BORAL RESOURCES (NSW) PTY LTD

ABN: 51 000 756 507

2023 Annual Environmental Management Report

Stockton Transgressive Dune Quarry

Prepared by:

RWCorkery&co

April 2024

ACKNOWLEDGEMENT

R.W. Corkery & Co. acknowledge and pay our respects to the Traditional Custodians of the lands in NSW and Australia on which our projects are located. We value the knowledge, advice and involvement of the Elders and extended Aboriginal community that contribute to our Projects and extend our respect to all Aboriginal and Torres Strait Islander peoples.

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2023 Annual Environmental Management Report

Stockton Transgressive Dune Quarry

Period: 1 January 2023 to 31 December 2023

Prepared for:

Boral Resources (NSW) Pty Ltd
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ORANGE NSW 2800

Ref No. 822/14 April 2024

RWCorkery&co

Table 1
Title Block

Name of operation	Stockton Transgressive Dune Quarry
Name of operator	Boral Resources (NSW) Pty Ltd
Development consent / project approval #	DA 140-6-2005
Name of holder of development consent / project approval	Boral Resources (NSW) Pty Ltd
Water licence #	Groundwater Licence 20BL171772
Name of holder of water licence	Boral Resources (NSW) Pty Ltd
AEMR start date	1 January 2023
AEMR end date	31 December 2023
I, Rod Johnson, certify that this audit report is a true and accurate record of the compliance status of the Stockton Transgressive Dune Quarry for the period 1 January 2023 to 31 December 2023 and that I am authorised to make this statement of behalf of Boral Resources (NSW) Pty Ltd. *Note.* *a) The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.* *b) The Crimes Act 1900 contains other offences relating to false and misleading information: Section 192G (Intention to defraud by false or misleading statement – maximum penalty 5 years imprisonment); Section 307A, 307B and 307C (false or misleading application/information/documents – maximum penalty 2 years imprisonment or $22,000, or both).*	
Name of authorised reporting officer	Rod Johnson
Title of authorised reporting officer	Quarry Manager
Signature of authorised reporting officer	
Date	3 April 2024

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LIST OF ACRONYMS

AEMR	Annual Environmental Management Review
ANZECC	Australia and New Zealand Environment and Conservation Council
BTEX	Benzene, toluene, ethylbenzene and xylene
DA	Development Application
DPE	Department of Planning and Environment
DPIE	Department of Planning, Industry and Environment
dB(A)	A-weighted decibels
EC	Electrical Conductivity
ECS	Environmental Management Strategy
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EPL	Environment Protection Licence
EPP	Environmental Permit Planner
GDE	Groundwater Dependent Ecosystem
GWMP	Groundwater Management Plan
HLM	Hunter Land Management
MDL	Mineral Deposit Limited
NSW	New South Wales
RLMP	Rehabilitation and Landscape Management Plan
RWC	R.W. Corkery & Co. Pty Limited
TARP	Trigger Action Response Plan
TPH	Total Petroleum Hydrocarbons
WAL	Water Access Licence

1. Statement of Compliance

Table 2
Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	Yes / No
DA 140-6-2005	No
EPL 10132	Yes

Table 3
Non-compliances

Relevant Approval	Condition #	Condition Description (summary)	Compliance Status	Comment	Where Addressed in Annual Review
DA 140-6-2005	Schedule 2 Condition 2	The Applicant shall carry out the development generally in accordance with DA-140-6-2005	Low Risk	This condition relates to general compliance with requirements described in DA 140-6-2005, the EIS for the operation and associated documents. Due to the non-compliances with Condition 12 of Schedule 3 of DA 140-6-2005, the operation does not comply with the condition.	9.1.1, 9.1.2
DA 140-6-2005	Schedule 3 Condition 12	Requirement to implement a Groundwater Monitoring Program in accordance with the approved plan.	Low Risk	Aspects of the groundwater and surface water monitoring program were not undertaken in accordance with GWMP.	9.1.1 and 9.2.1

Compliance Status Key

Risk level	*Colour code*	*Description*
High	*Non-compliant*	*Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence.*
Medium	*Non-compliant*	*Non-compliance with:* • *potential for serious environmental consequences, but is unlikely to occur; or* • *potential for moderate environmental consequences, but is likely to occur.*
Low	*Non-compliant*	*Non-compliance with:* • *potential for moderate environmental consequences, but is unlikely to occur; or* • *potential for low environmental consequences, but is likely to occur.*
Administrative non-compliance	*Non-compliant*	*Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions).*

2. Introduction

2.1 Scope and Format

The Stockton Transgressive Dune Quarry ("Stockton Quarry") is owned and operated by Boral Resources (NSW) Pty Ltd ("Boral") and is located east of Fullerton Cove, approximately 9km northeast of Newcastle (see **Figure 1**). Development Consent DA 140-6-2005 (DA 140-6-2005) was granted on 24 January 2006 to permit extraction of sand from the active dune system within Pit 7 (see **Figure 2**), an area historically mined by Mineral Deposits Limited (MDL). Boral continues to take responsibility for revegetation and maintenance of the former Quarry Site (Pits 1-6 in **Figure 2**).

This *Annual Environmental Management Report* (AEMR) has been compiled by R.W. Corkery & Co. Pty Limited (RWC) on behalf of Boral Resources (NSW) Pty Ltd ("Boral"). This report is applicable for the period 1 January 2023 to 31 December 2023 ("the reporting period"). The information presented within this AEMR has been prepared based on information provided by Boral and observations made during a site visit on 14 February 2024.

It should be noted that this AEMR has been prepared based upon the approval and licencing requirements applicable for the reporting period, however, the report generally follows the format and content requirements identified in the *Annual Review Guideline* dated October 2015.

This AEMR has been prepared in accordance with *Condition 4(3)* of Development Consent 140-6-2005 to record the activities and environmental monitoring undertaken within the Stockton Quarry during the reporting period and to outline the activities and environmental monitoring planned throughout the next reporting period (1 January 2024 to 31 December 2024). *Condition 4(3)* requires the preparation of a report that:

- identifies the standards and performance measures that apply to the development (see Section 3 and Section 7);
- describes the works carried out throughout the last 12 months (see Section 5);
- describes the works that will be carried out throughout the next 12 months (Section 12);
- includes a summary of the complaints received during the past year, and compares this to the complaints received in previous years (see Section 11.2);
- includes a summary of the monitoring results for the development during the past year (see Section 8, Section 9 and Section 10);
- includes an analysis of these monitoring results against the relevant:
  - *impact assessment criteria;*
  - *monitoring results from previous years; and*
  - *predictions in the EIS.*

  (see Sections 8 and Section 9);

Figure 1
LOCALITY PLAN

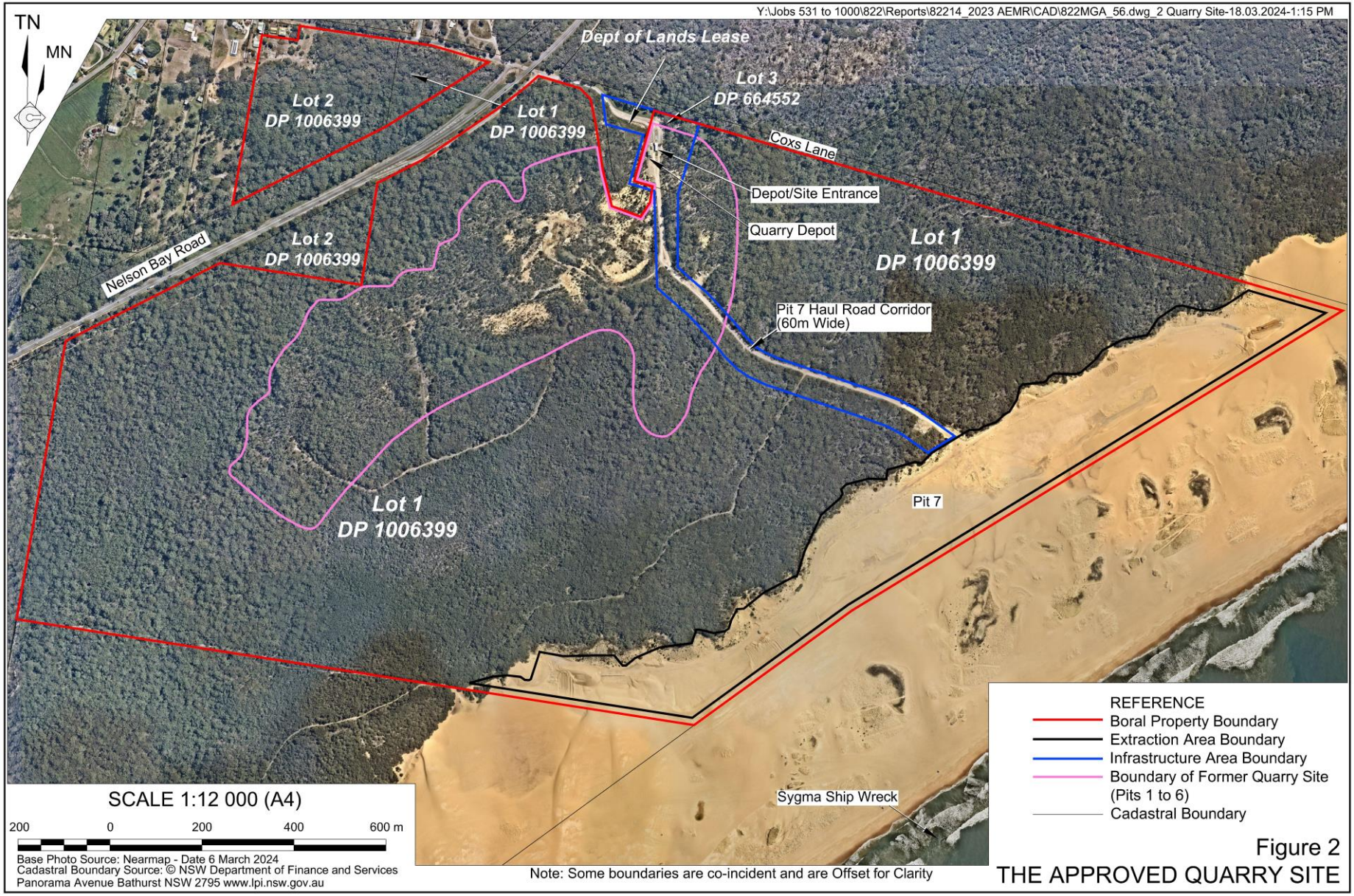


Figure 2
THE APPROVED QUARRY SITE

- identifies any trends in the monitoring results over the life of the development to date (see Sections 8 and Section 9);
- identifies any non-compliance(s) during the previous year (see Section 1, Section 11 and **Appendix 1**); and
- describes what actions were, or are, being taken to ensure future compliance (see Section 11).

2.2 Key Personnel Contact Details

The key personnel contact names, positions and phone numbers are as follows.

Name	Position	24 Hour Contact
Mr Rod Johnson	Quarry Manager	0401 896 198

2.3 Management of Document Preparation

This report has been prepared by Ms Leilani Banerjee, (B.Sc (Earth Sciences); M EnvSci & Sustainability) Environmental Consultant with R.W. Corkery & Co Pty. Limited, and was peer reviewed by Mr Caiden O'Connor, (B.Sc. (Geology)) Senior Environmental Consultant, with the same Company.

On behalf of Boral, Mr Rod Johnson supplied documentation and information for review and inclusion within the report.

Mr Ben Rose, Associate Hydrogeologist at Jacobs, prepared the annual Groundwater Monitoring Review (included as **Appendix 2**).

3. Existing Approvals

Boral is required to operate the Stockton Quarry in accordance with a development consent and four licences, listed in **Table 4**.

Table 4
Stockton Transgressive Dune Quarry – Approvals and Licences

Consent/Lease/Licence	Issue Date	Expiry Date
Development Consent 140-6-2005	24/01/2006	15/10/2028#
Environment Protection Licence No 10132	13/07/2007*	1 December+
Crown Land Licence No. LI 196915	08/11/1994	Termination date not specified
Bore Licence 20 BL 171772	04/03/2008	In Perpetuity
Water Access Licences 20AL213136 20AL220991 20AL221243 20AL221416		

\# Provides for "20 years after the date operations commence" – Condition 2(5)
* Date Received
\+ Anniversary Date

No modifications or variations to the development consent or licences outlined in **Table 4** were obtained within the reporting period.

Table 5 outlines the sections within this document that address the conditional requirements under Development Consent 140-6-2005 *Condition 4(3)* regarding annual reporting.

Boral operates the Stockton Quarry in accordance with Environment Protection Licence (EPL) 10132. This licence incorporates standard conditions for extractive industries and includes a limit for noise emissions from Quarry operations (see Section 8.1).

A development application (SSD-9490) to permit extraction of sand from inland dunes within the Boral property using free dig and dredging methods was publicly exhibited between 13 March 2020 and 9 April 2020. That application is separate to the wind-blown sand extraction activities permitted under DA 140-6-2005 with product despatch and associated transportation activities the only components that would require combined limitations. At the time of finalising this report, that application was yet to be determined.

Due to the ongoing delay in resolving outstanding water matters relating to SSD-9490, Boral determined that an interim application would be required to maintain extraction operations. A separate development application (SSD-52984213) to extract the remaining dry sand resource by free dig method from within the inland dune area was publicly exhibited between 14 September 2023 and 11 October 2023. At the time of finalising this report, that application was yet to be determined.

Table 5
Development Consent 140-6-2005 (Mod 2) Condition 4(3) Requirements

Development Consent 140-6-2005 *Condition 4(3)*	AEMR Section
Condition 4(3)(a) – Identify the standards and performance measures that apply to the development	Sections 8.1, 9.1 and 9.2
Condition 4(3)(b) – Describe the works carried out in the last 12 months	Sections 5 and 10.1
Condition 4(3)(c) – Describe the works that will be carried out in the next 12 months.	Section 12
Condition 4(3)(d) – Include a summary of the complaints received during the past year, and compare this to the complaints received in previous years.	Section 11.2
Condition 4(3)(e) – Include a summary of the monitoring results for the development during the past year	Sections 8, 9.1 and 9.2
Condition 4(3)(f) – Include an analysis of these monitoring results against the relevant: ▪ impact assessment criteria; ▪ monitoring results from previous years; and ▪ predictions in the EIS.	Sections 8, 9.1 and 9.2
Condition 4(3)(g) – Identify any trends in the monitoring results over the life of the development.	Sections 8, 9.1 and 9.2
Condition 4(3)(h) – Identify any non-compliances during the previous year.	Section 11.3
Condition 4(3)(i) – Describe what actions were, or are being taken to ensure compliance.	Section 11.3

A groundwater licence (20BL171772) was re-issued to Boral on 4 March 2008 by the then Department of Water and Energy (now Water NSW) for the purposes of groundwater monitoring. This licence covers the groundwater bores that constitute the groundwater monitoring network (described in detail in Section 9.2.1).

Despatch of sand products from the Depot entrance to Coxs Lane occurs via a road constructed across Crown Reserve 170039 (under a Crown Land Licence No. LI 196915). This licence was granted by the Minister for Land and Water Conservation on 8 November 1994 and will remain in force until Boral determines to revoke the licence in accordance with *Condition 38* of the Licence.

Water Access Licence (WAL) 20AL213136 (zero share allocation) was issued on 5 January 2015, to permit extraction of water from the Stockton Groundwater Source. Water within this source is managed through the *Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016*. The WAL permits extraction of groundwater in accordance with the conditions provided in the licence.

Boral lodged an application for a Water Allocation Licence (ROI-20-019) with the Natural Resources Access Regulator on 9 December 2020 and was granted WAL 20AL220991 and 20AL221243 for 100 and 320 shares respectively under the *North Coast Coastal Sands Groundwater Sources - Stockton Groundwater Source*. Boral was granted WAL 20AL221416 for a further 104 shares during the reporting period. Water management during the reporting period is described in Section 9.1 and groundwater management and monitoring is described in Section 9.2.

4. Site Components

Development Consent 140-6-2005 refers to "the Site" (i.e. the specific area within the Boral landholding to which the DA applies). **Figure 2** displays the boundary of the Site which incorporates the following principal components.

i) Extraction Area (Pit 7) (29.7 ha)

ii) Infrastructure Area (7.8ha) – includes the Pit 7 haul road, the Depot and access from Coxs Lane

It is important to note that the site does not include the previously approved and operated Pits 1 to 6 (see **Figure 2**). Development Consent 140-6-2005 has been modified twice since originally being granted, with the first modification approved on 10 May 2006, permitting the extraction of windblown sand dunes on Lots 1 and 2 DP 1006399 and Lot 3 DP 664552.

5. Operations Summary

5.1 Introduction

The following subsections provide a summary of activities undertaken during the reporting period. Activities were generally consistent with those described in previous environmental management reporting.

All activities occurred during the approved operating hours during the reporting period.

Plates 1 to **6** display a set of photographs of the Stockton Quarry taken on 14 February 2024 and are representative of operations that occurred within the reporting period.

5.2 Extraction Operations

Extraction during the reporting period occurred entirely within Pit 7 (as shown on **Figure 3**), a defined area in which existing dune sands are present. Pit 7 is located between the frontal beach dune system and existing vegetation and does not disturb the frontal dune and beach system and does not remove sand from the foredune or interfere with beach replenishment.

Two types of sand are recovered from Pit 7, namely concrete sand and fill sand. Concrete sand is essentially free of organic materials and other impurities, whereas fill sand potentially includes some organic matter and other materials and is primarily used as fill material. during the reporting period only concrete sand was recovered.

During the reporting period, concrete sand was principally extracted from the northern (~20%) and southern (~80%) sections of Pit 7 (see **Figure 3**). All the sand recovered was loaded directly into road-registered trucks from the active extraction area.

Production during the reporting period and forecast for the 2024 reporting period is displayed in **Table 6**. During the reporting period, the reported production rate from Pit 7 was 118,821 tonnes (t), all of which was concrete sand. The forecast production is expected to be higher than the current reporting period.

Table 6
Production Summary – tonnes

Material	Approved limit	Previous reporting period (actual)	This reporting period (actual)	Next reporting period (forecast)
Concrete Sand	500 000 (DA 140-6-2005)	66,407	118,821	150,000
Fill Sand		4,039	0	0
Total		70,446	118,821	150,000

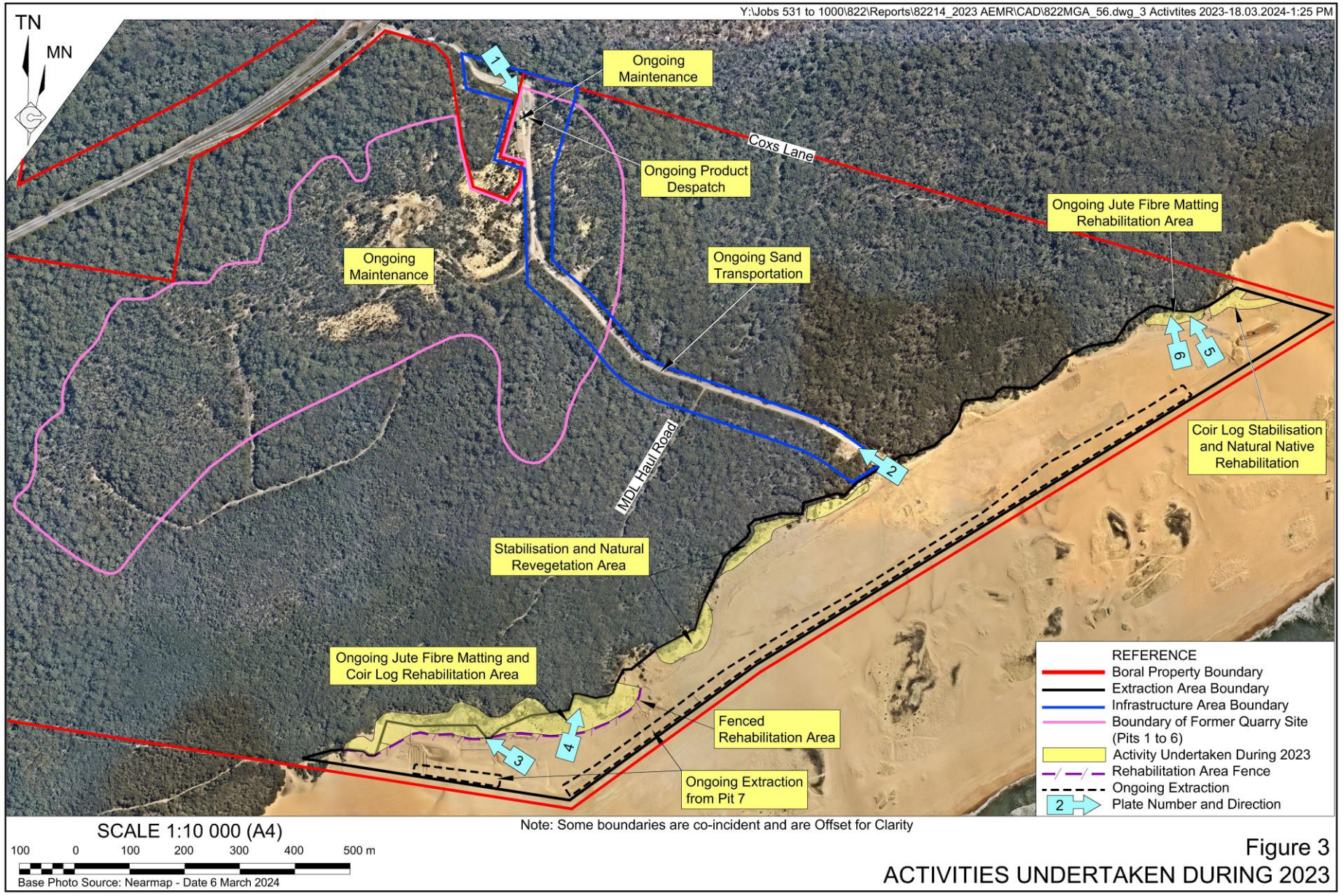


Figure 3
ACTIVITIES UNDERTAKEN DURING 2023

Plate 1: View of the depot including office, weighbridge, workshop and watercart
(Ref: E822L_037)

Plate 2: View of the Pit 7 Haul Road at the exit of Pit 7
(Ref: E822L_031)

Plate 3: View south taken from the Haul Road on the southern end of Pit 7 showing coir logs in rehab area
(Ref: E822L_029)

Plate 4: View north taken from the Haul Road on the southern end of Pit 7 showing rehab area
(Ref: E822L_026)

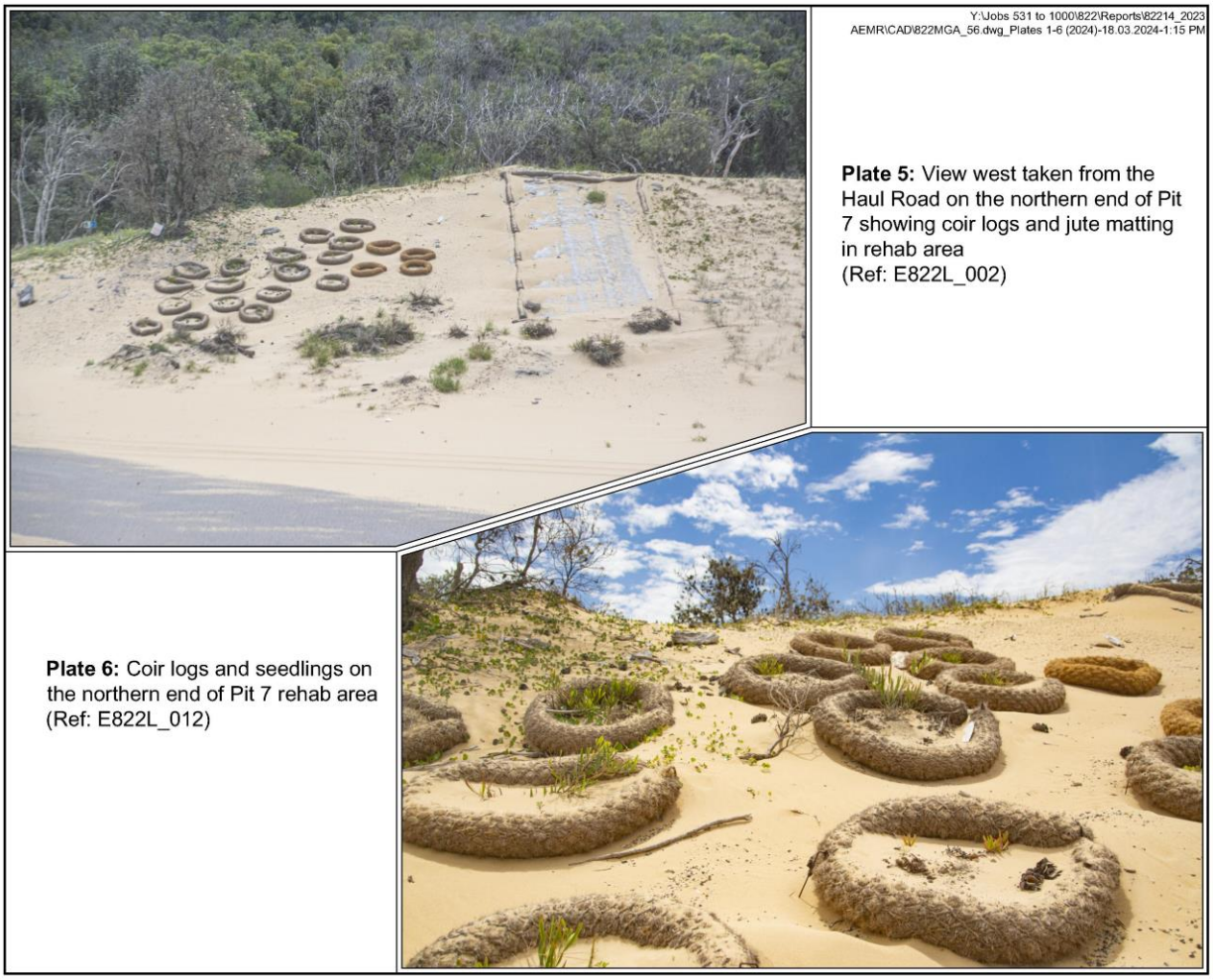


Plate 5: View west taken from the Haul Road on the northern end of Pit 7 showing coir logs and jute matting in rehab area
(Ref: E822L_002)

Plate 6: Coir logs and seedlings on the northern end of Pit 7 rehab area
(Ref: E822L_012)

5.3 Processing Activities

Where necessary, sand is screened to remove natural materials that may have been buried within the dunes as they formed naturally. Where screening is required, mobile screening equipment is used on a campaign basis to screen and stockpile sand. Screening was undertaken for approximately five weeks in May 2023 with 27,000 tonnes of sand screened.

