1.000	1.500	
1.500	2.000	
2.000	2.500	
2.500	5.000	
5.000	7.500	
7.500	10.000	
10.000	24.500	



ORIENTATION

SCALE

200 400 600 800 1000 metres

ROBINA

PO Box 4115 Robina QLD4230 07 5578 9944
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LEGEND

Cadastral boundaries

Site boundary - Existing

Site boundary - Expansion area

Lake boundary - Existing

Lake boundary - Ultimate expansion area

SOURCES

Image: Nearmap image dated 14 September 2020.
Cadastral: NSW Six Maps, sourced 23 November 2020.

PROJECT

TWEED SAND PLANT EXPANSION

CLIENT

HANSON CONSTRUCTION MATERIALS

SCALE

1:20 000@A3

DATE

15/12/2020

DRAWN

AJF

CHECKED

CMA

DRAWING

MODELLED POST DEVELOPMENT GROUNDWATER CONDITIONS

PROJECT

12035

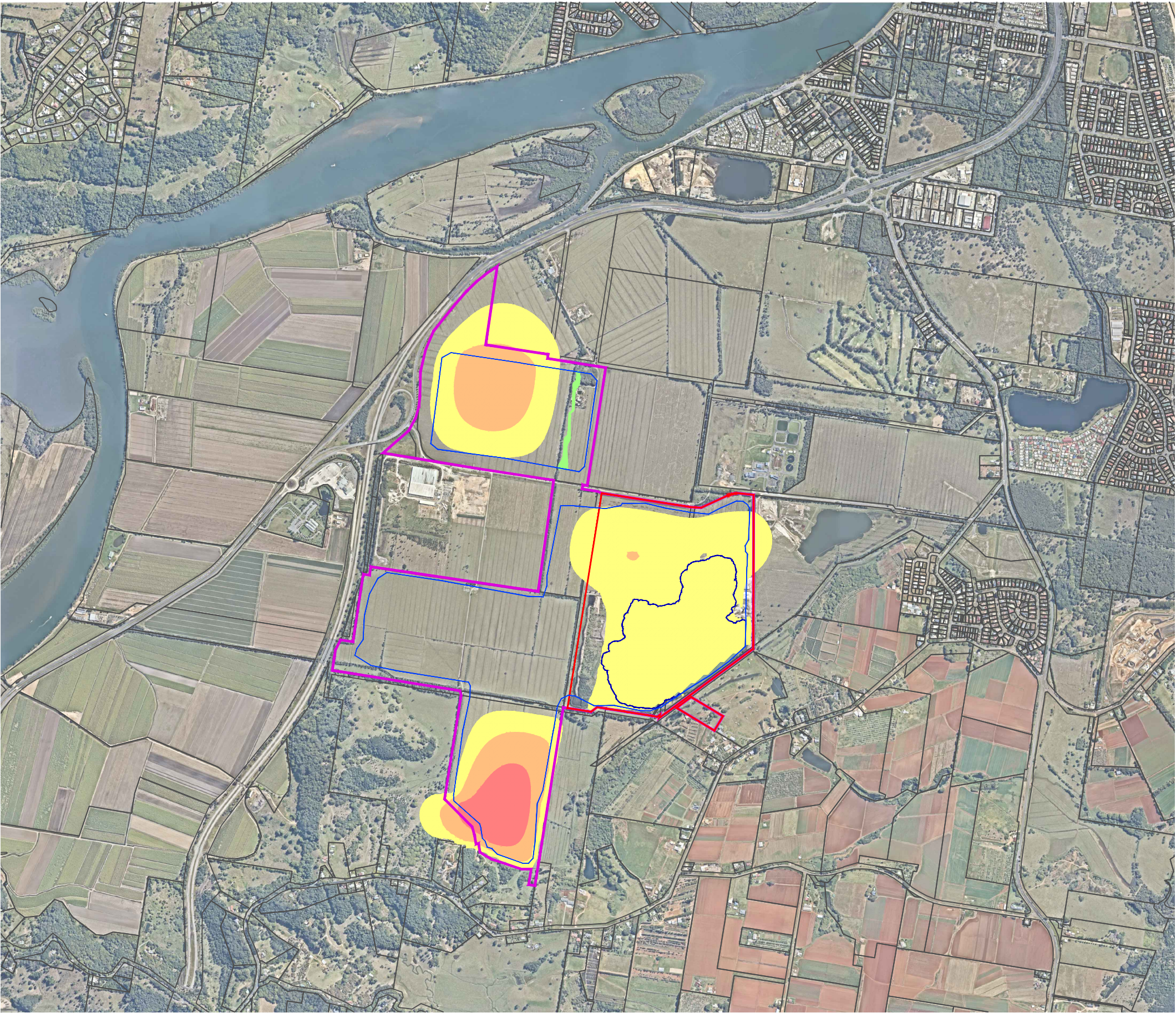
DRAWING

511

REVISION

-





Change in groundwater elevation		
Minimum change (m)	Maximum change (m)	Color
-1.000	-0.500	
-0.500	-0.300	
-0.300	-0.100	
0.100	0.500	
0.500	1.000	



ORIENTATION

SCALE

200 400 600 800 1000 metres

ROBINA

PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs www.access.gs

LEGEND

Cadastral boundaries

Site boundary - Existing

Site boundary - Expansion area

Lake boundary - Existing

Lake boundary - Ultimate expansion area

SOURCES

Image: Nearmap image dated 14 September 2020.

Cadastral: NSW Six Maps, sourced 23 November 2020.