5.4 Transport Activities

All products were despatched via the on-site weighbridge located near the Quarry entrance near Coxs Lane. There are no conditions within DA 140-6-2005 limiting truck movements from the Quarry, although it is noted that the annual product despatch limit provides a limit to truck movements. A total of 3,353 laden loads were despatched from the Quarry during the reporting period (equivalent to 6,706 total truck movements in and out of the Quarry). All laden trucks travel westwards along Coxs Lane and use the southbound on-ramp to Nelson Bay Road. Those trucks that needed to travel northwards to Medowie, Nelsons Bay and Raymond Terrace and beyond take a U-turn at the Fern Bay Road Roundabout before travelling northwards. The access arrangements for the Quarry are described in the Quarry driver induction documents which all drivers are required to sign during induction and/or training.

5.5 Employment, Operating Hours, Utilities and Services

5.5.1 Employment

During the previous reporting period, a total of 4 full-time personnel were employed at the Quarry. During the current reporting period, one full-time employee left the Company and was replaced with labour hire for 1-2 days a week.

5.5.2 Operating Hours

During the reporting period, the permissible operating hours as set out in *Condition 3(8)* of Development Consent 140-6-2005 (Mod 2) were adhered to.

Extended hours for major supply contracts were not required during the reporting period. Operations on a Saturday have been limited due to the decrease in production on site.

5.5.3 Utilities and Services

Water Usage

Boral obtains its water requirements for its on-site use from three sources.

i) Boral purchased its own water cart in September 2021 and sources water for dust suppression from an approved standpipe hired from Hunter Water.

ii) All water used for on-site ablutions is collected from rainwater and supplemented with purchased water supplied in bulk, as required.

iii) All drinking water is brought to site in 19L containers.

During the reporting period, dust suppression required approximately 0.162 ML of water which is significantly lower than the long-term average water usage for dust suppression i.e. 12ML per annum.

Rainwater capture continued during the reporting period through the use of the existing 10 000L water storage tank. This ensures there is sufficient water stored for on-site ablutions and purchase of supplementary bulk water was not required.

Equipment and Diesel Usage

Equipment was maintained and, where necessary, replaced throughout the reporting period with the equipment used on site including the following.

- Volvo 180H Front-end loader
- Cat D7 LGP Bulldozer
- ‘Fuel Ute’ (Ford Ranger with 400L tank to service dozer)
- STG WT13000 Water Truck (Hino 500)

Annual diesel usage of all on-site mobile equipment was approximately 41,370L, an increase of approximately 18,031L from the previous reporting period. This is principally due to the increased production during the reporting period.

Electrical Power

The Depot is connected to mains electricity providing power to both the office and workshop and for security lighting and monitoring. During the reporting period, the electrical power usage was approximately 919kW.h per month. This represented a decrease in electricity usage compared to 2022 (approximately 937kW.h per month).

5.6 Waste Management

The dedicated waste metal bin and waste skips were utilised throughout the reporting period, as well as the existing fortnightly general waste collection service.

No waste oil was collected during the reporting period. Service suppliers were asked to remove oil and filters from site wherever possible during 2023 to minimise costs associated with waste oil removal.

5.7 Construction Activities

No construction activities were undertaken during the reporting period.

6. Actions Required

6.1 DPHI Feedback on 2022 AEMR

Feedback on the 2022 AEMR was provided by the DPIE (now DPHI) on 10 November 2023 outlining that it generally satisfied the reporting requirements of the consent and the *NSW Planning Annual Review Guideline 2015*. Further correspondence was received from DPHI on 29 February 2024 informing Boral that non-compliances relating to the implementation of the groundwater monitoring program were being investigated. The matter is ongoing.

6.2 Independent Environmental Audit

An independent environmental audit was not carried out during the reporting period. The next audit is scheduled to take place in 2024.

7. Environmental Management

7.1 Environmental Management Responsibilities

The overall management of Pit 7 and all quarrying and related activities is the responsibility of the Quarry Manager, Mr Rod Johnson, who is assisted on site by Boral employees.

Environmental management and monitoring is undertaken generally in accordance with the following documents prepared for the Quarry.

- Environmental Management Strategy (ECS, January 2017) – prepared in accordance with *Condition 4(1)*, of DA 140-6-2005.
- Erosion and Sediment Management Plan (Boral, July 2018) – prepared in accordance with *Condition 3(11)*, DA 140-6-2005.
- Groundwater Management Plan (Jacobs, 2019) – prepared in accordance with *Condition 3(12)* of DA 140-6-2005. and
- Rehabilitation and Landscape Management Plan (RWC, September 2018) – prepared in accordance with *Condition 3(19)* of DA 140-6-2005.

The operations are also undertaken in accordance with Boral's Corporate Environmental Policy.

Boral also require Quarry management to review and complete a monthly Environmental Permit Planner (EPP) that covers general environmental management and performance.

Prior to undertaking work on site, all employees, visitors, contractors and drivers are inducted and provided with Boral's environmental and occupational health and safety requirements. All personnel on site are trained and encouraged to identify a range of environmental risks and to either manage and/or inform management. Signage has also been established to alert all truck drivers to notify site personnel if they observe any trespassers within the Boral property at Stockton.

8. Noise

8.1 Relevant Criteria

Condition 3(7) of Development Consent 140-6-2005 (Mod 2) is relevant to noise compliance assessment and is reproduced as follows.

> *The Applicant shall ensure the noise generated by the development does not exceed 35dB(A)Leq(15 minute) at the nearest residential receiver.*
>
> *Notes:*
>
> - *Noise from the development is to be measured at the most affected point or within the residential boundary, or at the most affected point within 30 meters of a dwelling (rural situations) where the dwelling is more than 30 meters from the boundary, to determine compliance with the noise limits in the above table. Where it can be demonstrated that direct measurement of noise from the development is impractical, the DECC may accept alternative means of determining compliance. The modification factors in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise levels where applicable.*
> - *Noise from the premises is to be measured at 1m from the dwelling façade to determine compliance with the noise limit.*
> - *The Criteria above apply to noise emissions under the following weather conditions:*
>   - *wind speed up to 3 m/s as 10m above ground level; or*
>   - *temperature inversion conditions of up to 3oC/100m and wind speed up to 2m/s at 10m above ground level.*

Condition L6 of the EPL 10132 is relevant to the noise compliance assessment and is reproduced as follows.

> *Noise emissions from the premises must not exceed an Leq(15 minute) noise emission criterion of 35dB(A) at the nearest residential receiver.*

8.2 Noise Monitoring

Boral typically only conduct noise monitoring following complaints from residents which is consistent with the approved Environmental Management Strategy (ECS, 2017). However, a noise monitoring survey was undertaken by Muller Acoustic Consulting in December 2021 with the results summarised in the 2021 AEMR. The results of this survey identified that operational emissions generated by the Quarry comply with all relevant statutory noise limits. Furthermore, Quarry-related noise emissions generally remain inaudible at monitoring locations and are masked by extraneous non-quarry sources.

These results are consistent with historical noise monitoring results and predictions in the relevant assessment documents. Potential noise impacts remain a low risk for the operation.

9. Water Management

9.1 Surface Water

Surface water monitoring is undertaken in accordance with the Groundwater Management Plan (GWMP) prepared by Jacobs in 2019. Jacobs undertook an external review of the surface water monitoring results collected during the reporting period as part of the annual groundwater monitoring review. A copy of the annual groundwater monitoring review (Jacobs, 2024) for the reporting period is provided as **Appendix 2** of this document. A summary of the results of surface water monitoring is provided in Section 9.1.2.

9.1.1 Surface Water Monitoring Network

Surface water monitoring sites, SW1, SW2, SW3 and SW4 are included in the GWMP to monitor potential impacts to Groundwater Dependent Ecosystems (GDEs) proximal to operational areas (**Figure 4**). SW1 and SW2 are located inland of the current extraction area and intermittently contain surface water. GDEs near these sites comprise swamp forests in the dune swales and low-lying heath. SW3 and SW4 are located seaward of the extraction area. GDEs in the vicinity of SW3 and SW4 comprise small ephemeral and mobile shallow deflation basins, vegetated with a variety of grasses, sedges and reeds. Due to the variable nature of the foredune system, the locations of the two GDE monitoring sites may change between sampling programs.

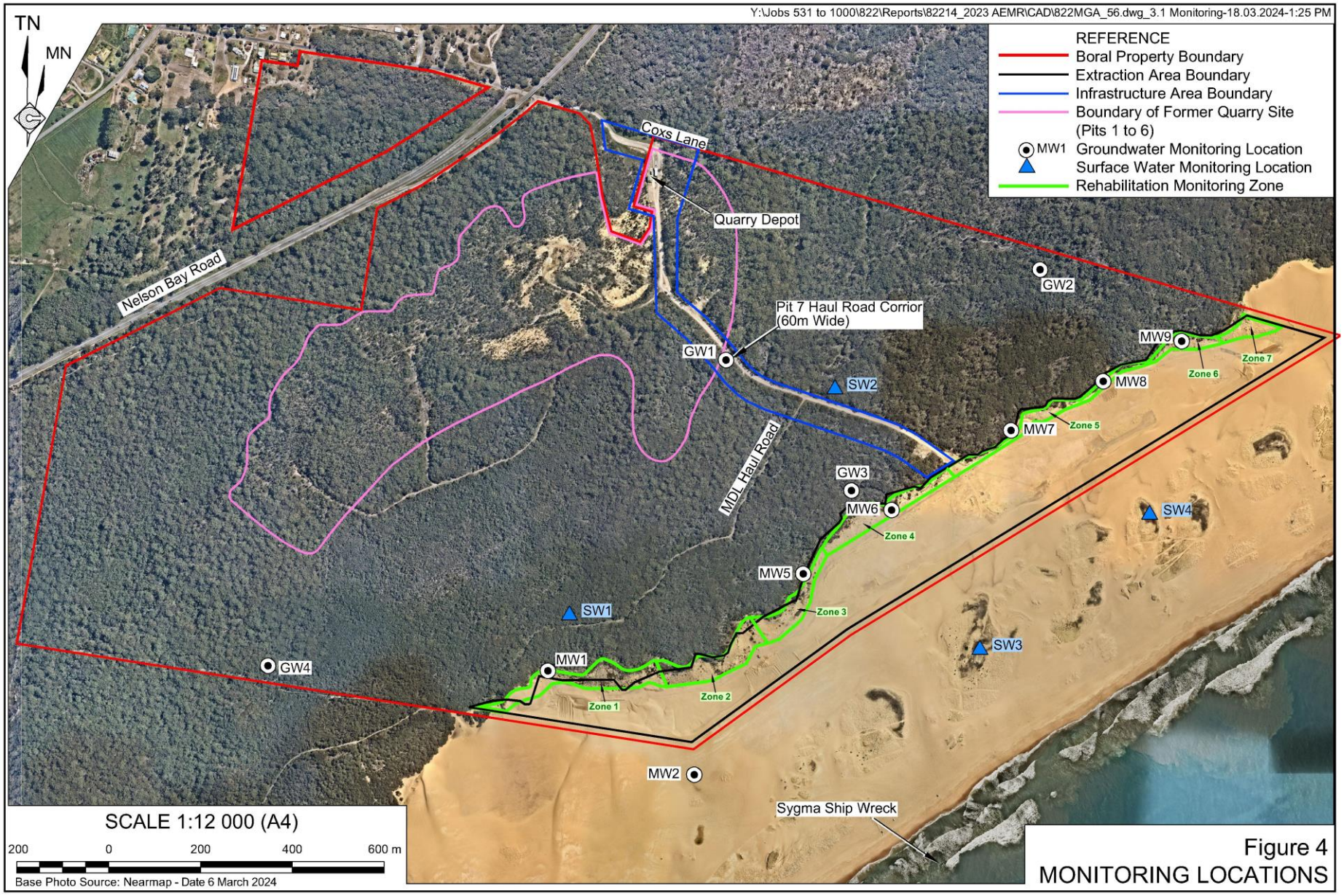
Surface water sampling was generally completed in accordance with the GWMP during the reporting period with the exception of the following.

- Total petroleum hydrocarbons (TPH)[1] were not monitored annually.
- Surface water monitoring was undertaken generally monthly, which is beyond the quarterly frequency requirement for all analytes except TPH and BTEX (annual frequency).
- TRH was not reported for SW3 as the dam was dry at the time of sampling.

9.1.2 Surface Water Results and Analysis

Tables 7 and **8** present the results of monthly pH and EC surface water sampling, respectively. It is noted that the GWMP does not provide trigger levels for surface water due to insufficient baseline data and requires that sites SW1 to SW4 are assessed against the ANZECC 2000 guidelines until sufficient data is collected to enable development of site-specific trigger levels.

[1] It is noted that total recoverable hydrocarbons (TRH) were monitored instead of total petroleum hydrocarbons (TPH). Results for TRH and TPH are considered to be interchangeable.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TN
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REFERENCE
Boral Property Boundary
Extraction Area Boundary
Infrastructure Area Boundary
Boundary of Former Quarry Site (Pits 1 to 6)
MW1 Groundwater Monitoring Location
Surface Water Monitoring Location
Rehabilitation Monitoring Zone
Coxs Lane
Quarry Depot
Nelson Bay Road
Pit 7 Haul Road Corrior (60m Wide)
MDL Haul Road
GW1
GW2
GW3
GW4
MW1
MW2
MW5
MW6
MW7
MW8
MW9
SW1
SW2
SW3
SW4
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Sygma Ship Wreck
SCALE 1:12 000 (A4)
200 0 200 400 600 m
Base Photo Source: Nearmap - Date 6 March 2024
Figure 4
MONITORING LOCATIONS

Table 7
Surface Water pH Monitoring Results

Monitoring Location	Lower / upper trigger level [1]	2023 range (pH units)	2023 average (pH units)
SW1	6.50 / 8.50	4.60 to 5.70	5.00
SW2		7.00 to 7.90	7.30
SW3		7.90 to 8.40	8.10
SW4		7.90 to 8.90	8.60
Note 1: ANZECC 2000 default trigger value for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems, lowland rivers.			
Source: Jacobs (2024) – Table 13			

The median pH at SW4 for 2023 was above the upper guideline pH value of pH 8.50. However, the range for 2023 is within the historic range for SW4 and it is likely that this exceedance is part of the natural variation for the site. The median pH at SW1 for 2023 is below the lower guideline value of 6.5. However, the 2023 pH range is consistent with the findings of 2020 - 2022 data and it is likely that this reflects a naturally low pH at SW1.

Table 8
Surface Water EC Monitoring Results

Monitoring Location	Lower / upper trigger level [1]	2023 range (µS/cm)	2023 average (µS/cm)
SW1	125 / 2200	247 to 479	306
SW2		360 to 411	411
SW3		300 to 416	355
SW4		247 to 460	290
Note 1: ANZECC 2000 default trigger value for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems, lowland rivers.			
Source: Jacobs (2024) – Table 14			

The median EC measurement for 2023 at each site was with in the lower and upper trigger range for all monitoring locations and were within the guideline value range of 125 to 2200 µS/cm. EC in the surface water sites increased over the second half of the year, likely reflecting evaporative concentration and reduced dilution due to the decreased rainfall.

9.1.3 Discussion

The SW1, SW2, SW3 and SW4 analyte concentrations are similar to typical groundwater concentrations for a given analyte, suggesting that quarrying activities are unlikely to have had an impact on surface water quality. The exception is pH at SW1, which is lower than typical groundwater pH but is similar to nearby MW01. While a number of exceedances of trigger values are noted, there is no reason to believe that the results are indicative of an influence from quarrying.

Based on 2023 surface water monitoring results, there appears to be no significant trends indicating that surface water quality has been impacted by quarrying operations. With continued data collection, the understanding of surface water quality is expected to improve.

9.1.4 Comparison to EIS Predictions

Due to the lack of topsoil and vegetation cover, the EIS (ERM, 2005) concludes that the consequent high groundwater recharge and negligible surface runoff would result in insignificant impacts to surface water quality. Despite lacking baseline data, a review of 2023 surface water results cannot attribute any exceedances to quarry operations. Results are therefore consistent with the EIS (ERM, 2005).

9.2 Groundwater

Jacobs undertook an external review of the groundwater monitoring results collected during the reporting period with the results discussed in Section 9.2.3. A copy of the annual groundwater monitoring review for the reporting period is provided as **Appendix 2** of this document. A summary of the results of groundwater monitoring is provided in Section 9.2.2.

Groundwater is required to be monitored at the Quarry as outlined within Development Consent 140-6-2005 (Mod 2) *Condition 3(12)* which states that:

The Groundwater Monitoring Program shall include:

a) detailed baseline data on groundwater levels, flows and quality, based on statistical analysis, to benchmark the pre-quarrying natural variation in groundwater levels and quality;

b) groundwater impact assessment criteria; and

c) a program to monitor groundwater levels and quality.

9.2.1 Groundwater Monitoring Network

Figure 4 displays the locations of the groundwater monitoring bore network. The current groundwater monitoring network includes 10 monitoring bores. All bores are licensed under monitoring license 20BL171772. The monitoring network includes groundwater monitoring bores (MW series bores) that were installed as part of the Stockton Sand Quarry monitoring network, as well as four pre-existing groundwater monitoring bores (GW series bores).

As noted in the 2021 AEMR, monitoring bore MW2, a bore included in the 2019 GWMP groundwater monitoring network, was found to have been removed by persons unknown on 3 November 2021, whilst completing a groundwater monitoring round. Boral have reported the loss of MW2 to DPE and advised that they are no longer able to carry out monitoring at the bore. Additionally, Boral have advised that they do not propose to replace the bore due to its location on Worimi lands under the control of National Parks and have no way of protecting the bore from vandalism. It was also stated that bore MW11, a bore included in the 2019 GWMP groundwater monitoring network was destroyed, and Boral do not intend to replace the bore.

Jacobs (2024) has reviewed the current groundwater monitoring network and concluded that despite MW2 and MW11 being destroyed, the current monitoring network is considered suitable. It is noted that there is now a substantial monitoring gap between MW1 and MW5, however with the lack of historical impacts due to quarrying and the low risk of future impacts, reduced monitoring bore frequency is not considered to pose a significant risk.

Groundwater sampling was generally completed in accordance with the GWMP during the reporting period with the exception of the following.

- Water quality and groundwater levels were not monitored at MW2 and MW11 due to the loss of the bores.
- Consecutive groundwater quality quarterly trigger level exceedances were not actioned (i.e. repeat sampled, reported and investigated) as per the 2019 GWMP TARP. There were consecutive quarterly trigger level exceedances at all groundwater monitoring locations. The associated analytes comprised aluminium, chromium, iron, potassium, sodium, chloride, phosphorus and hardness.

9.2.2 Groundwater Results and Analysis

9.2.2.1 Groundwater Levels

Table 9 presents the collated groundwater level results from the groundwater monitoring network.

Table 9
Groundwater Levels (m AHD)

Month	GW1	GW2	GW3	GW4	MW1	MW5	MW6	MW7	MW8	MW9
	Water Level (m AHD)									
Upper Trigger	*2.92*	*2.72*	*2.60*	*2.28*	*2.92*	*2.51*	*2.66*	*2.52*	*2.57*	*2.56*
Lower Trigger	*0.98*	*0.99*	*1.13*	*1.00*	*0.98*	*0.77*	*0.60*	*1.17*	*2.57*	*2.56*
January	1.92	2.12	1.82	1.68	1.67	1.72	1.81	1.88	1.87	1.85
February	1.78	1.2	1.95	1.6	1.66	1.73	1.9	1.96	1.94	1.89
March	1.66	1.85	1.65	1.47	1.54	1.59	1.65	1.71	1.72	1.71
April	1.74	1.96	1.84	1.52	1.64	1.76	1.86	1.91	1.91	1.9
May	1.71	1.91	1.81	1.53	1.64	1.76	1.82	1.85	1.89	1.91
June	1.74	1.91	1.78	1.61	1.73	1.76	1.82	1.84	1.86	1.86
July	1.67	1.83	1.72	1.56	1.68	1.71	1.74	1.78	1.79	1.8
August	1.68	1.89	1.81	1.53	1.64	1.73	1.82	1.87	1.85	1.84
September	1.62	1.79	1.64	1.47	1.55	1.6	1.67	1.69	1.7	1.7
October	1.54	1.69	1.48	1.37	1.41	1.43	1.49	1.53	1.53	1.54
November	1.42	1.58	1.43	1.29	1.38	1.41	1.47	1.5	1.51	1.51
December	1.29	1.43	1.28	1.14	1.25	1.26	1.3	1.33	1.34	1.34
Average[1]	2.85	1.86	1.84	1.68	1.84	1.78	1.89	1.86	1.88	1.87
Median[1]	3.14	1.85	1.77	1.58	1.77	1.73	1.82	1.79	1.82	1.81
Note 1: Statistics derived from all available data										
Source: Jacobs (2024) – Modified after Table 10										

During 2023, monthly rainfall was significantly below long-term average values. January to April recorded average or near average rainfall and from May rainfall was well below the long-term average, with June only receiving 8.8 mm substantially less than the 121.5 mm monthly long-term average. Consequently, groundwater levels fell throughout the 2023 monitoring period. The decrease in groundwater levels, correspond to a decline in the cumulative rainfall deviation (CRD). A climbing CRD line slope represents above average rainfall whilst a declining slope represents below average rainfall. An association between groundwater levels and CRD, can indicate where rainfall recharge is an important process. The decrease in rainfall was reflected in groundwater levels which, decreased uniformly across all monitoring wells between July and December 2023.

Groundwater levels did not exceed the quarry's limit of extraction level of 2.5 mAHD in any of the monitoring locations. Groundwater levels plateaued from January to April with all monitoring wells recording the maximum values in this period.

Quarrying does not appear to be impacting groundwater levels throughout the reporting period.

9.2.2.2 Groundwater Quality

Tables 10 and **11** present the results of field parameters recorded for the groundwater quality monitoring program for pH and EC levels, respectively. Laboratory assessed monitoring records are presented in Appendix B of Jacobs (2024) (see **Appendix 2**).

Table 10
Groundwater pH Monitoring Results

Monitoring Location	Lower / upper triggers	2023 range (pH units)	2023 average (pH units)	Long term average (2007 to 2023)
MW1	5.67 / 7.47	5.00 to 5.90	5.50	6.25
MW5	5.88 / 7.68	5.90 - 6.10	5.98	6.45
MW6	6.60 / 7.65	6.80 – 7.00	6.90	7.00
MW7	6.64 / 7.53	6.90 – 7.30	7.13	7.08
MW8	6.71 / 7.59	7.30 - 7.40	7.34	7.18
MW9	4.93 / 8.33	6.00 - 6.50	6.35	6.58
Source: Jacobs (2024) – Table 11				

Table 11
Groundwater Electrical Conductivity Monitoring Results

Monitoring Location	Lower / upper triggers	2023 range (µS/cm)	2023 average (µS/cm)	Long term average (2007 to 2023) (µS/cm)
MW1	195 / 444	468 - 594	533	343
MW5	105 / 1015	369 - 523	431	492
MW6	115 / 584	336 - 408	369	333
MW7	470 / 1037	618 - 742	666	688
MW8	453 / 1021	698 - 795	743	758
MW9	155 / 965	515 - 679	629	523
Source: Jacobs (2024) – Table 12				

During the reporting period, pH values for all monitored bores ranged from 5.00 to 7.40, with an average pH of 6.54. At MW1, the samples taken in March (pH 5.00), and December (pH 5.40), were under the lower trigger of 5.67. At all other locations, the observed pH values in 2023 were within the trigger level range.

Whilst pH observations for the first and last quarters at MW1 were below the lower trigger level for that location, the relatively lower pH values are considered unlikely to be due to quarrying and are instead attributed to natural variability. A similar pH trend was not observed at other monitoring bores. The relatively low pH values observed in 2023 at MW1 do not correlate well with groundwater levels at MW1. Observed groundwater levels at MW1 decreased throughout 2023. However, pH did not exceed lower trigger values in the middle two quarters of the year. This suggests that the pH exceedances in 2023 are not associated with drawdown by quarrying, which is the primary mechanism that could lead to a lowering of pH due to quarrying.

EC provides a measurement of the groundwater salinity. Throughout the reporting period, EC values ranged from 336 to 795 µS/cm, with an average of 562 µS/cm. At MW1 measurements of EC are above the upper trigger of 444 µS/cm during March (594 µS/cm), June (583 µS/cm), September (488 µS/cm) and December (468 µS/cm), however a declining trend is noted and the values are well within the range of EC values across the site. There are no deleterious trends apparent and the observed EC values during the monitoring period are consistent with historical variation and are considered to lie within natural variability. While EC measurements exceeding the upper threshold trigger at MW1 throughout 2023, the EC in MW1 dropped throughout the year from a rainfall high point in December of 2022 which was considered reasonable.

Jacobs reviewed the results of a range of analytes nominated within the GWMP. The results are summarised in Section 4.4.3 of Jacobs (2024) with the full results presented in Appendices A and B. Several baseline triggers were exceeded during the reporting period. Jacobs reviewed these results against historic data and confirmed that the levels reflected natural conditions consistent with historic records. Jacobs considered that results outside the upper and lower trigger levels were the result of natural variation in groundwater within the locally recharged, shallow groundwater system that is readily influenced by rainfall, evaporation / evapotranspiration and coastal processes. As with past years, the results do not indicate trends away from site-based trigger levels or historical variation and therefore it is concluded that the minor and short-term variations are not related to Quarry activities.

9.2.3 Discussion

The results of groundwater monitoring during the reporting period indicate the following.

- Groundwater levels continued to fluctuate naturally in response to rainfall recharge and seasonal patterns and were not impacted by quarrying operations.
- Several groundwater quality triggers, defined in the GWMP, were exceeded during the reporting period. However, the groundwater setting remained consistent with historical patterns during the reporting period. Minor and short-term exceedances of site-based trigger levels remain consistent with historical data.
- Quarrying operations are having a negligible impact on the groundwater setting.

During the next reporting period, it is recommended that groundwater level and quality monitoring frequency remain consistent with that specified by the GWMP. Jacobs (2024) further recommends that any consecutive quarterly groundwater trigger level exceedances should be actioned as per the TARP within the GWMP.

9.2.4 Comparison to EIS Predictions

The EIS (ERM, 2005) predicts minimal impacts to groundwater levels if sand extraction is restricted to 2.5m AHD, which would limit potential impacts to changes in local groundwater recharge characteristics. Quarry activities are not predicted to influence local or regional groundwater supply. The 2023 groundwater level data indicate that the quarry has not impacted groundwater supply and the results are therefore consistent with the EIS.

Extraction limits proposed in the EIS (ERM, 2005) were adopted to ensure quarry operations had no direct impact on local or regional groundwater quality. Following review of the 2023 groundwater laboratory results, it has been concluded that quarry activity has not impacted groundwater quality as exceedances lie within historical ranges and can be attributed to natural variability. The 2023 groundwater quality results are therefore consistent with the predictions outlined in the EIS.

10. Rehabilitation

10.1 Rehabilitation During the Reporting Period

Boral is required to progressively rehabilitate the site, including the batters, buffer area, floor of the extraction area and haul road, in a manner that is generally consistent with the final landform described in the EIS, to the satisfaction of the Planning Secretary.

A Rehabilitation and Landscape Management Plan (RLMP) was prepared by R.W. Corkery & Co. Pty Limited (RWC) in September 2018 in accordance with *Condition 3(19)* of DA 184-6-2005. The objectives of the plan are as follows.

- *To ensure compliance with all relevant project approval conditions, statements of commitment and reasonable community expectations.*
- *To implement appropriate progressive rehabilitation and landscape management and mitigation measures during Quarry development.*
- *To appropriately manage site preparation works to ensure that suitable rehabilitation material remains for rehabilitation operations during all stages of the Quarry.*
- *To implement appropriate weed, pest and bushfire management measures.*
- *To implement appropriate corrective and preventative actions, if required.*
- *To establish a final landform that is consistent with the surrounding remnant vegetation.*

Rehabilitation and maintenance activities undertaken during the reporting period are displayed in **Figure 5**. In summary, rehabilitation activities undertaken during the reporting period included the following.

- Maintenance of existing jute fibre matting areas within the transgressive dune system located on the border to existing vegetated areas. The existing jute matting is often damaged during strong winds and requires pegging or other obstacles to limit wind damage.
- Application of timber and coir logs and pegging within the transgressive dune system currently under rehabilitation to provide additional stabilisation in these areas.
- Translocation of dune colonising species (Spinifex, Pig Face and Coastal Wattle) to stabilise and revegetate dune systems.
- Minor profiling and removal of significant amounts of litter along the transgressive dune system to repair damage caused by trespassers and litter from recreational beach users.
- Maintenance of the active rehabilitation area in former extraction pits.

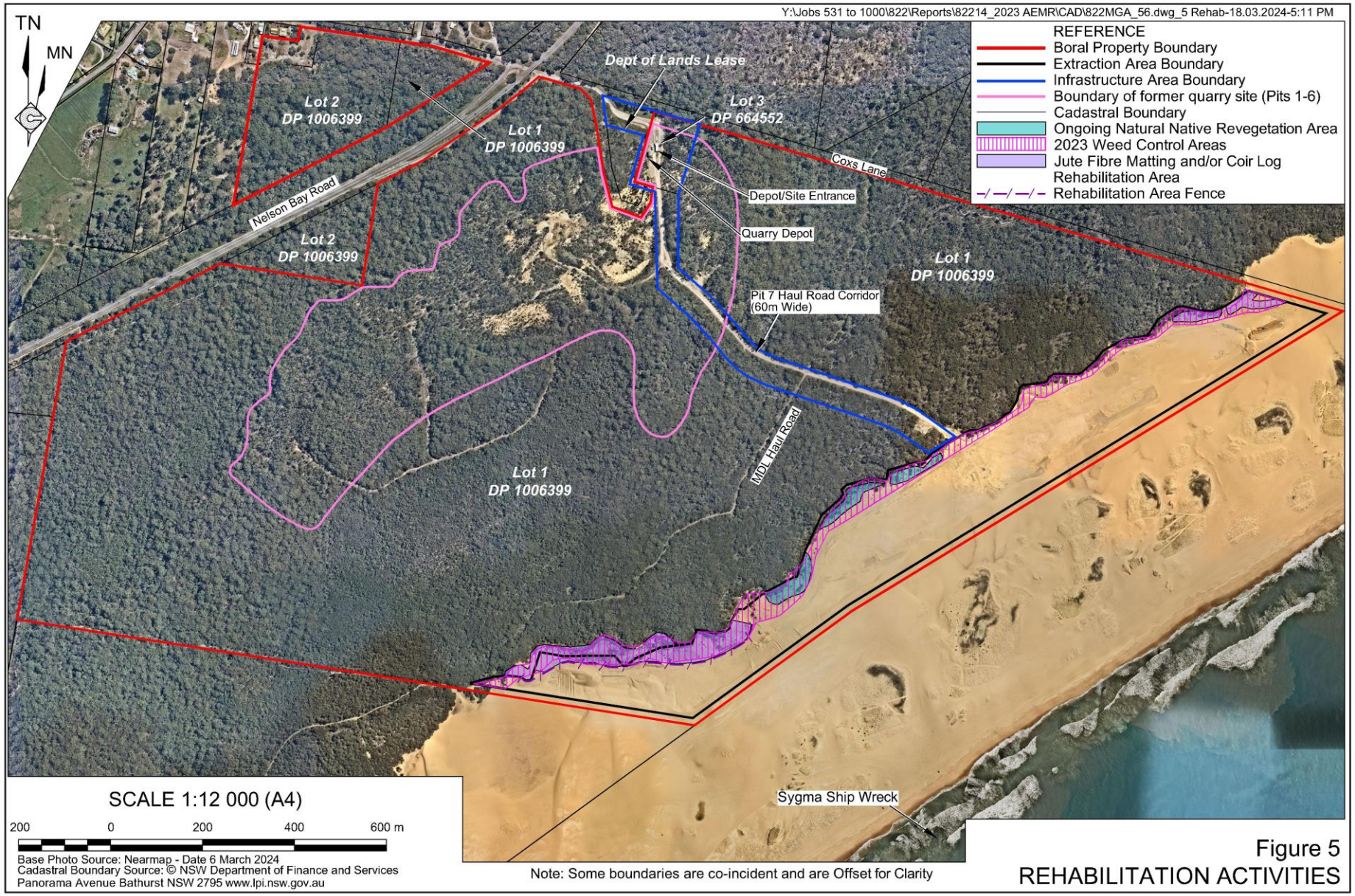

Figure 5
REHABILITATION ACTIVITIES

It is noted that the approved operation does not include the previously approved and operated Pits 1 to 6 (see **Figure 2**), nor is rehabilitation of these areas subject to DA 140-6-2005.

Table 12 presents an assessment of the progress of rehabilitation during the reporting period against the rehabilitation target and performance criteria nominated in the RLMP.

Table 12
Rehabilitation Targets and Performance Indicators

Management Measure	Frequency	Performance Indicators	Targets	Status Report – 2023
Compliance with approved extraction boundaries to prevent encroachment into existing vegetation.	Ongoing	Weekly visual inspections of boundary markers. Review of extraction activities for each year in the Annual Environmental Management Report (AEMR).	No disturbance beyond the extraction boundary.	No area beyond the extraction boundary was disturbed during the reporting period.
Use of site haul roads to contain disturbance to approved areas.	Ongoing	Daily visual inspections of haul road.	No disturbance beyond the existing haul roads.	All vehicles continued to use existing haul roads. No area beyond the existing haul roads were disturbed during the reporting period.
Erosion and sediment controls are maintained and functional.	Ongoing	Daily visual inspection for evidence of erosion or uncontrolled discharge. Additional inspections following prolonged or heavy periods of rain.	Water management structures are functioning effectively to minimise erosion.	All water management structures continued to function effectively during the reporting period.
Toolbox talks to educate Quarry personnel of risks to flora and fauna due to vegetation clearing.	Ongoing	Quarry personnel educated / informed of native flora and fauna likely to be encountered.	Reduce risk to native flora and fauna that may be encountered at the Quarry.	Periodic toolbox talks were undertaken throughout the reporting period to educate Quarry personnel of native flora and fauna likely to be encountered on site.
Weed management programs by a person suitably experienced in weed identification and involving spraying and manual weed removal.	Quarterly (or more frequent if needed)	Maintenance weeding occurs quarterly and is recorded in daily work sheets.	Weed infestations are contained and weed cover is no greater than surrounding remnant vegetation.	Periodic weed management programs were undertaken throughout the reporting period (see Section 10.2).
Visual monitoring programs of site security by Quarry personnel.	Ongoing	Daily visual inspection for evidence of trespassers.	The site is secured.	Security measures continued to be implemented during the reporting period. A total of eight incidents were recorded during the reporting period (see Section 11.1).
Visual monitoring programs of feral animal presence by Quarry personnel.	Ongoing	Daily visual inspection for evidence of feral animals.	Feral animal presence is used to guide ongoing management.	Visual monitoring programs continued to be undertaken during the reporting period.
Feral animal control programs involving trapping and/or baiting.	As needed	Baiting program undertaken by suitably qualified person.	The Quarry does not become a harbor for feral animals.	No wild dog baiting was undertaken during the reporting period.

Table 12 (Cont'd)
Rehabilitation Targets and Performance Indicators

Management Measure	Frequency	Performance Indicators	Targets	Status Report – 2023
Visual monitoring programs of progressive revegetation activities.	Following planting campaigns and then monthly.	Revegetation success and signs of dieback monitored at least monthly. Native vegetation coverage and percentage foliage cover recorded in the Annual Environmental Management Report.	Revegetation campaigns have an 85% success rate. Revegetation failures are replaced.	Revegetation continued to be monitored during the reporting period within Pit 7. It was noted that translocated Pig Face and Coastal Wattle was more successful in establishing cover than Spinifex in the lower dunes.
Visual inspection of active coconut fibre matting areas within the transgressive dune system located on the border to existing vegetated areas.	Weekly	Condition of coconut fibre and potential damage due to strong winds or trespassers.	Dunes are stable and vegetation is regenerating naturally.	Areas in which jute fibre matting have been installed are stabilising successfully with significantly more vegetation cover noted during the site inspection than in the previous year.
Application of timber and logs in Pit 7 to stabilise dunes.	As needed based on monitoring	Dunes becoming stable and natural vegetation regeneration is occurring.	Dunes are stable and vegetation is regenerating naturally. Foredune has an average angle of repose of approximately 34 degrees.	Coir logs continued to be installed in rehabilitation areas during the reporting period with previously stabilised dune faces showing signs of natural regeneration.
Revegetation of dunes in Pit 7 with stabilising species.	Annual campaigns	Revegetated plants are surviving.	Dunes are stable and vegetation cover is approaching 15%.	Stabilisation and revegetation of dunes in Pit 7 continued throughout the reporting period.
Maintenance of Pits 1 to 6, including replanting (if required).	As needed based on results of monitoring	Vegetation is starting to naturally regenerate.	Vegetation cover of 70% 75% of species consistent with flora species in **Appendix 1**. Weed coverage less than 5%.	Pits 1 to 6 continued to be maintained during the reporting period principally through the undertaking of targeted weeding campaigns (see Section 10.2).

Table 13 presents a summary of the outcomes of rehabilitation within each of the rehabilitation monitoring zones within Pit 7. It is noted that rehabilitation is currently limited to areas immediately adjacent to existing vegetation at the western extent of Pit 7. **Figure 4** displays the location of each rehabilitation monitoring zone.

Table 13
Rehabilitation Performance Monitoring

Rehab Zone	Current success of Revegetation program	Results of Dieback (%)	Cover of Native Vegetation (%)	Cover of Foliage (%)	Plantings conducted	Evidence of Weed Infestation
Zone 1	Very Good Dune is stable Evidence of natural revegetation occurring from top of dune. Growth in the northern section of zone is very good. Coastal Wattle planting is going well.	No evidence of dieback	20-25% Mostly Spinifex	15-20% Mostly spinifex	Coastal Wattle	None
Zone 2	Very Good Dune is stable Plantings of Pigface are surviving and look healthy, Spinifex is stable and evidence of spread. Plantings of Coastal Wattle are progressing very well, especially in low areas	No evidence of dieback	20-30% Mostly Spinifex and Pigface Coastal Wattle growing well	20-30% Mostly Spinifex and Pigface Coastal Wattle in lower areas	Coastal Wattle Pigface	None
Zone 3	Good Plantings of Pigface and Coastal Wattle are surviving and look healthy, Spinifex is stable and evidence of spread	No evidence of dieback	10-15% Mostly Spinifex and Pigface	10-15% Mostly Spinifex and pigface plantings	Coastal Wattle	None
Zone 4	Good This zone is stable and natural revegetation is dominant, prevalent in hollows. Coastal Wattle planted in areas.	No evidence of dieback	30% Mostly Spinifex and Pigface	30% Mostly Spinifex and Pigface	Coastal Wattle	None
Zone 5	Good This zone is stable and natural revegetation is dominant Spinifex is starting to grow onto road in areas	No evidence of dieback	60% Mostly Spinifex and tree regrowth	60% Mostly Spinifex and tree regrowth	None	None
Zone 6	Good Dune is stable Plantings of Pigface and Coastal Wattle are surviving and look healthy	No evidence of dieback	10-15% Mostly Spinifex and Pigface	10-15% Mostly Spinifex and pigface plantings	Coastal Wattle Pigface	None
Zone 7	Good Coir logs placed to assist in dune stabilisation. Evidence of Spinifex growing runners along coir logs Coir logs trapping drifting sand very well. Individual coir logs wells placed and planted out with Pigface and Coastal Wattle. Watering undertaken on new plantings	No evidence of dieback	10% Mostly Spinifex	10% Mostly Spinifex	Coastal Wattle Pigface	None

10.2 Weed Management

In previous reporting periods Hunter Land Management (HLM) was commissioned to complete weed management activities at the Stockton Quarry, with a focus directed at Bitou Bush weed spraying.

During the reporting period, weed management was conducted internally. This was partially due to reduced production and therefore staff were available for weeding activities. Weed management predominantly consisted of targeted spraying, cutting and pulling of Bitou Bush on a weekly basis.

Boral has confirmed that Port Stephens Council is aware of the presence of Chinese Violet on site and that the locations have been recorded on their register.

The following weeds will continue to be targeted during future mixed weed spraying campaigns.

- Chinese Violet
- Mother of Millions
- Ambrosia
- Berry Bush
- Bitou Bush
- Burr
- Canary Island Date Palm
- Castor Oil Plant
- Cobblers Pegs
- Dandelion
- Fire Weed
- Fleabane
- Guinea Grass
- Lantana
- Milk Thistle
- Natal Grass
- Pampas Grass
- Primrose
- Purple Top
- Rocket
- Salt Bush
- Scotch Thistle
- Sticky Weed
- Stinking Roger
- Summer Grass
- Torpedo Grass
- Vetch.

10.3 Feral Animal Control

No wild dog baiting was conducted during the reporting period.

11. Community

11.1 Security and Public Safety

Security Incidents

A total of 26 recorded security and public safety incidents occurred during the reporting period as outlined in **Table 14** below.

Table 14
Security Incidents

Date	Event
9 February	A member of the public drove into the quarry
20 February	A member of the public drove a LV into the site, along haul road toward the beach
26 February	Two unknown persons cut through the compound perimeter fence and gained entry to the site compound. The fuel cap on the Water Cart was broken and diesel fuel was syphoned
16 March	Private recreational vehicle was observed driving inside the site fence on dune, in an area that FEL was operating
7 June	Unknown vehicle drove through the Beach Gates into Pit 7 snapping metal gate
14 June	A member of the public drove a LV into the site, along haul road toward the beach
19 June	A member of the public entered work area of FEL
4 July	A member of the public drove into site compound
17 July	A member of the public was spotted on haul road and escorted offsite
19 July	Group of quad bikes entered Pit 7 South, driving on haul road and along dune
19 July	DPE Contractor accessed Pit 7 South to undertake unauthorised survey works
29 August	A member of the public drove onto site and down haul road towards Pit 7
11 September	Quadbikes travelling along Pit 7 haul road into bush at RB3
12 September	A member of the public drove through compound a down haul road towards Pit 7 to gain access to beach
15 September	A member of the public drove a LV into the site, along haul road toward the beach
21 September	A member of the public drove a LV into the site, along haul road toward the beach
27 September	Members of the public accessed a sand dune in the Pit adjacent to where the loader and dozer were operating
5 October	Quadbike entered into Pit 7 South when FEL and Dozer were operating.
18 October	Quadbike riders were spotted riding along bush track near Pit 6
10 November	Kids sliding down sand dune in Pit 7 South whilst loader operating in the area
16 November	Quadbike has attempted to push over rehab fence to gain access to rehab area
20 November	A member of the public drove a LV into the site, along haul road toward the beach
17 November	Two youths on Quad Bikes accessed Pit 7 South whilst Loader in operation
1 December	Member of public became bogged in sand in Pit 7
18 December	A member of the public drove a LV into the site, along haul road toward the beach
19 December	A member of the public drove a LV into the site, along haul road toward the beach

Status of Fencing

The existing fencing arrangement was continued throughout the reporting period with the maintenance of high visibility line/reflective tags and warning signs surrounding the operations area (consistent with **Figure 6**). The high visibility line/reflective tags and warning signs are installed at the property boundary as this has been proven to reduce the potential for vandalism of the signs to occur (compared with previous practices that applied the signs 50m outside of the high visibility line/reflective tags).

These signs and high visibility line on the current fencing are maintained in place during operational and non-operational times. Personnel check the signs and high visibility line regularly to ensure they are in place and immediately repair any damaged sections. Posts for signage and high visibility line are made of flexible shatterproof plastic to prevent injury to public during possible collision. The warning signs are now attached to stakes using eyelets to improve performance during strong wind conditions.