PROJECT

TWEED SAND PLANT EXPANSION

CLIENT

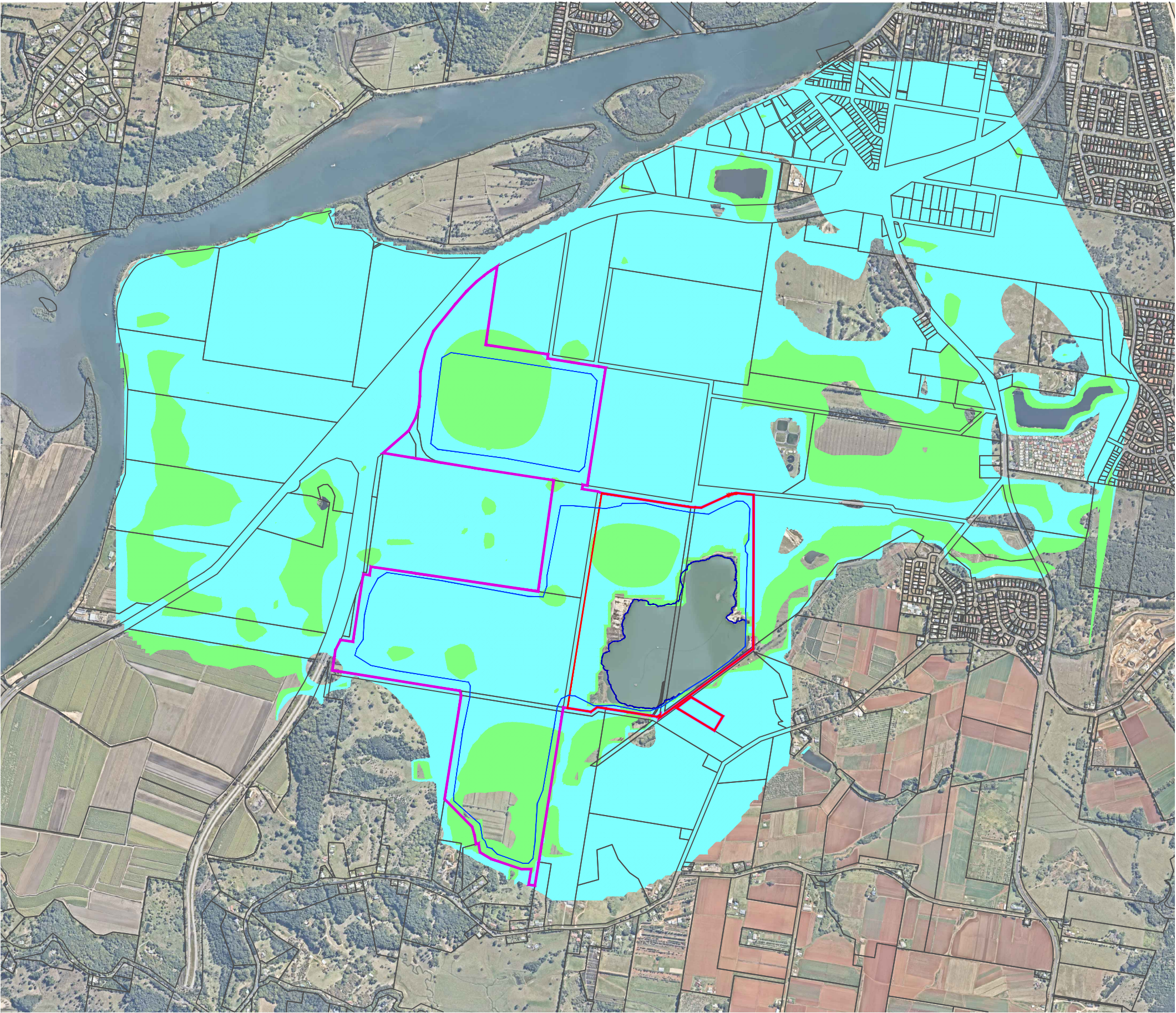
HANSON CONSTRUCTION MATERIALS

DRAWING

CHANGE IN MODELLED GROUNDWATER ELEVATION (EXISTING TO DEVELOPED SITE CONDITIONS)

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:20 000@A3	15/12/2020	AJF	CMA	12035	512	-





Change in groundwater elevation		
Minimum change (m)	Maximum change (m)	Color
-1.000	-0.500	
-0.500	-0.300	
-0.300	-0.100	
0.100	0.500	
0.500	1.000	



ORIENTATION

SCALE

200 400 600 800 1000 metres

ROBINA

PO Box 4115 Robina QLD4230 07 5578 9944
Email robina@access.gs www.access.gs

LEGEND

Cadastral boundaries

Site boundary - Existing

Site boundary - Expansion area

Lake boundary - Existing

Lake boundary - Ultimate expansion area

SOURCES

Image: Nearmap image dated 14 September 2020.
Cadastral: NSW Six Maps, sourced 23 November 2020.

PROJECT

TWEED SAND PLANT EXPANSION

CLIENT

HANSON CONSTRUCTION MATERIALS

DRAWING

CHANGE IN GROUNDWATER ELEVATION (EXISTING SITE TO DEVELOPED SITE WITH 0.9m SEA LEVEL RISE)

SCALE	DATE	DRAWN	CHECKED	PROJECT	DRAWING	REVISION
1:20 000@A3	15/12/2020	AJF	CMA	12035	513	-



16 Appendix 8 – Groundwater volumetric allocation

Appendix 8 - Groundwater volumes for licencing**Groundwater take due to extraction of sand**

Annual extraction (tonnes)	Insitu Bulk density	Cubic metres	Fines (returned to lake) m3	Balance extracted (m3)	Assuming Porosity (30%)	ML
950000	1.95	487179.49	31666.67	455512.82	318858.97	318.86

Groundwater entrained in product

Annual extraction (tonnes)	Dry density of sand	Dry cubic metres	Retained water (%)	Retained water (KL)	Retained water (ML)
950000	1.99	477386.9347	0.03	14321.60804	14.32

Groundwater take for dust suppression

Current workings indicate 27KL of water used for dust suppression/day. Based on 254 working days per year.

Daily	Annual	ML
27000	6858000	6.858

	ML
Total required	340.04