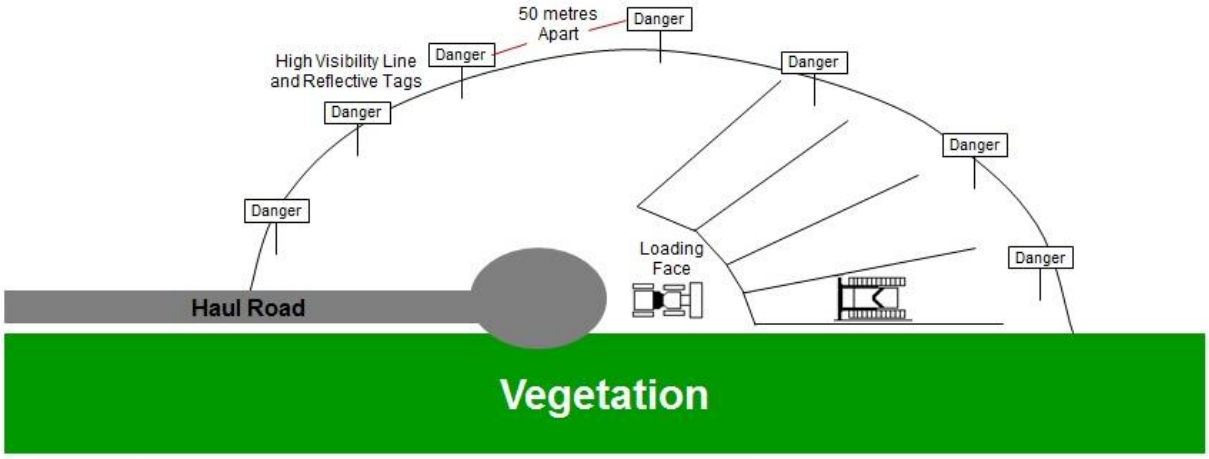

Figure 6 **Plan View of Extraction Area showing Signage and High Visibility Line**

Current Public Risk Controls

In addition to procedures and standards required by Boral, the following controls have also been in place during the reporting period to reduce the risk of public interaction.

- **Operate and maintain safe batters**
  Boral continues to maintain a working extraction area face that does not produce a grade greater than 1:3 (V:H) (18 degrees at the base) to blend the extraction area with the surrounding dune system to limit risks to quad bikers and 4WD vehicles.

- **Equipment Requirements**
  Heavy earthmoving equipment continues to operate on the windblown dunes with fit-for-purpose safety equipment, such as, flashing lights for visibility in all weather conditions, UHF radio for site communications and rear camera.

- **Operating Hours**

  Boral has elected to limit operation on Saturdays unless required to satisfy client demand. Although operations on a Saturday are approved between the hours of 6.15am and 12pm (and 6.15am to 3.00pm during major supply contacts), the hours of operation have been reduced due to the decrease in production on site.

- **Trespasser Procedures**

  Truck drivers and quarry personnel continue to inform site management in the event they notice any trespassers (including pedestrians, 4WD vehicles, motorcyclists or equestrians) within the site following which the procedure requires that all heavy vehicle machinery is stopped until safe to do so (i.e. the trespasser leaves the Quarry).

11.2 Complaints Records and Management

Condition M4.1 within EPL 10132 requires the licensee to keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies. *Condition M5.1* requires a telephone complaint line for the purpose of receiving any complaints from the members of the public in relation to activities conducted at the premises or by the vehicle or mobile plant.

No complaints were received on the Boral special complaints line established for the Quarry during the reporting period which is consistent with the previous reporting period.

No complaints were received from DPIE, Council or any other authority during the reporting period.

Complaints will continue to be logged within the complaints register and investigated fully when they are received.

11.3 Compliance Summary

An internal compliance review was undertaken by R.W. Corkery & Co. during a site visit on 14 February 2024 and is provided as **Appendix 1**. The compliance review considers all conditions of DA 140-6-2005 and EPL 10132 as well as the EIS for the operation (ERM, 2005) and associated application documents and management plans.

In summary, the operation remained generally compliant with its conditional requirements during the reporting period, however, aspects of the groundwater and surface water monitoring program were not undertaken in accordance with GWMP. Details of the oversights are included in Sections 9.1.1 and 9.2.1.

It is acknowledged that failure to implement the monitoring requirements under the GWMP was non-compliant with both the GWMP and DA 140-6-2005, however the risk of environmental harm was minor given the long history of compliance and good environmental performance at the Quarry.

12. Activities to be Completed in the next Reporting Period

The following section provides a brief summary of the operational activities planned throughout 2024. **Figure 7** presents the location(s) of the activities described.

12.1 Extraction and Loading Activities

Extraction of concrete sand will continue within Pit 7 throughout the next reporting period, i.e. from 1 January 2024 to 31 December 2024. **Figure 7** displays the approximate area of sand extraction proposed throughout 2024.

12.2 Processing Activities

Campaign screening will be undertaken where necessary throughout the reporting period, likely operating for a few weeks at a time. Screening will operate within the active extraction areas and stored adjacent to the active extraction areas.

The screening campaigns will result in product stockpiles being ready for direct loading to product vehicles, as required.

12.3 Water Management

Surface water and groundwater will continue to be managed in accordance with the Erosion and Sediment Management Plan and GWMP.

12.4 Waste Management

The dedicated waste metal bin and waste skips will continue to be utilised throughout the reporting period. The existing fortnightly general waste collection service will also continue.

Waste oil is collected and stored within a 300L bunded tank, located within the fuel storage and maintenance shed. Renewable Oils will continue to remove the waste oil at regular intervals as required, with this expected to occur quarterly during the reporting period, similar to previous reporting periods.

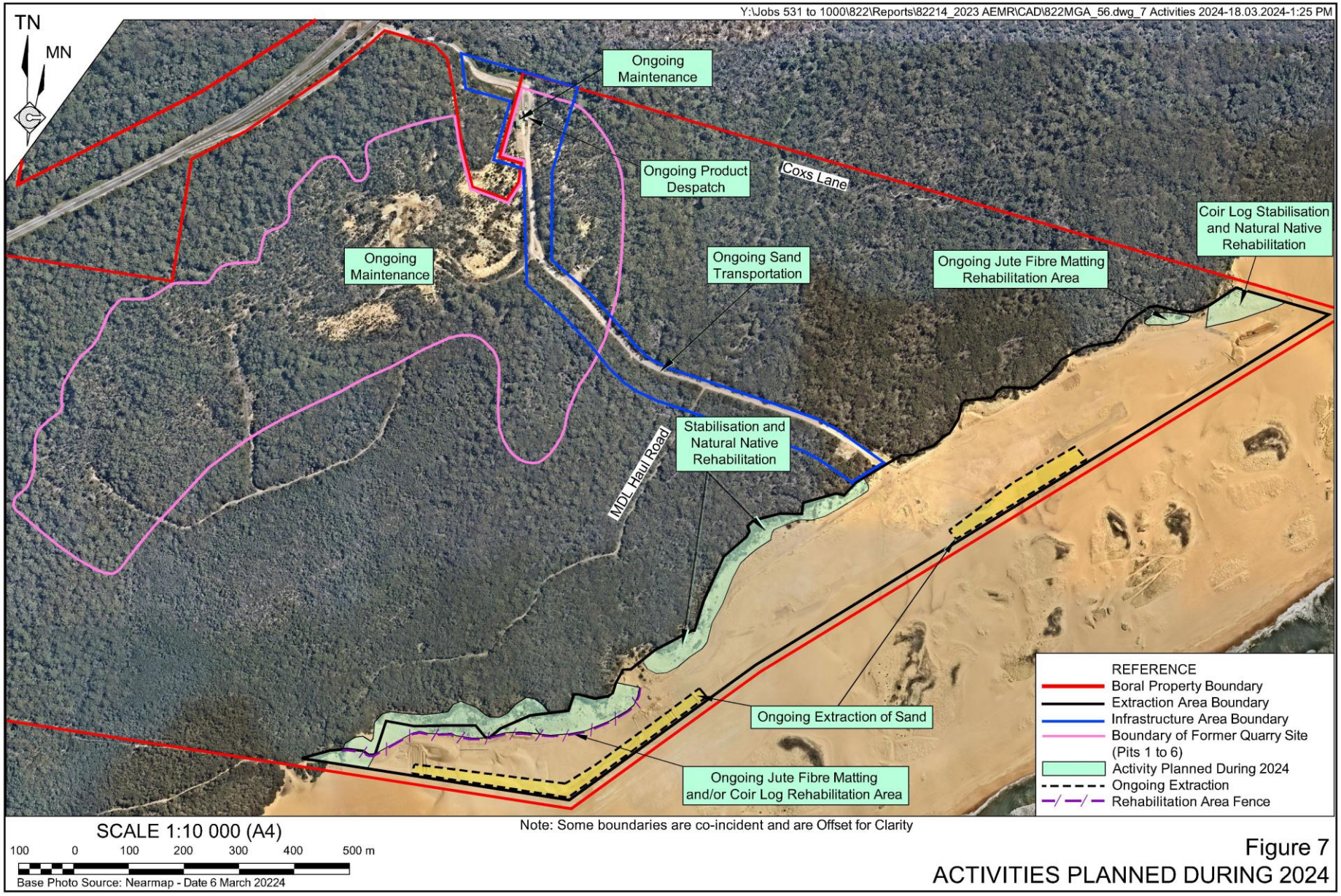

Figure 7
ACTIVITIES PLANNED DURING 2024

12.5 Product Despatch

All products will continue to be despatched via the on-site weighbridge and all laden trucks will continue to travel westwards along Coxs Lane and use the southbound on-ramp to Nelson Bay Road. It is conservatively estimated that 4,230 laden truck loads would be despatched from the Quarry in 2024.

The final destination for sand products will continue to be split consistent with current operations with approximately half despatched to the south and half despatched to the north of the Quarry.

12.6 Security and Public Safety

It is proposed that the fencing arrangement within the 2024 reporting period will involve the ongoing use of high visibility line with reflective tags and warning signs as displayed on **Figure 6**. Posts for signage and high visibility line are made of flexible shatterproof plastic to prevent injury to public during possible collision.

12.7 Rehabilitation Activities

The following rehabilitation activities are planned to occur throughout the 2024 reporting period, subject to suitable climatic conditions and other external factors.

- Ongoing management of active jute fibre matting areas within transgressive dune system located on the border to existing vegetated areas.
- Application of coir logs (see **Figure 7**) to stabilise the dune surface and encourage natural revegetation. Areas that have started to degrade will be recovered.
- Ongoing maintenance of Pit 6 rehabilitation area.
- Continued natural revegetation on final stages on the western side of the previously extracted eastern extraction area (see **Figure 7**).
- 1080 baiting programs undertaken in consultation with National Parks and other local landowners, would continue in the event there is an increase in feral animal sightings.
- Weed management by HLM will be re-established to maintain previously rehabilitated areas to ensure that germinating weeds are eradicated before re-establishment. Weed management of ongoing rehabilitation areas will continue to be undertaken internally.

12.8 Environmental Documentation

It is noted that all management plans for the site will be reviewed and updated, where required, following the completion of the independent audit that will be completed in 2024.

13. References

ANZECC (2000). *Australian and New Zealand Guidelines Fresh and Marine Water Quality.*

Boral Resources (NSW) Pty Ltd (2018). *Erosion and Sediment Control Plan*, July 2018.

ERM (2005). *Stockton Sandpit Windblown Sand Extraction Environmental Impact Statement*. Prepared for Boral Resources (Country) Pty Ltd.

ECS (2017) *Environmental Management Strategy.* Compiled on behalf of Boral Resources (NSW) Pty Ltd

Jacobs Group (Australia) Pty Limited (2019). *Groundwater Management Plan*. Prepared for Boral Resources (NSW) Pty Ltd.

Jacobs Group (Australia) Pty Limited (2024). *Groundwater Assessment for 2023 AEMR*. Compiled on behalf of Boral Resources (NSW) Pty Ltd.

R.W. Corkery & Co. Pty Limited (RWC) (2018). *Rehabilitation and Landscape Management Plan*. Prepared on behalf of Boral Resources (NSW) Pty Ltd.

Appendix 1

Compliance Schedule for Relevant Development Consent Conditions for Stockton Transgressive Dune Quarry Activities

1 January 2023 to 31 December 2023

(Total No. of pages including blank pages = 22)

Table A1-1
Internal Compliance Audit of Relevant Conditions of Development Consent DA94-4-2004 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 2: ADMINISTRATION CONDITIONS				
Obligation to Minimise Harm to the Environment				
1.	The Applicant shall implement all practicable measures to prevent and/or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the development.	Yes	No harm to the environment resulted from the operation or rehabilitation of the Quarry during the reporting period.	O/D
Terms of Approval				
2.	The Applicant shall carry out the development generally in accordance with the: a) Development Application: DA 140-6-2005 b) EIS titled Environmental Impact Statement Stockton Sandpit Extraction, dated June 2005; c) report titled Stockton Quarry EIS Response to Submissions, dated August 2005; d) Letter from Environmental Resources Management Australia Pty Ltd to the Department dated 20 October 2005 about site rehabilitation; e) the modification application for Mod 2 and supporting letter dated 12 January 2011; and f) conditions of this development consent.	Yes		O/D
3.	If there is any inconsistency between the above documents, the most recent document shall prevail to the extent of the inconsistency. However, the conditions of this approval shall prevail to the extent of any inconsistency.	N/A		
4.	The Applicant shall comply with any reasonable requirements of the Director-General arising from the Department's assessment of: a) any reports, plans or correspondence that are submitted in accordance with this development consent; and b) the implementation of any actions or measures contained in these reports, plans or correspondence.	Yes	All reasonable requirements made by DPIE were addressed during the reporting period as outlined in Sections 6.1 and 6.2.	O/D

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Table A1-1 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Development Consent DA94-4-2004 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 2: ADMINISTRATION CONDITIONS (Cont'd)				
Limits on Approval				
5.	Quarrying operations may take place on the site for a period of 20 years after the commencement of operations.	NYA		
6.	The Applicant shall not transport more than 500 000 tonnes of product from the site each calendar year.	Yes	Annual production during the reporting period was 118,821 tonnes.	D
7.	The Applicant shall not extract sand or carry out any work below 2.5m AHD.	Yes	Boral confirmed that extraction did not occur below 2.5m AHD during the reporting period. Depth markers have been installed within Pit 7 to ensure this limit is not exceeded.	O
Protection of Public Infrastructure				
8.	The Applicant shall: a) repair, or pay the full costs associated with repairing any public infrastructure that is damaged by the development; and b) relocate, or pay the full costs associated with relocating any public infrastructure that needs to be relocated as a result of the development.	N/A	No public infrastructure was damaged or needed to be relocated during the reporting period.	O
Operation of Plant and Equipment				
9.	The Applicant shall ensure that all plant and equipment at the site, or used in connection with the development, are: a) maintained in a proper and efficient condition; and b) operated in a proper and efficient manner.	Yes	Boral reported that all equipment was maintained during the reporting period.	O
Reporting				
10.	At least one month before operations commence, the Applicant shall notify the Director-General in writing of the date of the commencement of operation of the development.	N/A	Not applicable to the reporting period.	

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Internal Compliance Audit of Relevant Conditions of Development Consent DA94-4-2004 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: SPECIFIC ENVIRONMENTAL CONDITIONS				
GENERAL EXTRACTION AND PROCESSING PROVISIONS				
Identification of Boundaries				
1.	Prior to carrying out any development on the site, the Applicant shall: a) engage a registered surveyor to mark out the boundaries of the approved limits of extraction; and	NYA	Not applicable to the reporting period.	D
	b) submit a survey plan of these boundaries to the Director-General, to the satisfaction of the Director-General.	NYA	Not applicable to the reporting period.	D
TRAFFIC AND TRANSPORT				
Transport Route				
2.	The Applicant shall ensure that all heavy vehicles coming to or leaving the site use the Nelson Bay Road interchange, and do not use Fullerton Cove Road and Coxs Lane west of the Nelson Bay Road interchange, except as directed by the Police or other authorities.	Yes	Boral reported that all vehicles used the approved transport route.	D
Road Haulage				
3.	The Applicant shall ensure that all loaded vehicles entering or leaving the site are covered.	Yes	Boral reported that all loads were covered during the reporting period.	O
4.	The Applicant shall ensure that all loaded vehicles leaving the site are cleaned of materials that may fall on the road before they are allowed to leave the site.	Yes	Boral reported that during the reporting period no material was tracked onto external roads.	O
Haul Road				
5.	The Applicant shall construct the proposed haul road on the site to the satisfaction of the Director-General.	N/A	Not applicable during the reporting period.	
Parking				
6.	The Applicant shall provide sufficient parking on-site for all quarry-related traffic to the satisfaction of the Director-General.	Yes	Sufficient parking is available at the site. Upgrades to the parking area were undertaken during the reporting period as discussed in Section 5.7.	O

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: SPECIFIC ENVIRONMENTAL CONDITIONS **GENERAL EXTRACTION AND PROCESSING PROVISIONS (Cont'd)**				
NOISE				
Noise Limits				
7.	The Applicant shall ensure that the noise generated by the development does not exceed 35dB(A) $L_{eq\ (15\ minute)}$ at the nearest residential receiver.	Yes	Boral conduct noise monitoring, only following complaints from residents which is consistent with the approved Environmental Management Strategy.	O
Operating Hours				
8.	The Applicant shall comply with the operating hours in Table 1: Table 1: Operating Hours	Yes	Boral reported that no operations occurred outside the approved operating hours during the reporting period. Operations do not typically occur on a Saturday.	D

Period	Normal Operations	During Major Supply Contracts
Monday to Friday	6.15am to 5.00pm	6.15am to 6.00pm
Saturday	6.15am to 12 noon	6.15am to 3.00pm
Sundays and Public Holidays	No operations	No operations

SOIL AND WATER				
Pollution of Waters				
9.	Except as may be expressly provided by a DEC licence, the Applicant shall comply with section 120 of the *Protection of the Environment Operations Act 1997*; during the carrying out of the development.	Yes	No pollution of waters occurred during the reporting period.	O
Monitoring and Management				
10.	Prior to carrying out any development on the site, the Applicant shall prepare and implement a Soil and Water Management Plan for the development, in consultation with DNR, and to the satisfaction of the Director-General. The Plan must be prepared by a suitably qualified hydrogeologist / hydrologist whose appointment(s) have been approved by the Director-General, and shall include: a) an Erosion and Sediment Control Plan; and b) a Ground Water Monitoring Program.	N/A	Not applicable during the reporting period.	

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: SPECIFIC ENVIRONMENTAL CONDITIONS GENERAL EXTRACTION AND PROCESSING PROVISIONS (Cont'd)				
SOIL AND WATER (Cont'd)				
Monitoring and Management (Cont'd)				
11.	The Erosion and Sediment Control Plan shall: a) be consistent with the requirements of Managing Urban Stormwater, Soils and Construction Volume 1, 4th edition (Landcom); b) identify activities that could cause soil erosion and generate sediment; c) describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters; d) describe the location, function, and capacity of erosion and sediment control structures; and e) describe what measures would be implemented to maintain the structures over time.	Yes	The approved Erosion and Sediment Control Plan satisfies these requirements.	D
12.	The Ground Water Monitoring Program shall include: a) detailed baseline data on ground water levels, flows and quality, based on statistical analysis, to benchmark the pre-quarrying natural variation in groundwater levels and quality; b) ground water impact assessment criteria; and c) a program to monitor ground water levels and quality.	No	The following matters were not undertaken in accordance with the approved GWMP. • Water quality and groundwater levels were not monitored at MW2 and MW11 due to the loss of the bores. • Consecutive groundwater quality quarterly trigger level exceedances were not actioned as per the GWMP Trigger Action Response Plan (TARP).	D/O
13.	Within 3 months of the completion of each independent environmental audit required under Condition 4, Schedule 4, the Applicant shall review, and if necessary, update the Soil and Water Management Plan to the satisfaction of the Director-General.	Yes	Not applicable to the reporting period.	D

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: SPECIFIC ENVIRONMENTAL CONDITIONS GENERAL EXTRACTION AND PROCESSING PROVISIONS (Cont'd)				
VISUAL IMPACT				
14.	The Applicant shall implement all practicable measures to minimise the visual impacts of the development on Stockton Beach to the satisfaction of the Director-General.	Yes	No actions required during reporting period.	O
HAZARD MANAGEMENT				
Safety				
15.	The Applicant shall: a) place appropriate warning signs surrounding the active extraction area; and	Yes	Warning signs are placed along the dune system to warn beach users of the presence of the Quarry.	O
	b) ensure that all sand extraction working faces are of no greater slope than 1:3 (V: H) when left at the end of each working day,	Yes	Boral reported that this condition was satisfied during the reporting period and was the case during the site visit.	O
	to the satisfaction of the Director-General.	Yes	The hazard management approach was approved in documentation relating to Modification 2 to the development consent in June 2011.	O
Dangerous Goods				
16.	The Applicant shall ensure that the storage, handling, and transport of dangerous goods are conducted in accordance with the relevant Australian Standards, particularly AS194C, and AS1596, and the Dangerous Goods Code.	Yes	All hazardous materials are stored in a secure bunded area consistent with the relevant Australian Standards.	O
BUSH FIRE MANAGEMENT				
17.	The Applicant shall: a) ensure that the development is suitably equipped to assist in the management of any fires on-site; and b) assist the rural fire service and emergency services as much as possible if there is a fire on-site.	Yes	Standard firefighting equipment is available, and Boral personnel are available to assist with regional firefighting where needed.	O
Rehabilitation				
18.	The Applicant shall progressively rehabilitate the site, including the batters, buffer area, floor of the extraction area and haul road, in a manner that is generally consistent with the final landform described in the EIS, to the satisfaction of the Director-General.	Yes	Rehabilitation activities continued during the reporting period to progressively develop the final landform and encourage vegetation grown along the dune system.	O

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Internal Compliance Audit of Relevant Conditions of Development Consent DA94-4-2004 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: SPECIFIC ENVIRONMENTAL CONDITIONS **GENERAL EXTRACTION AND PROCESSING PROVISIONS (Cont'd)**				
REHABILITATION AND LANDSCAPING				
Rehabilitation and Landscape Management Plan				
19.	Prior to carrying out any development on the site, the Applicant shall prepare and subsequently implement a Rehabilitation and Landscape Management Plan for the development in consultation with Council, and to the satisfaction of the Director-General. This plan must: a) identify the disturbed area at the site; b) describe in general the short, medium, and long-term measures that would be implemented to rehabilitate the site; c) describe in detail the measures that would be implemented over the next 5 years to rehabilitate the site; d) describe how the performance of these measures would be monitored over time; e) describe the measures that would be implemented to prevent and eradicate the occurrence of pests and weeds on the site; and f) set completion criteria for the rehabilitation of the site.	Yes	The approved Rehabilitation and Landscape Management Plan satisfies these requirements.	D
20.	Within 3 months of the completion of each independent environmental audit required under Condition 4, Schedule 4, the Applicant shall review, and if necessary, update the Rehabilitation and Landscape Management Plan to the satisfaction of the Director-General.	Yes	Not applicable to the reporting period.	D

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Internal Compliance Audit of Relevant Conditions of Development Consent DA94-4-2004 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: SPECIFIC ENVIRONMENTAL CONDITIONS GENERAL EXTRACTION AND PROCESSING PROVISIONS (Cont'd)				
REHABILITATION AND LANDSCAPING (Cont'd)				
Rehabilitation and Landscape Management Plan (Cont'd)				
Rehabilitation Bond				
21.	Prior to carrying out any development on the site, the Applicant shall lodge a rehabilitation bond for the development with the Director-General. The sum of the bond shall be calculated at \$0.50/m^2 for the total additional area to be disturbed in each 5 year review period, or as otherwise directed by the Director-General.	Yes	A Rehabilitation Bond has been submitted to DPE.	D
22.	Within 3 months of the completion of each independent environmental audit required under Condition 4, Schedule 4, the Applicant shall review, and if necessary, revise, the sum of the bond to the satisfaction of the Director-General. This review must consider: a) the effects of inflation; b) any changes to the total area of disturbance; and c) the performance of the rehabilitation against the completion criteria of the Rehabilitation and Landscape Management Plan.	Yes	Not applicable to the reporting period.	D
PRODUCTION DATA				
23.	The Applicant shall:			
	a) provide annual production data to the Department of Primary Industries using the standard form for that purpose; and	Yes	The annual production data is provided to the relevant government agencies each year.	D
	b) include a copy of this data in the AEMR.	Yes	This data is provided in Section 5.2 of the AEMR.	D
QUARRY EXIT STRATEGY				
24.	At least 3 years prior to the cessation of quarrying, the Applicant shall prepare a Quarry Exit Strategy for the development, in consultation with the Council, and to the satisfaction of the Director-General. The plan must: a) define the objectives and criteria for quarry closure; b) investigate options for the future use of the site;	NYA		

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 3: SPECIFIC ENVIRONMENTAL CONDITIONS **GENERAL EXTRACTION AND PROCESSING PROVISIONS (Cont'd)**				
QUARRY EXIT STRATEGY (Cont'd)				
24. (Cont'd)	c) describe the measures that would be implemented to minimise or manage the ongoing environmental effects of the development; and d) describe how the performance of these measures would be monitored over time.			
SCHEDULE 4 - ENVIRONMENTAL MANAGEMENT, MONITORING, AUDITING AND REPORTING				
ENVIRONMENTAL MANAGEMENT STRATEGY				
1.	Prior to carrying out any development on the site, the Applicant shall prepare, and subsequently implement, an Environmental Management Strategy for the development to the satisfaction of the Director-General. This strategy must: a) provide the strategic context for environmental management of the development; b) identify the statutory requirements that apply to the development; c) describe in general how the environmental performance of the development would be monitored and managed during the development; d) describe the procedures that would be implemented to: – keep the local community and relevant agencies informed about the operation – and environmental performance of the development; – receive, handle, respond to, and record complaints; – resolve any disputes that may arise during the course of the development; – respond to any non-compliance; – manage cumulative impacts; and – respond to emergencies; and	Yes	The approved Environmental Management Strategy satisfies these requirements.	D

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Internal Compliance Audit of Relevant Conditions of Development Consent DA94-4-2004 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 4 - ENVIRONMENTAL MANAGEMENT, MONITORING, AUDITING AND REPORTING (Cont'd)				
ENVIRONMENTAL MANAGEMENT STRATEGY (Cont'd)				
1. (Cont'd)	e) describe the role, responsibility, authority, and accountability of all the key personnel involved in environmental management of the development; and f) Be updated within 3 months of the completion of each independent environmental audit.			
2.	Within 3 months of the completion of each independent environmental audit required under Condition 4 below, the Applicant shall review, and if necessary, update the Strategy to the satisfaction of the Director-General	Yes	Not applicable to the reporting period.	D
ANNUAL REPORTING				
3.	Each year following the date of this consent, the Applicant shall prepare and submit an Annual Environmental Management Report (AEMR) to the Director-General and the relevant agencies. This report must:	Yes	This report	D
	a) identify the standards and performance measures that apply to the development; b) describe the works carried out in the last 12 months; c) describe the works that will be carried out in the next 12 months; d) include a summary of the complaints received during the past year, and compare this to the complaints received in previous years; e) include a summary of the monitoring results for the development during the past year; f) include an analysis of these monitoring results against the relevant: – impact assessment criteria; – monitoring results from previous years; and – predictions in the EIS.	Yes	These requirements are satisfied in this AEMR.	D

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Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
SCHEDULE 4 - ENVIRONMENTAL MANAGEMENT, MONITORING, AUDITING AND REPORTING (Cont'd)				
ANNUAL REPORTING (Cont'd)				
3. (Cont'd)	g) identify any trends in the monitoring results over the life of the development; h) identify any non-compliance during the previous year; and i) describe what actions were, or are being taken to ensure compliance.			
INDEPENDENT ENVIRONMENTAL AUDIT				
4.	Within 3 years of the date of this consent, and every 5 years thereafter, unless the Director-General directs otherwise, the Applicant shall commission and pay the full cost of an Independent Environmental Audit of the development. This audit must:	Yes	Not applicable to the reporting period.	D
5.	Within 3 months of commissioning this audit, the Applicant shall submit a copy of the audit report to the Director-General, with a response to the recommendations contained in the audit report.	Yes	Not applicable to the reporting period.	D
ACCESS TO INFORMATION				
6.	Within 1 month of the approval of any management plan/strategy or monitoring program required under this consent (or any subsequent revision of these management plans/strategies or monitoring programs), the completion of the independent audits required under this consent, or the completion of the AEMR, the Applicant shall to the satisfaction of the Director-General: a) provide a copy of the relevant documents to the Council and relevant agencies; and b) ensure that a copy of the relevant documents is made publicly available at the quarry.	Yes	All relevant plans, strategies and audit have been provided to Council and are available for public review at the Quarry.	D

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Table A1-2
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
1. Administrative Conditions				
A1 - What the licence authorises and regulates				
A1.1	This licence authorises the carrying out of the scheduled activities listed below at the premises specified in A2. The activities are listed according to their scheduled activity classification, fee-based activity classification and the scale of the operation. Unless otherwise further restricted by a condition of this licence, the scale at which the activity is carried out must not exceed the maximum scale specified in this condition.	Yes	All activities remained consistent with the approved scheduled activities.	D
	Scheduled Activity / **Fee Based Activity** / **Scale**			
	Extractive Activities / Land-based extractive activity / > 100000 - 500000T extracted, processed or stored			
A2 - Premises or plant to which this licence applies				
A2.1	The licence applies to the following premises: **Premises Details** Stockton Sand Quarry 18-20 Cox's Lane Fullerton Cove NSW 2318 Lot 3 DP 664552, Lot 1 DP 1006399, Lot 2 DP 1006399 Part Portions 3 and 167 Parish of Stowell. DP 753192 and Crown Reserve R170039	N/A		
A3 - Information supplied to the EPA				
A3.1	Works and activities must be carried out in accordance with the proposal contained in the licence application, except as expressly provided by a condition of this licence.	Yes	All works and activities complied with the conditions of this licence during the reporting period.	O

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Table A1-2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
2. Limit Conditions				
L1 - Pollution of waters				
L1.1	Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.	Yes	No pollution of waters occurred during the reporting period.	Yes
L2 - Waste				
	The licensee must not cause, permit or allow any waste to be received at the premises, except the wastes expressly referred to in the column titled "Waste" and meeting the definition, if any, in the column titled "Description" in the table below. Any waste received at the premises must only be used for the activities referred to in relation to that waste in the column titled "Activity" in the table below. Any waste received at the premises is subject to those limits or conditions, if any, referred to in relation to that waste contained in the column titled "Other Limits" in the table below. This condition does not limit any other conditions in this licence.	Yes	No waste material was received on site during the reporting period.	Yes

Code	Waste	Description	Activity	Other Limits
NA	Waste	Any waste received on site that is below licensing thresholds in Schedule 1 of the POEO Act, as in force from time to time	-	NA
NA	General or Specific exempted waste	Waste that meets all the conditions of a resource recovery exemption under Clause 51A of the Protection of the Environment Operations (Waste) Regulation 2005.	As specified in each particular resource recovery exemption	NA

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Table A1-2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
2. Limit Conditions (Cont'd)				
L3 - Noise limits				
L3.1	Noise emissions from the premises must not exceed an $L_{eq(15\ minute)}$ noise emission criterion of 35 dB(A) at the nearest residential receiver.	Yes	While compliance with these limits was not demonstrated during the reporting period, the absence of complaints, location of the nearest receiver and historical compliance indicates that this condition would have been satisfied.	O
L3.2	Noise from the premises is to be measured at the worst affected point or within the residential boundary, or the most affected point within 30 metres of a dwelling (rural situations) where the dwelling is more than 30 metres from the boundary, to determine compliance with the noise limit in this licence.	Yes	While compliance with these limits was not demonstrated during the reporting period, the absence of complaints, location of the nearest receiver and historical compliance indicates that this condition would have been satisfied.	O
L3.3	The noise emission limit identified in this licence applies in the following weather conditions: • wind speed up to 3m/s at 10m above ground level; or • temperature inversion conditions of up to 30C/100m and wind speed up to 2m/s at 10m above ground level.	N/A		
3. Operating Conditions				
O1 - Activities must be carried out in a competent manner				
O1.1	Licensed activities must be carried out in a competent manner. This includes: a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.	Yes	Boral reports that all activities were carried out in a competent manner during the reporting period. This includes the management of materials and substances used to carry out the operation such as diesel and other hazardous substances. All waste generated by the operation was managed in accordance with the Environmental Management Strategy.	O
O2 - Maintenance of plant and equipment				
O2.1	All plant and equipment installed at the premises or used in connection with the licensed activity: a) must be maintained in a proper and efficient condition; and b) must be operated in a proper and efficient manner.	Yes	Boral reports that all plant and equipment was maintained and operated in a proper and efficient manner.	O

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Table A1-2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
3. Operating Conditions (Cont'd)				
O3 - Dust				
O3.1	The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.	Yes	Boral reports that dust was managed appropriately during the reporting period, and that they have purchased their own water cart.	O
O3.2	Trucks entering and leaving the premises that are carrying loads must be covered at all times, except during loading and unloading.	Yes	Boral reports that all loads were covered during the reporting period.	O
O4 - Processes and management				
O4.1	All fuel and chemicals stored on site must be stored in an appropriately sealed, bunded area as per EPA guidelines.	Yes	All fuel and chemicals were stored appropriately on site.	O
O5 - Other operating conditions				
O5.1	Rehabilitation Suitable barriers must be installed to restrict vehicular access to area awaiting or being rehabilitated.	Yes	Warning signs are in place along the dune system and areas under rehabilitation are fenced. However, given that the dune system is open to the beach areas, it is not possible to restrict beach users from the site permanently. A fence has been erected to block trespassers on the rehabilitation area.	O
	Stabilisation of regeneration areas must be carried out as soon as practicable to minimise wind-blown dust generated from the premises.	Yes	Areas within the site that are undergoing rehabilitation have in the past been stabilised with coconut fibre matting to reduce wind-blown dust and encourage revegetation.	O
	Rehabilitation must be carried out as quickly as practicable, in such a manner as to minimise dust generated and to prevent pollution.	Yes	Rehabilitation is commenced as soon as practical.	O
4. Monitoring and Recording Conditions				
M1 - Monitoring records				
M1.1	The results of any monitoring required to be conducted by this licence or a load calculation protocol must be recorded and retained as set out in this condition.	N/A	There are no monitoring requirements in EPL 10132.	D
M1.2	All records required to be kept by this licence must be: a) in a legible form, or in a form that can readily be reduced to a legible form; b) kept for at least 4 years after the monitoring or event to which they relate took place; and	N/A	There are no monitoring requirements in EPL 10132.	D

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Table A1-2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
4. Monitoring and Recording Conditions (Cont'd)				
M1 - Monitoring records (Cont'd)				
M1.2 (Cont'd)	c) produced in a legible form to any authorised officer of the EPA who asks to see them. The following records must be kept in respect of any samples required to be collected for the purposes of this licence: a) the date(s) on which the sample was taken; b) the time(s) at which the sample was collected; c) the point at which the sample was taken; and d) the name of the person who collected the sample.			
M2 Recording of pollution complaints				
M2.1	The licensee must keep a legible record of all complaints made to the licensee or any employee or agent of the licensee in relation to pollution arising from any activity to which this licence applies.	Yes	A complaints register is maintained, however no complaints were received during the reporting period.	O
M2.2	The record must include details of the following: a) the date and time of the complaint; b) the method by which the complaint was made; c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect; d) the nature of the complaint; e) the action taken by the licensee in relation to the complaint, including any follow-up contact with the complainant; and f) if no action was taken by the licensee, the reasons why no action was taken.	Yes	A complaints register is maintained, however no complaints were received during the reporting period.	O
M2.3	The record of a complaint must be kept for at least 4 years after the complaint was made.	Yes	A complaints register is maintained, however no complaints were received during the reporting period.	O

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Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
4. Monitoring and Recording Conditions (Cont'd)				
M2 Recording of pollution complaints (Cont'd)				
M2.4	The record must be produced to any authorised officer of the EPA who asks to see them.	NYA	No requests were received during the reporting period.	O
M3 - Telephone complaints line				
M3.1	The licensee must operate during its operating hours a telephone complaints line for the purpose of receiving any complaints from embers of the public in relation to activities conducted at the premises or by the vehicle or mobile plant, unless otherwise specified in the licence.	Yes	A telephone complaints line was maintained, however no complaints were received during the reporting period.	O
M3.2	The licensee must notify the public of the complaints line telephone number and the fact that it is a complaints line so that the impacted community knows how to make a complaint.	Yes	The telephone complaints number is displayed on the front gate of the Quarry.	O
M3.3	The preceding two conditions do not apply until 3 months after: a) the date of the issue of this licence or b) if this licence is a replacement licence within the meaning of the Protection of the Environment	Noted		
5. Reporting Conditions				
R1 - Annual return documents				
R1.1	The licensee must complete and supply to the EPA an Annual Return in the approved form comprising: a) a Statement of Compliance; and b) a Monitoring and Complaints Summary. At the end of each reporting period, the EPA will provide to the licensee a copy of the form that must be completed and returned to the EPA.	Yes	Annual Return submitted for the period 1 December 2022 to 30 November 2023.	D
R1.2	An Annual Return must be prepared in respect of each reporting period, except as provided below.	Noted		

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Table A1-2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
5. Reporting Conditions (Cont'd)				
R1 - Annual return documents (Cont'd)				
R1.3	Where this licence is transferred from the licensee to a new licensee: a) the transferring licensee must prepare an Annual Return for the period commencing on the first day of the reporting period and ending on the date the application for the transfer of the licence to the new licensee is granted; and b) the new licensee must prepare an Annual Return for the period commencing on the date the application for the transfer of the licence is granted and ending on the last day of the reporting period.	Noted		
R1.4	Where this licence is surrendered by the licensee or revoked by the EPA or Minister, the licensee must prepare an Annual Return in respect of the period commencing on the first day of the reporting period and ending on: a) in relation to the surrender of a licence - the date when notice in writing of approval of the surrender is given; or b) in relation to the revocation of the licence - the date from which notice revoking the licence operates.	Noted Noted		
R1.5	The Annual Return for the reporting period must be supplied to the EPA by registered post not later than 60 days after the end of each reporting period or in the case of a transferring licence not later than 60 days after the date the transfer was granted (the 'due date').	Yes	Annual Return submitted for the period 1 December 2022 to 30 November 2023.	D
R1.6	The licensee must retain a copy of the Annual Return supplied to the EPA for a period of at least 4 years after the Annual Return was due to be supplied to the EPA.	Noted		

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Table A1-2 (Cont'd)
Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
5. Reporting Conditions (Cont'd)				
R1 - Annual return documents (Cont'd)				
R1.7	Within the Annual Return, the Statement of Compliance must be certified and the Monitoring and Complaints Summary must be signed by: a) the licence holder; or b) by a person approved in writing by the EPA to sign on behalf of the licence holder.	Yes	Compliance declaration was signed by the Quarry Manager, Operations Manager, General Manager and Environmental Manager.	
R1.8	A person who has been given written approval to certify a certificate of compliance under a licence issued under the Pollution Control Act 1970 is taken to be approved for the purpose of this condition until the date of first review of this licence.	Noted		
R2 - Notification of environmental harm				
R2.1	Notifications must be made by telephoning the Environment Line service on 131 555.	Noted		
R2.2	The licensee must provide written details of the notification to the EPA within 7 days of the date on which the incident occurred.	Noted	No notifications were required during the reporting period.	O
R3 - Written report				
R3.1	Where an authorised officer of the EPA suspects on reasonable grounds that: a) where this licence applies to premises, an event has occurred at the premises; or b) where this licence applies to vehicles or mobile plant, an event has occurred in connection with the carrying out of the activities authorised by this licence, and the event has caused, is causing or is likely to cause material harm to the environment (whether the harm occurs on or off premises to which the licence applies), the authorised officer may request a written report of the event.	Noted		

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Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
5. Reporting Conditions (Cont'd)				
R3 - Written report (Cont'd)				
R3.2	The licensee must make all reasonable inquiries in relation to the event and supply the report to the EPA within such time as may be specified in the request.	Noted		
R3.3	The request may require a report which includes any or all of the following information: a) the cause, time and duration of the event; b) the type, volume and concentration of every pollutant discharged as a result of the event; c) the name, address and business hours telephone number of employees or agents of the licensee, or a specified class of them, who witnessed the event; d) the name, address and business hours telephone number of every other person (of whom the licensee is aware) who witnessed the event, unless the licensee has been unable to obtain that information after making reasonable effort; e) action taken by the licensee in relation to the event, including any follow-up contact with any complainants; f) details of any measure taken or proposed to be taken to prevent or mitigate against a recurrence of such an event; and g) any other relevant matters.	Noted		
R3.4	The EPA may make a written request for further details in relation to any of the above matters if it is not satisfied with the report provided by the licensee. The licensee must provide such further details to the EPA within the time specified in the request.	Noted		

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Internal Compliance Audit of Relevant Conditions of Environment Protection Licence 10132 for Stockton Transgressive Dune Quarry from 1 January 2023 to 31 December 2023

Condition No.	Paraphrased Requirement	Compliance	Comment	Basis*
6. General Conditions				
G1 - Copy of licence kept at the premises or plant				
G1.1	A copy of this licence must be kept at the premises to which the licence applies.	Yes	A copy of the licence is available at the Quarry.	D
G1.2	The licence must be produced to any authorised officer of the EPA who asks to see it.	Noted		
G1.3	The licence must be available for inspection by any employee or agent of the licensee working at the premises.	Noted		

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Appendix 2

Stockton Sand Quarry Annual Groundwater Monitoring Review for the 2023 AEMR

(Total No. of pages including blank pages = 69)

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02 April 2024

Attention: Caiden O'Connor
RW Corkery & Co
By email

Project Name: Stockton Sand Quarry
Project Number: IA133802

Subject: Groundwater assessment for 2023 AEMR

Dear Caiden,

This letter report has been prepared on behalf of Boral Resources (NSW) Pty Ltd ("Boral") to provide a review of the results of groundwater and surface water monitoring at Boral's NSW Stockton Sand Quarry (the Quarry) between 1 January 2023 and 31 December 2023 (the "reporting period").

The report is intended to support the Annual Environmental Management Report (AEMR) for the Quarry, prepared in accordance with Development Consent DA No. 140-6-2005 ("DA 140-6-2005") *Condition 4 (3).*

1. Quarry background

The development consent for the Quarry was granted on 24 January 2006 and was amended in May 2006 and again in June 2011. The Quarry commenced operations on 15 October 2008 and involves the extraction of windblown sand from the unsaturated zone of the Stockton sand dunes.

Historic heavy mineral sand extraction operations have previously occurred in the area dating back to 1976, including within the backdune and foredune areas.

The Quarry area is located within the Stockton Groundwater Source of the Water Sharing Plan for the North Coast Coastal Sands Groundwater Sources 2016. The Quarry activities are not regulated under this Water Sharing Plan as the Quarry does not intercept or extract groundwater.

2. Relevant development consent conditions

Groundwater within the Quarry is monitored in accordance with the approved groundwater monitoring program (see Section 3) and utilises the current groundwater monitoring network (Figure 1, Appendix A) to collect data for analysis and subsequent inclusion within the AEMR.

DA 140-6-2005, *Condition 3 (12)* states:

> The Groundwater Monitoring Program shall include:
>
> a) Detailed baseline data on groundwater levels, flows and quality, based on statistical analysis, to benchmark the pre-quarrying natural variation in groundwater levels and quality;
>
> b) Groundwater impact assessment criteria; and
>
> c) A program to monitor groundwater levels and quality

The Environment Protection Licence (No. 10132) for the Quarry does not specify any groundwater monitoring but outlines in *Condition L1.1* that the licensee must comply with Section 120 of the *Protection of the Environment Operations Act (1997)* (based upon no specific water quality limit conditions).

3. Groundwater monitoring program

3.1 Overview

A groundwater monitoring program (GWMP) was first prepared for the Quarry in 2008 (ERM, 2008). Numerous subsequent revisions have been undertaken (ERM, 2010, RPS Aquaterra, 2011, RPS, 2014, and RPS, 2015). However, until March 2020, the original 2008 GWMP remained the only document to have been formally approved by the NSW Department of Planning, Industry and Environment (DoPIE) or its predecessor departments. In March 2020, the NSW DoPIE approved an updated GWMP prepared by Jacobs (2019) (the 2019 GWMP).

The 2023 groundwater monitoring data has been assessed in accordance with the 2019 GWMP.

The 2019 GWMP documents baseline groundwater data and trigger levels based on a ten year data period (2007 to 2017). The purpose of the baseline data was to represent groundwater level and quality conditions which have not been altered due to quarrying. The purpose of the trigger levels was to provide quantitative limits, that if exceeded during future groundwater monitoring rounds, would prompt the results to be confirmed and reported to agencies and be assessed by an independent hydrogeologist / environmental scientist.

The baseline data period included data collected after commencement of quarrying in 2008 as at the time of the 2019 GWMP, no groundwater impacts due to quarrying had been identified. It was therefore considered that groundwater data collected throughout the entire ten year period was representative of baseline conditions.

It is noted that the 2019 GWMP outlines water quality monitoring for four surface water sites to monitor conditions in the vicinity of groundwater dependent ecosystems (GDEs). This surface water quality monitoring was adopted from a Surface Water Management Plan prepared by Boral (2018).

3.2 Groundwater monitoring network

With the exception of MW2 and MW11, the groundwater monitoring network, as documented in the 2019 GWMP, is summarised in Table 1. MW11 was reported as destroyed in the 2020 review of groundwater data (Jacobs, 2020). MW2 was found to have been destroyed by a vehicle sometime during October 2021. The current monitoring network is shown in Figure 1, Appendix A. The historic groundwater monitoring network is also included in Table 1 and is shown in

Figure 2, Appendix A.

Despite MW2 and MW11 being destroyed, the current monitoring network is considered suitable. It is noted that there is now a substantial monitoring gap between MW1 and MW5, however with the lack of historical impacts due to quarrying and the low risk of future impacts, the reduced number of monitoring bores is not considered to pose a significant risk.

Table 1: Stockton Sand Quarry groundwater monitoring network

Location ID	Easting (MGA94)	Northing (MGA94)	Elevation (m AHD)	Depth (mBGL)	Screened Interval (mBGL)	Status
Current groundwater monitoring network – Figure 1, Appendix A						
MW1	391032.68	6364177.29	4.41	25	19 – 25	Active
MW5	391588.87	6364388.10	4.89	8	2 – 8	Active
MW6	391781.34	6364527.27	3.51	8	2 – 8	Active
MW7	392042.74	6364700.52	4.03	8	2 – 8	Active
MW8	392242.75	6364807.46	2.98	8	2 – 8	Active
MW9	392413.71	6364895.09	5.50	8	2 – 8	Active
GW1	391421	6364854	3.0	N/A	N/A	Active
GW2	392028.71	6365103.30	2.99	N/A	N/A	Active
GW3	391884.98	6364614.76	4.00	N/A	N/A	Active
GW4	390446.05	6364167.1	3.86	N/A	N/A	Active
Historical groundwater monitoring network - Figure 2, Appendix A						
MW1	391128	6364095	21.7	22.7	19.7 – 22.7	Destroyed
MW2 (most recent, included in 2019 GWMP)	391351.81	6363950.74	9.86	25	19 – 25	Destroyed
MW2	391331	6364058	23.8	25	22 – 25	Destroyed
MW3 (old)	391457	6364185	21.0	23.5	20.5 – 23	Destroyed
MW3	391428	6364225	19.5	25	19 – 25	Destroyed
MW4	391699	6364229	9.5	10	7 – 10	Destroyed
MW5 (old)	391670	6364404	14.2	NA	NA	Destroyed
MW5A	391677	3634494	6.0	15.8	12.8 – 15.8	Destroyed
MW6	391864	6364375	11.8	14.7	11.7 – 14.7	Destroyed
MW7	392080	6364628	14.1	17.5	14.5 – 17.5	Destroyed
MW8	392274	6364633	14.2	17.5	14.5 – 17.5	Destroyed
MW9	392338	6364846	2.6	5	2-5 – 0	Destroyed
MW10 (old)	392629	6364845	9.4	11.5	8.5 – 11.5	Destroyed

Location ID	Easting (MGA94)	Northing (MGA94)	Elevation (m AHD)	Depth (mBGL)	Screened Interval (mBGL)	Status
MW10	392604	6364757	11	21	15 – 21	Destroyed
MW11	392600	6364951	15.5	18	12 – 18	Destroyed
GW5	390705	6365182	na	na	na	Destroyed

3.3 Surface water monitoring network

Surface water monitoring sites, SW1, SW2, SW3 and SW4 are included in the 2019 GWMP to monitor Groundwater Dependent Ecosystems (GDEs) within close vicinity of the operational area. These sites are shown in Figure 3, Appendix A.

SW1 and SW2 are located inland of the current extraction area and intermittently contain surface water. GDEs near these sites comprise swamp forests in the dune swales and low lying heath.

SW3 and SW4 are located seaward of the extraction area. GDEs in the vicinity of SW3 and SW4 comprise small ephemeral and mobile shallow deflation basins, vegetated with a variety of grasses, sedges and reeds. Due to the variable nature of the foredune system, the locations of the two GDE monitoring sites may change between sampling programs.

3.4 Groundwater and surface water monitoring

3.4.1 Ongoing monitoring

Ongoing groundwater and surface water monitoring as outlined in the 2019 GWMP is summarised in Table 2 and Table 3, respectively.

Table 2: Groundwater monitoring program

Parameter	Frequency	Location
Water level	Monthly	All groundwater monitoring bores
Field water Quality Parameters • pH • EC	Quarterly	MW Series Groundwater Monitoring Bores
Laboratory Chemical Analysis • Na, K, Ca, Mg, HCO3, CO3, Cl, SO4 • Al, As, B, Cd, Cr, Cu, F, Fe, Hg, Mn, Ni, Pb, Se, Zn • Alkalinity, Hardness, Phosphorous, Nitrate-N, Sulphate	Quarterly	MW Series Groundwater Monitoring Bores

Table 3: Surface water monitoring program

Parameter	Frequency	Location
Field water quality parameters • pH • EC	Quarterly	All surface water monitoring sites
Laboratory Analysis • Na, K, Ca, Mg, HCO3, CO3, Cl, SO4 • Al, As, B, Cd, Cr, Cu, F, Fe, Hg, Mn, Ni, Pb, Se, Zn • Alkalinity, Hardness, Phosphorous, Nitrate-N, Sulphate	Quarterly	All surface water monitoring sites
Laboratory Analysis • BTEX, Benzene, Toluene, Ethylbenzene, TRH	Annually	All surface water monitoring sites

3.4.2 Trigger levels

Groundwater trigger levels, as defined in the 2019 GWMP, for groundwater levels, pH, EC and laboratory analytes are shown in Table 4, Table 6, Table 5 and Table 7, respectively. With respect to the surface water monitoring sites, the 2019 GWMP did not provide trigger levels for these sites due to insufficient baseline data. The 2019 GWMP required that these surface water sites be assessed against the ANZECC 2000 guidelines as shown Table 8 until of site specific trigger levels are developed.

Based on ANZG (2018) a minimum of 18 samples per surface water monitoring location is recommended to define surface water trigger levels. Surface water monitoring has been undertaken monthly for four consecutive years (2020 - 2023), and a total number of 48 samples have been collected for most analytes. The GWMP will be reviewed and updated after the upcoming five-year Independent Audit (due to be completed in 2024) and it is suggested that trigger levels for surface water are calculated as part of the review. It is noted that monthly sampling exceeds the recommended quarterly sampling frequency as defined in the 2019 GWMP. It is acknowledged that as the 2019 GWMP TRH and BTEX sample frequency is annual, definition of triggers levels for TRH, BTEX, Benzene, Toluene and Ethylbenzene based on statistical sampling results is not appropriate. The definition of these triggers levels is therefore outside the scope of this report. ANZG (2018) notes that increases in water hardness reduce the toxicity of some metals (cadmium, chromium, lead, nickel, zinc), and concentrations of these metals are compared to their hardness modified guideline levels.

Updated guidance on guideline-value derivation by Batley et al. (2018) and Warne et al. (2018) advised that no hardness adjustment should be undertaken for copper for chronic toxicity, but that hardness adjustments should still be incorporated for other hardness-sensitive metals until otherwise advised.

Table 4: Groundwater level trigger levels

Monitoring Location	Units	Upper Limit	Lower Limit
MW1	mAHD	2.92	0.98
MW2	mAHD	2.33	1.09
MW5	mAHD	2.51	0.77
MW6	mAHD	2.66	0.60
MW7	mAHD	2.52	1.17
MW8	mAHD	2.57	1.23
MW9	mAHD	2.56	1.22
GW1	mBGL	7.42	9.04
GW2	mBGL	0.27	2.00
GW3	mBGL	1.40	2.87
GW4	mBGL	1.58	2.86

mAHD – meters Australian Height Datum; mBGL – meters below ground level

Table 5: Groundwater pH trigger levels

Monitoring Location	Upper Threshold Limit (pH Units)	Lower Threshold Limit (pH Units)
MW1	7.47	5.67
MW2	7.86	7.05
MW5	7.68	5.88
MW6	7.65	6.60
MW7	7.53	6.64
MW8	7.59	6.71
MW9	8.33	4.93

Table 6: Groundwater EC trigger levels

Monitoring Location	Upper Threshold Limit (µS/cm)	Lower Threshold Limit (µS/cm)
MW1	444	195
MW2	719	287
MW5	1015	105
MW6	584	115
MW7	1037	470
MW8	1021	453
MW9	965	155

µS/cm: Micro Siemens per centimetre

Table 7: Groundwater trigger levels for laboratory analytes

Analyte	MW1		MW2		MW5		MW6		MW7		MW8		MW9	
	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit
Turbidity (NTU)	145.4	na	103	na	39.4	na	33.2	na	187	na	25.7	na	74.7	na
Chloride (mg/L)	47	15.8	42.0	13.8	200.5	na	44	3.8	134	na	190.2	na	136.3	na
Sulphate as SO4 (mg/L)	48.8	na	60.9	0.12	76.18	na	56.6	na	191.7	na	196	na	41.7	na
Aluminium (mg/l)	0.251	na	0.074	na	1.861	na	0.158	na	0.391	na	0.077	na	1.515	na
Arsenic (mg/L)	0.02	na	0.018	na	0.024	na	0.026	na	0.067	na	0.029	na	0.111	na
Boron (mg/L)	0.089	na	0.182	na	0.090	na	0.078	na	0.091	na	0.085	na	0.095	na
Calcium (mg/L)	76.2	na	121.0	28.4	141.1	na	102.9	1.86	196.5	5.1	197.2	18.7	140.2	na
Cadmium (mg/L)	0.003	na	0.002	na	0.003	na	0.002	na	0.002	na	0.002	na	0.004	na
Chromium (mg/L)	0.009	na	0.002	na	0.01	na	0.006	na	0.005	na	0.006	na	0.007	na
Copper (mg/L)	0.011	na	0.008	na	0.011	na	0.012	na	0.007	na	0.01	na	0.004	na
Iron (mg/L)	1.78	na	1.81	na	2.68	na	3.44	na	8.23	na	10.69	na	7.21	na
Potassium (mg/L)	4.6	na	3	na	5.7	na	2.8	na	5.2	0.4	4.6	0.3	7.1	na
Magnesium (mg/L)	9.7	na	8.5	5.3	20	na	7.6	na	14.3	1.8	14.1	1.1	12.1	2.8

Manganese (mg/L)	0.03	na	0.43	na	0.32	na	0.06	na	0.82	na	0.32	na	1.32	na
Nitrogen (mg/L)	0.001	na	0.001	na	0.001	na	0.001	na	0.001	na	0.001	na	0.001	na
Sodium (mg/L)	38.6	na	24.9	5.2	173.3	na	26.8	na	99.2	na	127.4	na	78.7	na
Nickel (mg/L)	0.026	na	0.01	na	0.076	na	0.074	na	0.012	na	0.064	na	0.022	na
Lead (mg/L)	0.008	na	0.0028	na	0.022	na	0.010	na	0.009	na	0.014	na	0.008	na
Selenium (mg/L)	0.009	na	0.01	na	0.011	na	0.011	na	0.009	na	0.009	na	0.009	na
Zinc (mg/L)	0.124	na	0.032	na	0.030	na	0.027	na	0.028	na	0.022	na	0.061	na
Filterable Reactive P (mg/L)	0.03	na	0.09	na	0.07	na	0.37	na	0.21	na	0.38	na	0.30	na
Nitrate -N (mg/L)	10.57	na	2.11	0.75	4.74	na	2.38	0.01	1.36	na	0.91	na	1.04	na
Alkalinity (mg CaCO3/L)	157.4	6.2	294.1	47.4	293.3	18.0	246	22.8	313.3	74.6	317.8	71.7	360.32	na
Hardness as CaCO3	170.5	66.4	374.46	278.6	431.2	117.7	274.4	144.2	487.1	274.8	501.1	283.8	484.7	11.1
Mercury (mg/L)	0.0016	na	0.0012	na	0.0016	na	0.0015	na	0.0016	na	0.0016	na	0.0016	na
Fluoride (mg/L)	0.755	0.002	0.183	0.042	0.753	na	0.726	na	0.732	na	0.746	na	0.736	na

Note: na – method results in negative value or value below limit of reporting.
nd – insufficient data

Table 8: Surface water trigger levels for laboratory analytes

Surface water monitoring point I.D	Location	Analyte	Guideline for assessment	Trigger Value
SW1	Eastern Inland Basin	Analytes as shown in Table 3	▪ ANZECC 2000 Freshwater aquatic ecosystem (slightly to moderately disturbed) 95% species protection ▪ ANZECC 2000 Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems, lowland rivers ▪ ANZECC 2000 Ranges of default trigger values for conductivity (EC, salinity), turbidity and suspended particulate matter (SPM) indicative of slightly disturbed ecosystems in south-east Australia, lowland rivers	Specific trigger levels to be confirmed in next review of GWMP
SW2	Western Inland Basin			
SW3	Eastern Seaward GDE		▪ ANZECC 2000 Marine aquatic ecosystem (slightly to moderately disturbed) 95% species protection ▪ ANZECC 2000 Default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems, lowland rivers ▪ ANZECC 2000 Ranges of default trigger values for conductivity (EC, salinity), turbidity and suspended particulate matter (SPM) indicative of slightly disturbed ecosystems in south-east Australia, lowland rivers	
SW4	Western Seaward GDE			

3.4.3 Trigger action response plan (TARP)

The 2019 GWMP outlines a Trigger Action Response Plan (TARP) which details the required responses in the case of groundwater trigger levels being exceeded. The TARP is shown in Table 9.

Table 9: Trigger Action Response Plan (TARP)

Aspect	Parameter	Frequency	Purpose	Trigger	Trigger Action	Purpose	Trigger Response Action	Responsibility
Groundwater level monitoring	Groundwater level	Monthly	To identify any impacts to the groundwater level due to quarry operations.	Two consecutive monthly observations indicating a steady decline in groundwater levels below the designated lower trigger level threshold (Table 4).	Repeat water level monitoring to confirm exceedance. Review data for accuracy. Refer the matter to an independent hydrogeologist / environmental scientist (or similar) to review.	Identify, investigate and report on impacts to groundwater levels. Inform agencies of baseline assessment and monitoring.	Inform relevant regulatory agencies within 7 days of being notified of the exceedance with an exceedance notification letter. Exceedance investigation report to be issued within 60-days of initial notification to authorities.	Boral Resources (NSW) Pty Limited Environmental Officer
Groundwater quality in monitoring bores	EC	Quarterly	To identify any impacts to the groundwater level due to quarry operations.	Two consecutive quarterly EC observations above the designated upper trigger level threshold values (Table 6).	Repeat sampling of monitoring bore exceeding trigger. Review data for accuracy. Refer the matter to an independent hydrogeologist / environmental scientist (or similar) to review.	Identify, investigate and report on impacts to groundwater quality. Potentially prompt further investigation and sampling for analytes. Confirm and review trigger levels.		
	pH			Two consecutive quarterly pH observations outside of the designated trigger level threshold values (Table 5).				
	Major Ions and Metals			Two consecutive quarterly observations above the designated upper trigger level threshold values (Table 7).				

4. Monitoring results

4.1 2023 groundwater monitoring network status

As reported in the 2020, 2021 and 2022 groundwater assessments, bores MW2 and MW11 which are both included in the 2019 GWMP groundwater monitoring network have been destroyed.

Boral have reported the loss of MW2 to NSW DPIE and advised that they are no longer able to carry out monitoring at the bore. Additionally, Boral have advised that they do not propose to replace the bore due to its location on Worimi lands under the control of National Parks (Boral do not have permission to carry out any works on Worimi/National Parks land), and have no way of protecting the bore from vandalism.

Jacobs has reviewed the current groundwater monitoring network in light of the loss of MW2 and MW11. Despite the loss of MW2 and MW11, the current monitoring network is considered appropriate and replacing MW2 and MW11 is not considered necessary.

4.2 2023 groundwater and surface water monitoring

Groundwater and surface water sampling were generally completed in accordance with the 2019 GWMP with the exception of the following:

- MW2 water quality was not monitored in 2023 as the bore was destroyed in October 2021.
- Consecutive groundwater quality quarterly trigger level exceedances were not actioned (i.e. repeat sampling, reporting and investigation) as per the 2019 GWMP TARP. There were consecutive quarterly trigger level exceedances at all groundwater monitoring locations. The associated analytes comprised aluminium, chromium, iron, potassium, sodium, chloride, phosphorus and hardness.
- At surface water monitoring sites, total recoverable hydrocarbons (TRH) have been monitored instead of total petroleum hydrocarbons (TPH), however results for TRH and TPH are more or less interchangeable.
- Surface water monitoring was undertaken generally monthly, which is greater than the quarterly frequency requirement for all analytes except TPH/TRH and BTEX (annual frequency).
- TRH was not reported for SW3 as the dam was dry at the time of sampling for TRH.

4.3 Groundwater levels

Groundwater levels measured in 2023 are shown in Table 10 and are plotted with rainfall (source: BOM Williamtown RAAF station) in Figure 4, Appendix A, which includes the entire historical data record.

In 2023, rainfall was significantly below the long-term average. January to April recorded average or near average rainfall and from May rainfall was well below the long-term average, with June only receiving 8.8 mm substantially less than the 121.5 mm monthly long-term average. Consequently, groundwater levels fell throughout the 2023 monitoring period. The decrease in groundwater levels, correspond to a decline in the cumulative rainfall deviation (CRD). The CRD is calculated from the cumulative sum of observed rainfall minus long-term average rainfall. A climbing CRD line slope represents above average rainfall whilst a declining slope represents below average rainfall. An association between groundwater levels and CRD, can indicate where rainfall recharge is an important process. The decrease in rainfall was reflected in groundwater levels which, decreased uniformly across all monitoring wells between July and December 2023.

Groundwater levels did not exceed the quarry's limit of extraction level of 2.5 mAHD in any of the monitoring locations. Groundwater levels plateaued from January to April with all monitoring wells recording the maximum values in this period.

Quarrying does not appear to be impacting groundwater levels throughout the reporting period.

Table 10: 2023 groundwater levels

	Groundwater level (mAHD)									
	GW1	**GW2**	**GW3**	**GW4**	**MW1**	**MW5**	**MW6**	**MW7**	**MW8**	**MW9**
Upper trigger	2.92	2.72	2.60	2.28	2.92	2.51	2.66	2.52	2.57	2.56
Lower trigger	0.98	0.99	1.13	1.00	0.98	0.77	0.60	1.17	1.23	1.22
	Date									
25/01/2023	1.92	2.12	1.82	1.68	1.67	1.72	1.81	1.88	1.87	1.85
23/02/2023	1.78	2.1	1.94	1.6	1.66	1.73	1.9	1.96	1.94	1.89
21/03/2023	-	-	-	-	1.54	1.59	1.65	1.71	1.72	1.71
22/03/2023	1.66	1.85	1.65	1.47	-	-	-	-	-	-
19/04/2023	1.74	1.96	1.84	1.52	1.64	1.76	1.86	1.91	1.91	1.9
17/05/2023	1.7	1.91	1.81	1.53	1.64	1.76	1.82	1.85	1.89	1.91
22/06/2023	-	-	-	-	1.73	1.76	1.82	1.84	1.86	1.86
23/06/2023	1.74	1.91	1.78	1.61	-	-	-	-	-	-
12/07/2023	1.67	1.83	1.72	1.56	1.68	1.71	1.74	1.78	1.79	1.8
18/08/2023	1.68	1.89	1.81	1.53	1.64	1.73	1.82	1.87	1.85	1.84
6/09/2023	-	-	-	-	1.55	1.6	1.67	1.69	1.7	1.7
7/09/2023	1.62	1.79	1.64	1.47	-	-	-	-	-	-
4/10/2023	1.54	1.69	1.48	1.37	1.41	1.43	1.49	1.53	1.53	1.54
1/11/2023	1.42	1.58	1.43	1.29	1.38	1.41	1.47	1.5	1.51	1.51

	Groundwater level (mAHD)									
	GW1	**GW2**	**GW3**	**GW4**	**MW1**	**MW5**	**MW6**	**MW7**	**MW8**	**MW9**
14/12/2023	-	-	-	-	1.25	1.26	1.3	1.33	1.34	1.34
15/12/2023	1.29	1.43	1.28	1.14	-	-	-	-	-	-
Long term average	2.85	1.86	1.84	1.68	1.84	1.78	1.89	1.86	1.88	1.87
Long term median	3.14	1.85	1.77	1.58	1.77	1.73	1.82	1.79	1.82	1.81

4.4 Groundwater quality

4.4.1 pH

Quarterly pH sampling results are summarised in Table 11 and plotted in Figure 5, Appendix A, with the plot including historical data.

During the reporting period, pH values for all monitored bores ranged from 5.00 to 7.40, with an average of 6.54.

At MW1, the quarterly samples in March, at pH 5.00, and December, at pH 5.40, were below the lower trigger of 5.67.

At all other locations, the observed pH values in 2023 were within the lower and upper trigger level range.

Whilst pH observations for the first and last quarters at MW1 were below the lower trigger level for that location, the relatively lower pH values are considered unlikely to be due to quarrying and are instead attributed to natural variability. A similar pH trend was not observed at other monitoring bores. The relatively low pH values observed in 2023 at MW1 do not correlate well with groundwater levels at MW1. Observed groundwater levels at MW1 decreased throughout 2023. However, pH did not exceed lower trigger values in the middle two quarters of the year. This suggests that the pH exceedances in 2023 are not associated with drawdown by quarrying, which is the primary mechanism that could lead to a lowering of pH due to quarrying.

Table 11: Groundwater pH monitoring results

Monitoring Location	Lower / upper triggers	2023 range (pH units)	2023 average (pH units)	Long term average (2007 to 2023)
MW1	5.67 / 7.47	5.00 to 5.90	5.50	6.25
MW5	5.88 / 7.68	5.90 - 6.10	5.98	6.45
MW6	6.60 / 7.65	6.80 – 7.00	6.90	7.00
MW7	6.64 / 7.53	6.90 – 7.30	7.13	7.08
MW8	6.71 / 7.59	7.30 - 7.40	7.34	7.18
MW9	4.93 / 8.33	6.00 - 6.50	6.35	6.58

4.4.2 Electrical conductivity

Quarterly electrical conductivity (EC) results are available for the reporting period and are summarised in Table 12 and plotted in Figure 6, Appendix A, with the plot including historical data.

During the reporting period, EC values for all monitored bores ranged from 336 to 795 µS/cm, with an average of 562 µS/cm.

At MW1 measurements of EC are above the upper trigger of 444 µS/cm during March (594 µS/cm), June (583 µS/cm), September (488 µS/cm) and December (468 µS/cm), however a declining trend is noted and the values are well within the range of EC values across the site.

There were no other observed exceedances of either upper or lower trigger levels at the other monitoring locations.

There are no deleterious trends apparent and the observed EC values during the monitoring period, measurements are consistent with historical variation and are considered to lie within natural variability. While EC measurements exceeding the upper threshold trigger at MW1 throughout 2023, the EC in MW1 dropped throughout the year from a rainfall high point in December of 2022 which was considered reasonable.

Table 12: Electrical conductivity monitoring results

Monitoring Location	Lower / upper triggers	2023 range (µS/cm)	2023 average (µS/cm)	Long term average (2007 to 2023) (µS/cm)
MW1	195 / 444	468 - 594	533	343
MW5	105 / 1015	369 - 523	431	492
MW6	115 / 584	336 - 408	369	333
MW7	470 / 1037	618 - 742	666	688
MW8	453 / 1021	698 - 795	743	758
MW9	155 / 965	515 - 679	629	523

4.4.3 Laboratory results

Groundwater quality results from comprehensive laboratory analysis are presented in graphs in Figures 7 to 18, Appendix A, with raw results provided in Appendix B. Trigger level exceedances are discussed below.

- **Aluminium (Figure 7, Appendix A):** Trigger exceedances for aluminium were as follows:
  - **MW1:** four samples above trigger of 0.251 mg/L. Maximum observation of 1.50 mg/L.
  - **MW5:** four samples above trigger of 1.861 mg/L. Maximum observation of 3.90 mg/L.
  - **MW9:** two samples above trigger of 1.515 mg/L. Maximum observation of 2.10 mg/L.

  Aluminium exceeded trigger levels at three of the six monitoring bores in 2023. Historical observations show similar elevated values at MW5 and MW9 during 2014, however concentrations recorded in the current review period are maximum on record and aluminium concentrations at MW1, MW5 and MW9 display an overall increasing trend since 2021.

  Review of historical aerial imagery does not indicate any significant quarrying or disturbances in the vicinity of MW5 or MW9 coinciding with the increase and the exceedances could be due to natural variation associated with above average rainfall from 2020 through to 2022.
- **Arsenic (Figure 7, Appendix A):** MW6 had one observation of 0.032 mg/L, above its trigger level of 0.026 mg/L. Samples from other bores were below their respective trigger values.

  At MW6, historical observations show similar arsenic concentrations. Arsenic concentrations of 0.036 mg/L and 0.029 mg/L were reported in 2010 and early in 2022

respectively. The observed exceedance at MW6 is therefore attributed to natural variability and is not considered a result of quarrying.

- **Chromium (Figure 9, Appendix A):** MW9 had one observation at the upper trigger level of 0.007 mg/L, in March.

  The MW9 observations are consistent with site wide baseline data. For example, in 2010 chromium concentrations were observed at 0.023 mg/L at MW5 and 0.013 mg/L at MW8.

  Overall a slight increasing trend in chromium concentration is apparent since 2021, possibly associated with above average rainfall from 2020 to 2022. Trends are therefore unlikely to have resulted from quarrying.

- **Iron (Figure 10, Appendix A):** Trigger exceedances for iron were as follows:

  - **MW1:** three samples above trigger of 1.78 mg/L. Maximum observation of 2.00 mg/L.

  Iron levels exceeded the trigger value in three of the four quarters of 2023 at MW1. Revieing these exceedances against historical measurements from this site the 2023 maximum was well below the historical maximum iron measurement of 4.8 mg/L in 2020. Which suggests that these higher iron concentrations are part of the natural variability at the site. For context, iron concentrations at MW8 have exceeded 20 mg/L in the past and then subsequently declined.

- **Manganese (Figure 12, Appendix A):**

  - **MW1:** two samples above trigger of 0.027 mg/L. Maximum observation of 0.04 mg/L.

  Manganese concentrations exceeded the upper trigger limit at MW1 in September and December of 2023. The maximum exceedance in 2023 was 0.04 mg/L which is well below the maximum exceedances in 2018 when average concentration of manganese in MW1 was 0.165 mg/L. Previous observations of manganese concentrations greater than those measured in 2023 suggests measurements in 2023 were due to natural variability at the site and are not considered attributable to quarrying.

- **Potassium (Figure 13, Appendix A):**

  - **MW1**: three samples above trigger of 4.6 mg/L. Maximum observation of 8.80 mg/L.

  Although exceedances are noted, potassium concentrations at MW1 show a declining trend during 2023 from the high of 9.3 mg/L observed in 2022. The trend of decreasing potassium concentration in MW1 throughout 2023 suggests that these exceedances are within the range of natural variability at the site and are not considered attributable to quarrying. The increasing trend at MW1 commenced in 2020 and peaked in 2022, coinciding with the above average rainfall over the same period.

- **Sodium (Figure 14, Appendix A):**
  - **MW1:** four samples above trigger of 38.6 mg/L. Maximum observation of 85 mg/L.
  - **MW9:** one sample above trigger of 39.0 mg/L. Maximum observation of 83 mg/L.

  Sodium concentrations were elevated at MW1 throughout 2023, while MW9 recorded one exceedance of the trigger in December. Sodium concentrations at MW1 have been elevated in comparison to historical observations since mid-2022. However, these concentrations are similar to the site wide average for sodium concentrations over this period. For example, sodium was reported at 130 mg/L at MW5 during the 2022 monitoring period, which was below the trigger level for MW5 (173.3 mg/L).

  The 2023 observations at MW1 and MW9 are consistent with the site wide range of historical sodium concentrations. The observations at MW1 and MW6 are therefore within the range of natural variability at the site and are not considered attributable to quarrying.
- **Zinc (Figure 15, Appendix A):**
  - **MW5:** one sample above trigger of 0.030 mg/L. Maximum observation of 0.038 mg/L.
  - **MW6:** three samples above trigger of 0.027 mg/L. Maximum observation of 0.053 mg/L.
  - **MW7:** one sample above trigger of 0.028 mg/L. Maximum observation of 0.031 mg/L.
  - **MW8:** two samples above trigger of 0.022 mg/L. Maximum observation of 0.032 mg/L.

  Zinc concentrations displayed an increasing trend at most of the monitoring sites in 2023. This trend should be monitored in 2024 to check if there is a change occurring to baseline zinc concentrations across the site that may be brought about by quarrying. However, zinc levels have been historically as high as 0.115 mg/L and have been considered as occurring naturally and the 2023 exceedances are not currently attributable to quarrying.
- **Chloride (Figure 16, Appendix A):** Trigger exceedances for chloride were as follows:
  - **MW6:** one sample above trigger of 46 mg/L. Maximum observation of 43.97 mg/L.
  - **MW8:** one sample above trigger of 190 mg/L. Maximum observation of 240 mg/L.
  - **MW9:** two samples above trigger of 136 mg/L. Maximum observation of 150 mg/L.

  Although exceeding the trigger values, when compared to preceding data, the 2023 observations of chloride at MW8 show a drop in concentration since 2022. MW6 and MW9 both exceeded the trigger values for the specific monitoring sites. However, all the exceedances were within the historical site wide measurements for chloride and the 2023 observations are therefore considered not a result of quarrying.

  A general increase in chloride concentration is observed 2020, peaking in late 2022 early 2023, this coincides with above average rainfall from 2020 to 2022.

- **Hardness (as CaCO3) (Figure 16, Appendix A):** All monitored locations in 2023 except for MW1 and MW9 had instances of observations which were below their lower trigger levels:
  - **MW5:** four samples below trigger of 118 mg/L. Minimum observation of 65 mg/L.
  - **MW6:** two samples below trigger of 144 mg/L. Minimum observation of 100 mg/L.
  - **MW7:** four samples below trigger of 275 mg/L. Minimum observation of 150 mg/L.
  - **MW8:** four samples below trigger of 284 mg/L. Minimum observation of 120 mg/L.

  The 2023 hardness observations are in the range of site-wide baseline observations and considered unlikely to have been influenced by quarrying. In general, most sites show a decline in hardness since 2020, coinciding with above average rainfall.
- **Phosphorus (Figure 17, Appendix A):**
  - **MW1:** one sample above trigger of 0.03 mg/L. Maximum observation of 0.07 mg/L.

  It is noted that the laboratory limit of reporting (0.05 mg/L) is above the MW1 lower trigger level of 0.03 mg/L.

  Historical site wide phosphorous concentrations appear highly variable, with 2023 observations falling within the range of historical values. The exceedance at MW1 is a spiked occurrence and not considered attributable to quarrying.

4.5 Surface water quality

4.5.1 pH

pH results for surface water monitoring are summarised in Table 13. The pH measurements for 2023 at SW2 and SW3 were within the lower and upper guideline ranges.

The median pH at SW4 for 2023 was above the upper guideline pH value of pH 8.50. However, the range for 2023 is within the historic range for SW4 and it is likely that this exceedance is part of the natural variation for the site.

The median pH at SW1 for 2023 is below the lower guideline value of 6.5. However, the 2023 pH range is consistent with the findings of 2020 - 2022 data and it is likely that this reflects a naturally low pH at SW1.

Table 13: Surface water pH monitoring results

Monitoring Location	Lower - Upper guideline level[1]	2023 range	2023 median
SW1	6.5 – 8.5	4.6 – 5.7	5.0
SW2		7.0 – 7.9	7.3
SW3		7.9 – 8.4	8.1
SW4		7.9 – 8.9	8.6

Notes: [1] ANZECC 2000 default trigger value for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems, lowland rivers.

4.5.2 Electrical conductivity

EC surface water sampling results are summarised in Table 14. The median EC measurement for 2023 at each site was with in the lower and upper trigger range for all monitoring locations and were within the guideline value range of 125 to 2200 µS/cm.

EC in the surface water sites increased over the second half of the year, likely reflecting evaporative concentration and reduced dilution due to the decreased rainfall.

Table 14: Surface water EC monitoring results

Monitoring Location	Lower - Upper guideline level[1] (µS/cm)	2023 range (µS/cm)	2023 median (µS/cm)
SW1	125 – 2200	247 – 479	306
SW2		360 - 719	411
SW3		300 – 416	335
SW4		247 – 460	290

Notes: [1] ANZECC 2000 default trigger value for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems, lowland rivers.

4.5.3 Laboratory results

Surface water laboratory results for SW1, SW2, SW3 and SW4 were compared against ANZECC 2000 freshwater trigger values for 95% species protection and ANZECC 2000 default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems, lowland rivers.

The following observations were outside of the guideline ranges:

- **Chromium (Figure 27, Appendix A):**
  - **SW1:** Jan 2023 0.002 mg/L above the upper guideline of 0.001 mg/L.

  Chromium concentrations in SW1 fall within the historic ranges observed for this site and was below the guideline value for the remainder of the year. The 2023 chromium concentrations are anticipated to reflect natural variability in chromium concentration at the monitoring site and are not attributed to quarrying activities.
- **Zinc (Figure 27, Appendix A):**
  - **SW1:** 2023 range 0.021 – 0.067 mg/L above the upper guideline of 0.008 mg/L.
  - **SW2:** 2023 range 0.016 – 0.048 mg/L above the upper guideline of 0.008 mg/L.

  The zinc values in SW1 and SW2 fall within the historic ranges observed for these sites and remain below the historical peaks of 0.29 and 0.15 mg/L, respectively. The 2023 zinc concentrations are anticipated to reflect natural variability in zinc concentrations at the monitoring sites and are not attributed to quarrying activities.

- **Total Phosphorus (Figure 29, Appendix A):**
  - **SW1:** Sep – Nov 2023, range 0.06 – 0.08 mg/L above the upper guideline of 0.05 mg/L.
  - **SW2:** May 2023, 0.07 mg/L above the upper guideline of 0.05 mg/L.
  - **SW4:** 2023 range, 0.05 – 0.2 mg/L exceeded the the upper guideline of 0.05 mg/L throughout the year.

  The total phosphorus concentrations in SW1 and SW2 fell within the historic ranges observed for these sites and remained below the concentration maxima of 0.2 and 0.1 mg/L, respectively. Notably, SW4 recorded a new maximum concentration for total phosphorus at 0.2 mg/L. However, subsequent measurements showed that the total phosphorus concentration reverted to 0.05 mg/L after reaching this peak, likely indicating short-term fluctuations in total phosphorus.

Surface water sites have been consistently monitored since 2020. It is expected that in future years with continued monitoring there will be increased confidence in detecting shifts in the surface water chemistry of the monitoring sites. It is also noted that SW1, SW2, SW3 and SW4 analyte concentrations are similar to typical groundwater concentrations for a given analyte, suggesting that quarrying activities are unlikely to have had an impact on surface water quality. The exception is pH at SW1, which is lower than typical groundwater pH but is similar to nearby MW01.

5. 2023 monitoring results compared to EIS predictions

5.1 Groundwater levels

The EIS (ERM, 2005) predicts minimal impacts to groundwater levels when sand extraction is restricted to 2.5 m AHD, limiting potential impacts to changes in local groundwater recharge characteristics. Quarry activities are not predicted to influence local or regional groundwater supply.

2023 groundwater level data does not indicate that the quarry has impacted groundwater supply and results are therefore consistent with the EIS (ERM, 2005).

5.2 Groundwater quality

Extraction limits proposed in the EIS (ERM, 2005) were to ensure quarry operation had no direct impact on local or regional groundwater quality. Following review of the 2023 groundwater laboratory results, quarry activity has not impacted groundwater quality as exceedances lie within historical ranges and can be attributed to natural variability. 2023 groundwater quality results are therefore in-line with EIS (ERM, 2005) predictions.

5.3 Surface water quality

Due to the lack of topsoil and vegetation cover, the EIS (ERM, 2005) concludes that the consequent high groundwater recharge and negligible surface runoff will result in insignificant impacts to surface water quality Although baseline triggers have not been developed, the examination of 2023 surface water results do not link any exceedances to quarry operations. Consequently, these findings align with the EIS (ERM, 2005).

6. Conclusions and recommendations

A review of the groundwater monitoring results over the 2023 reporting period suggests that the quarry operations are not impacting groundwater resources, with natural variability accounting for a number of trigger exceedances noted during the year.

Based on data collected from 2020 to 2023, there appear to be no significant trends indicating that surface water quality has been impacted by quarrying operations. It is also noted that SW1, SW2, SW3 and SW4 analyte concentrations are similar to typical groundwater concentrations for a given analyte, suggesting that quarrying activities are unlikely to have had an impact on surface water quality. The exception is pH at SW1, which is lower than typical groundwater pH but is still similar to nearby MW01. While a number of exceedances of site specific trigger values are noted, there is no reason to believe that the results are indicative of an influence from quarrying.

The following conclusions and recommendations are made:

- In 2024 and beyond, with the exception of destroyed locations MW2 and MW11, groundwater level and quality monitoring frequency should remain consistent and at a minimum, as per that specified by the 2019 GWMP, including ongoing monitoring at GW1.
- Several groundwater quality triggers, defined in the 2019 GWMP, were exceeded during the reporting period. Exceedances against the site-specific trigger levels are attributed to natural background conditions, not Quarry operations.
- Some increasing trends in groundwater analytes (e.g. aluminium, chromium and zinc) have been noted over the review period. While not attributed to quarrying, these trends should be assessed through 2024 monitoring results.
- Based on 2023 surface water monitoring results, there appears to be no significant trends indicating that surface water quality has been impacted by quarrying operations. As per ANZG (2018) surface water trigger levels can be defined, it is suggested that surface water trigger levels are calculated in the next review of the GWMP after the five-year Independent Audit. With continued data collection, the understanding of surface water quality is expected to improve.
- For 2023 and beyond, consecutive quarterly groundwater trigger level exceedances should be actioned as per the TARP within the 2019 GWMP.
- At surface water monitoring sites, total recoverable hydrocarbons (TRH) have been monitored instead of total petroleum hydrocarbons (TPH), however results for TRH and TPH are more or less interchangeable.
- The monitoring results are in-line with the EIS predictions.

Yours sincerely

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7. References

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ERM. (2010). *Stockton Transgressive Dune Quarry, Groundwater Monitoring Program and Baseline Data. Revision 2.*

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RPS. (2015). *Stockton Sand Quarry Gorundwater Monitoring Program - Revision 5.*

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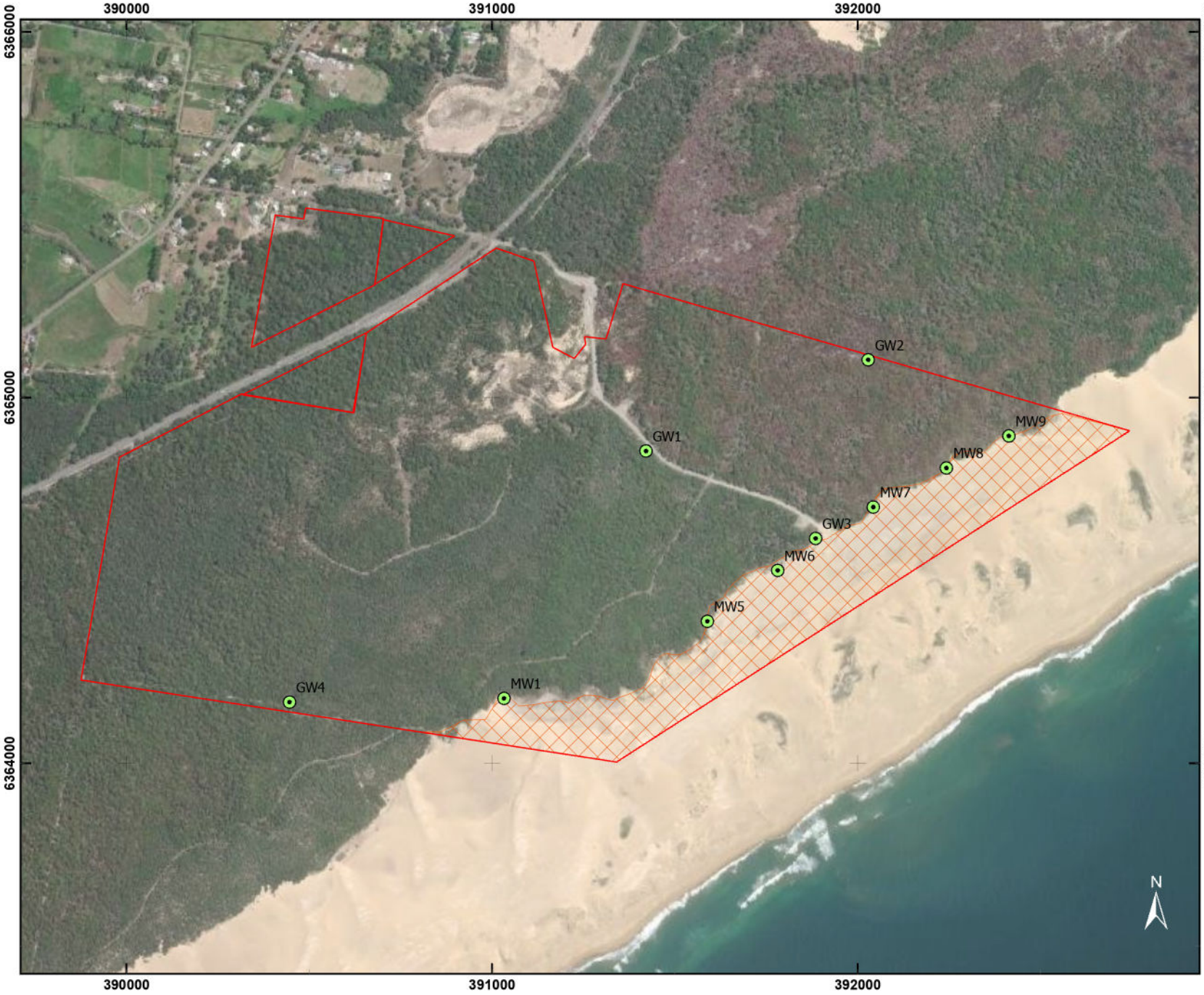
RPS Water. (2016). *Boral Stockton Quarry - Groundwater Gap Analysis. Consultant report provided for Boral Resources (NSW) Pty Ltd.*

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

Appendix A – Figures



LEGEND

- Active Tenement
- Current Extraction Area

Service Layer Credits: World Imagery: Maxar

0 125 250 375 500

Meters

GDA 1994 MGA Zone 56

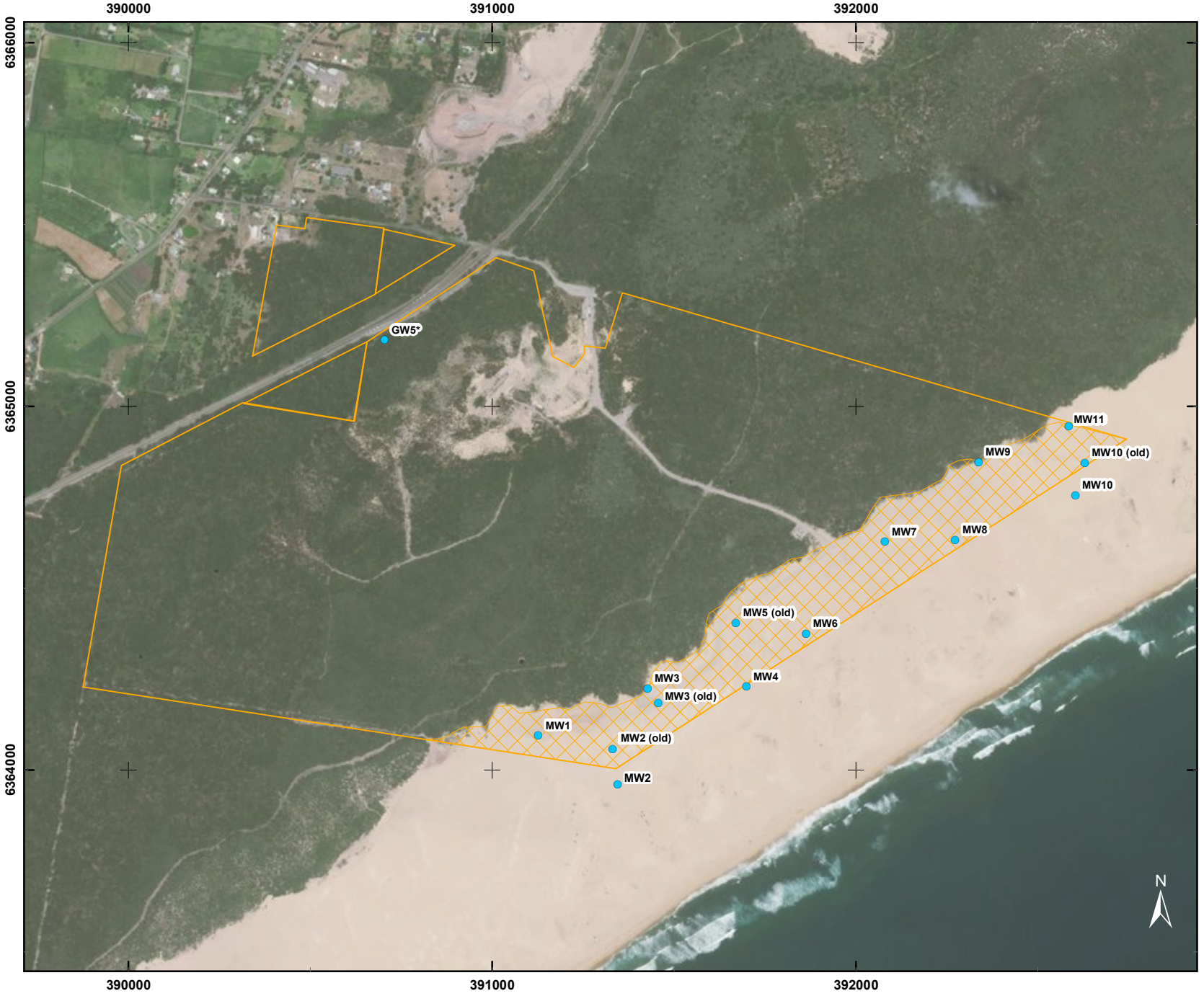
A4

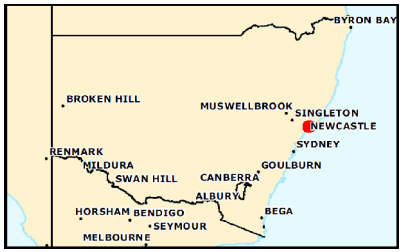
1:15,000

FIGURE1
Boral Stockton Sand Quarry
GW Monitoring Network

JACOBS

IA147700





LEGEND

- Active Tenement
- Current Extraction Area
- Historic Piezometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 125 250 375 500
Meters

GDA 1994 MGA Zone 56

A4 1:15,000

FIGURE 2
Boral Stockton Sand Quarry
Historic Groundwater Monitoring Network

JACOBS

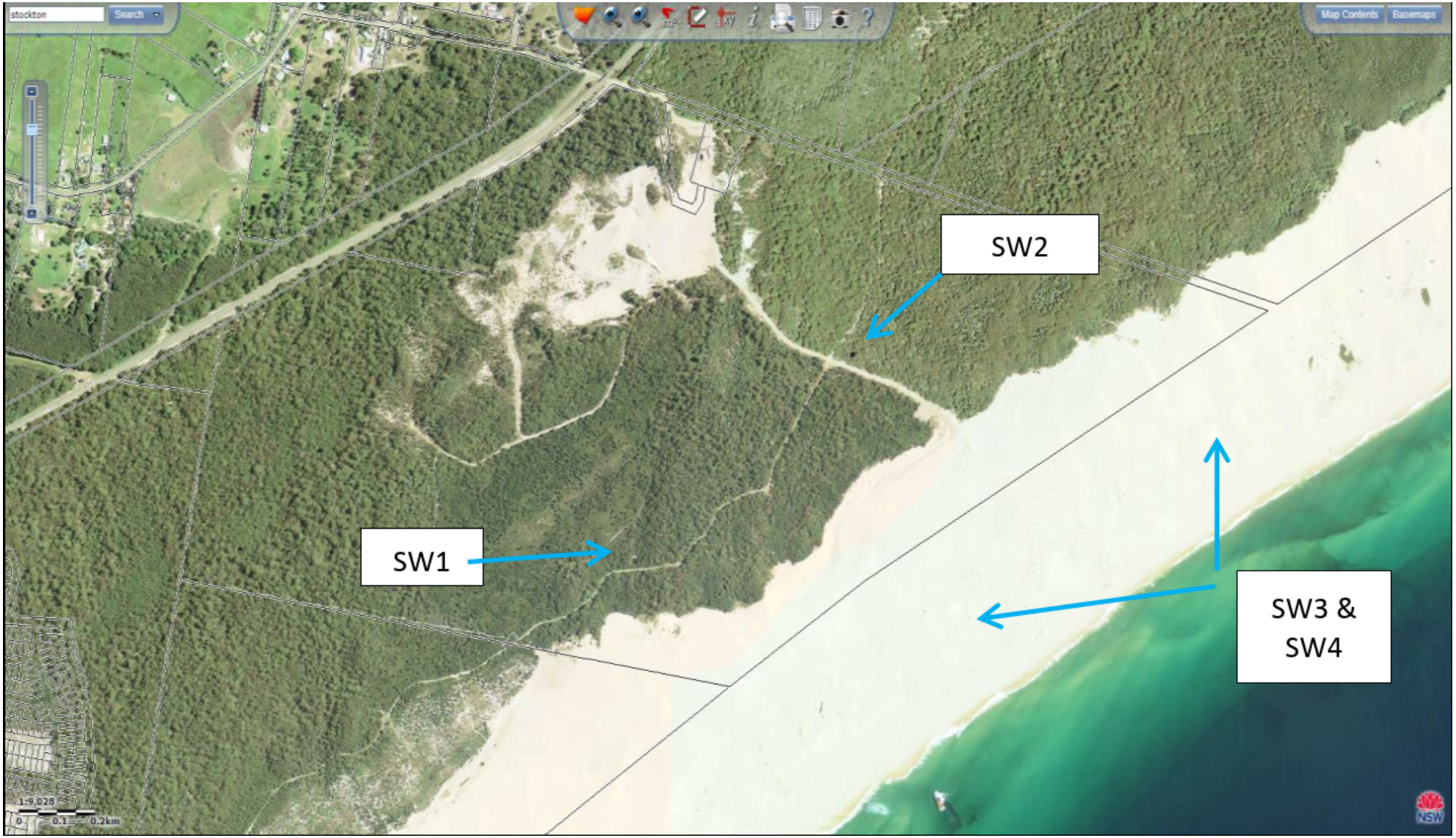
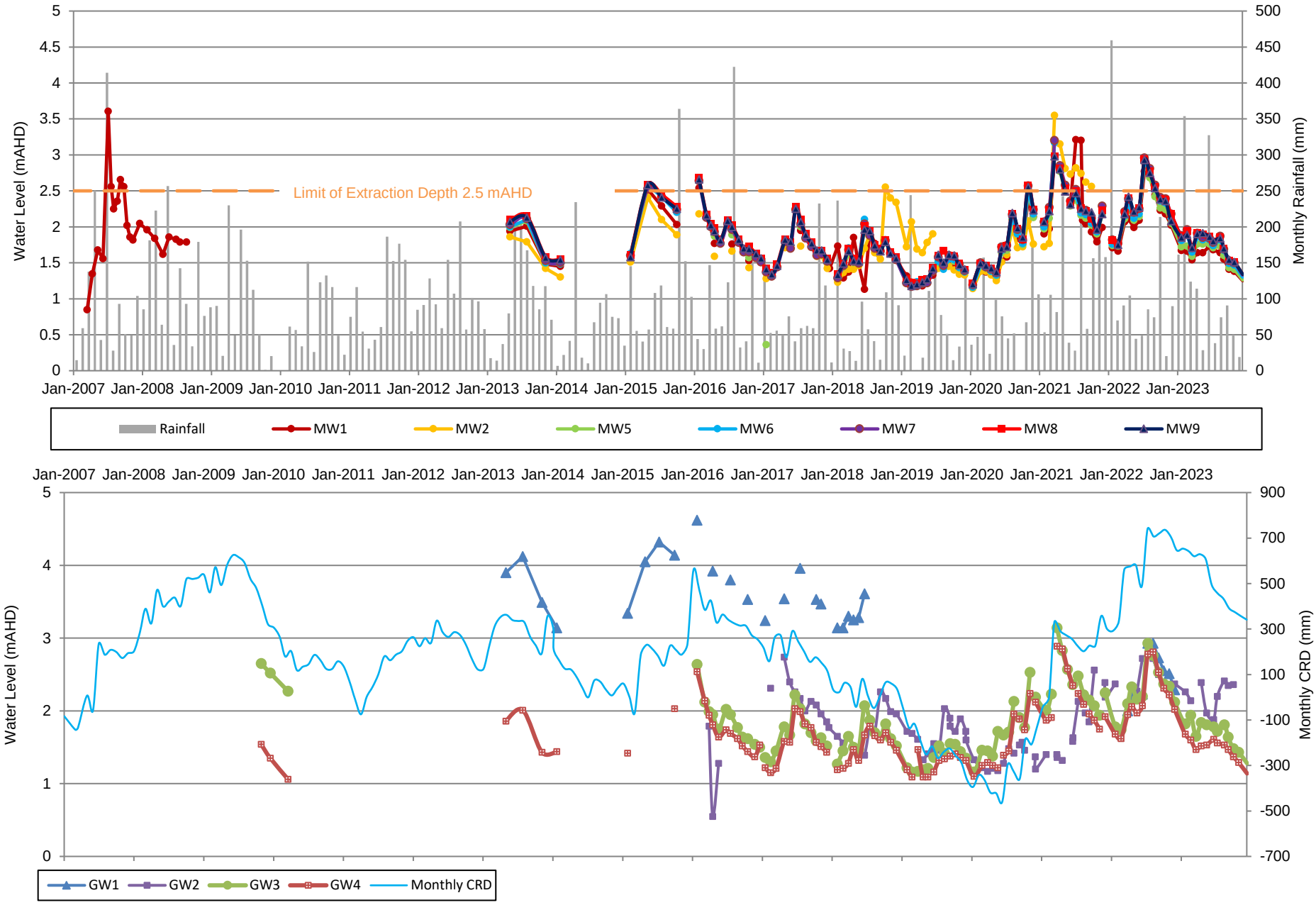
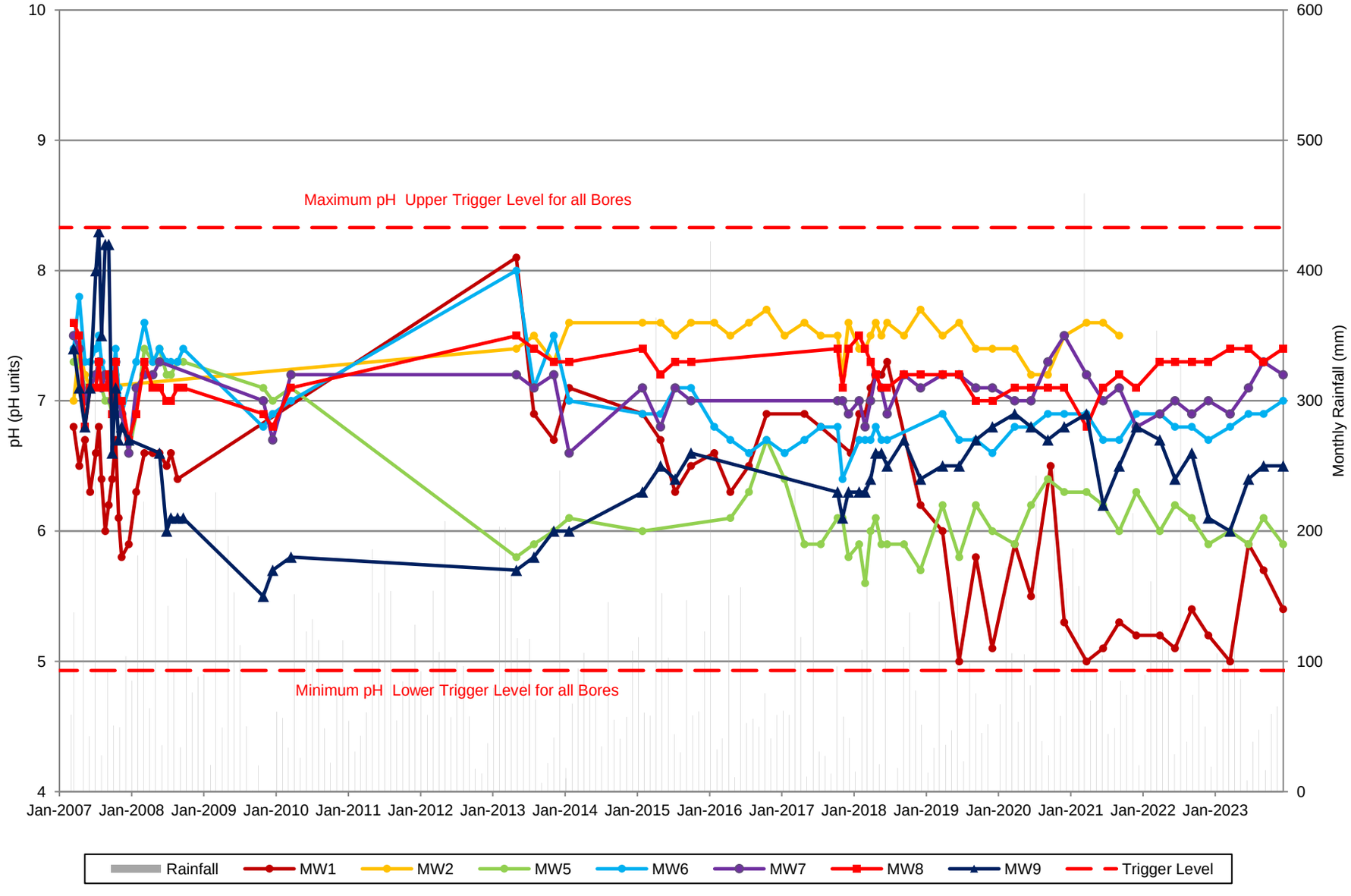


Figure 3: Surface water monitoring locations



Jacobs

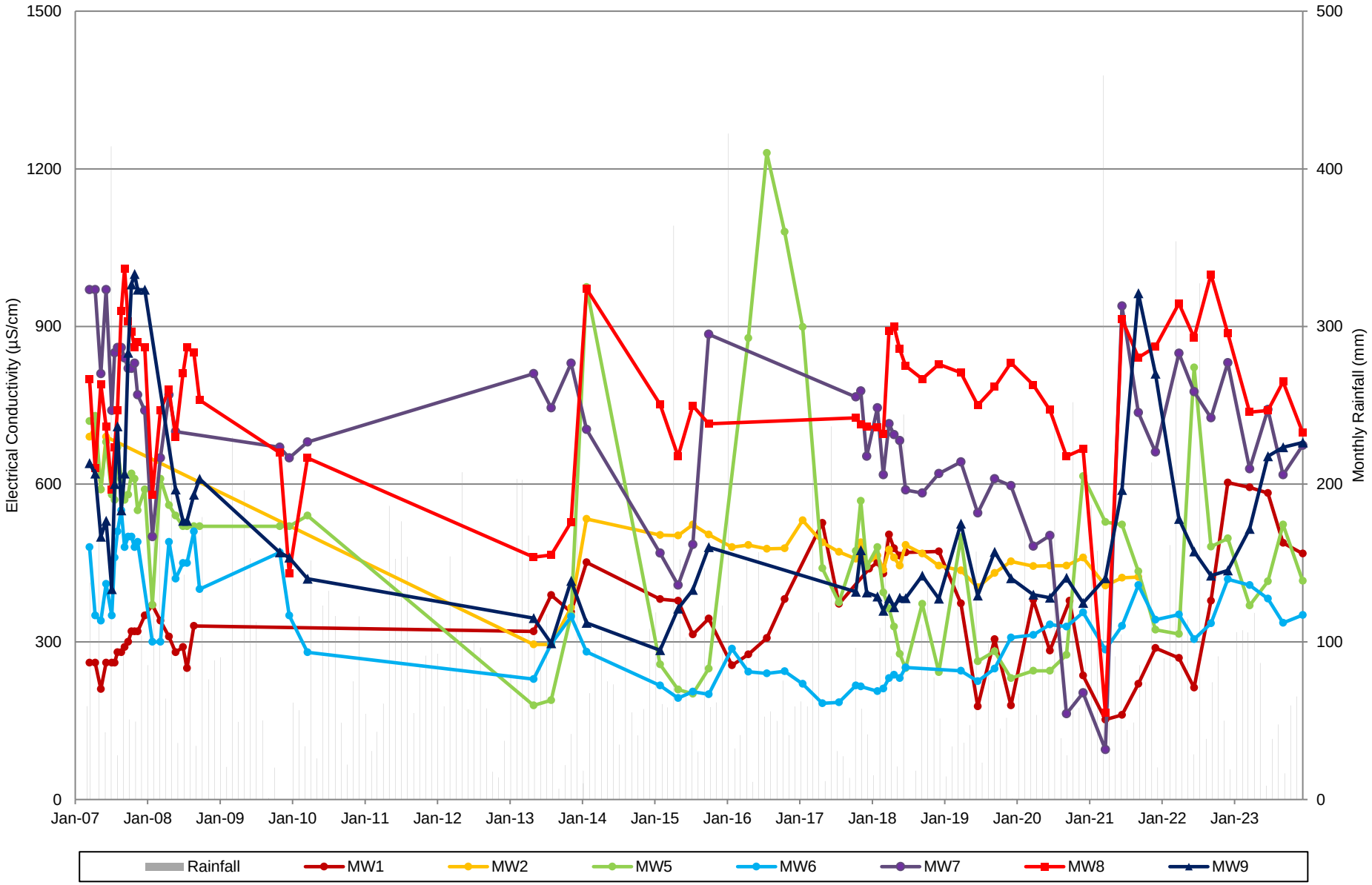
GROUNDWATER LEVELS FIGURE 4



Jacobs

pH Groundwater Quality FIGURE 5

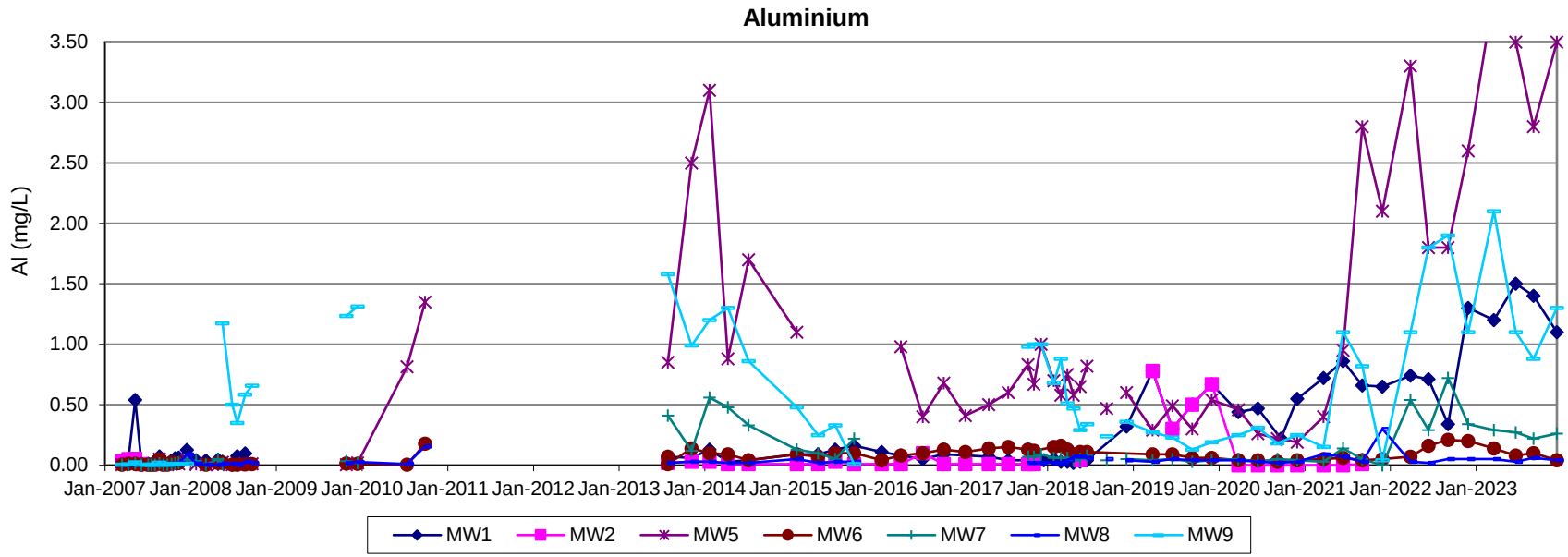
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Copy of Groundwater Levels and Field Chem figs_GW series mAHD_2023_CRD.xlsx]Fig 5 pH

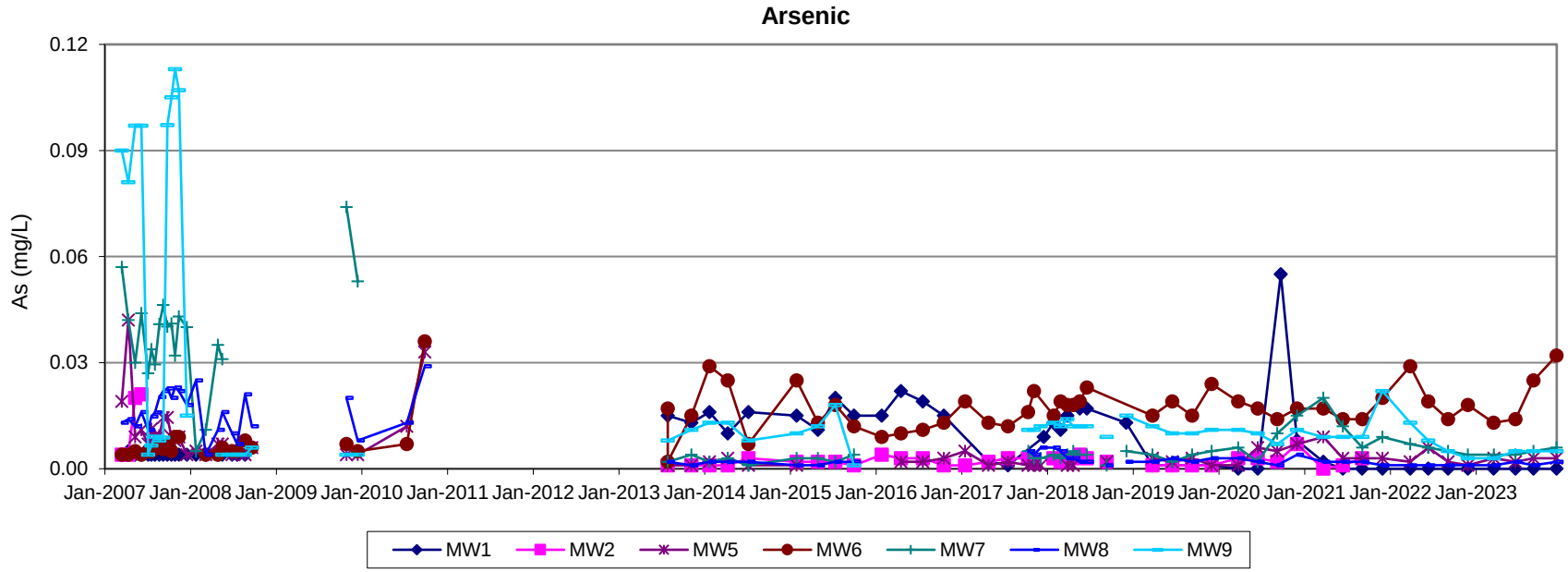


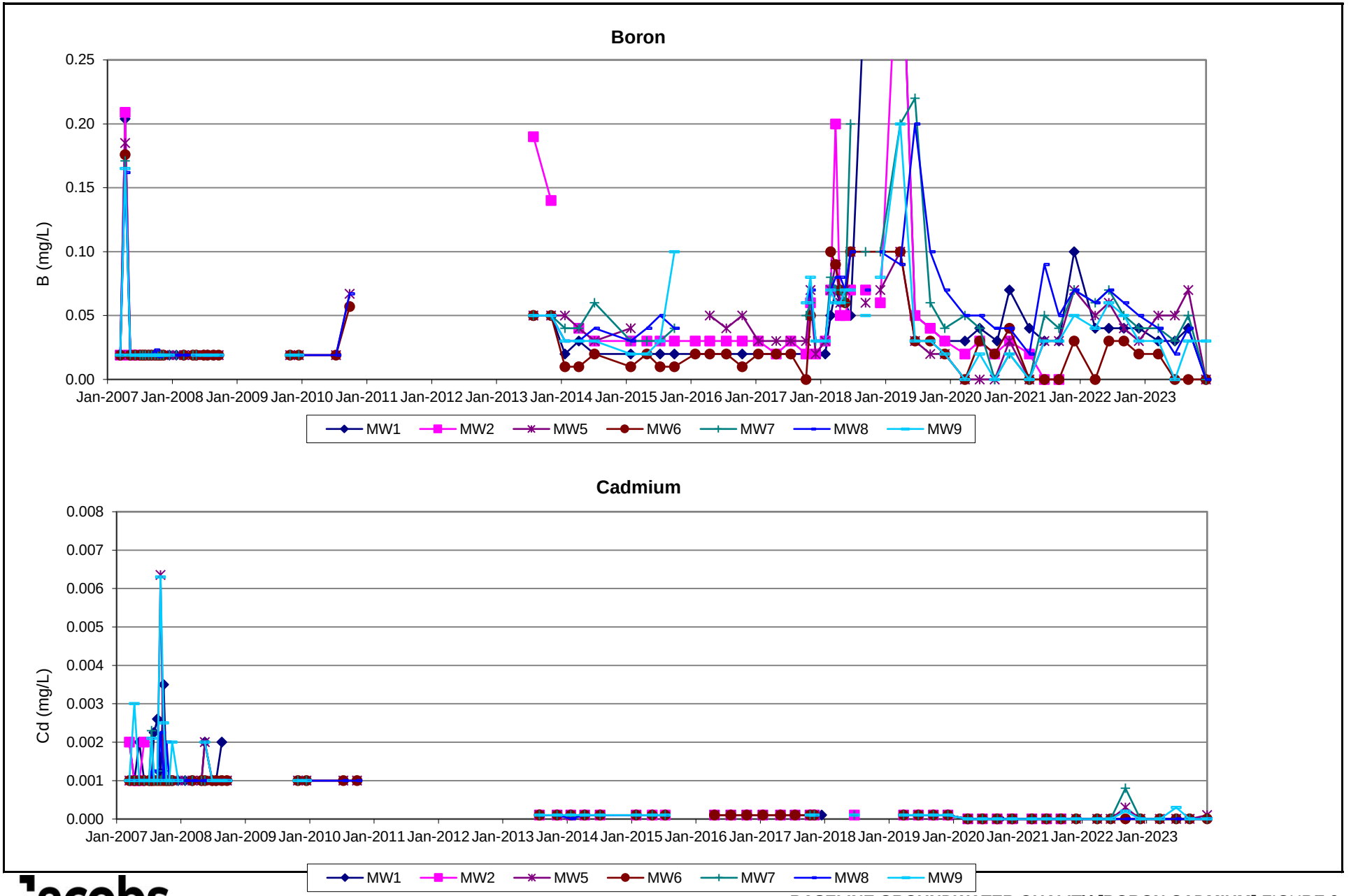
Jacobs

Electrical Conductivity Groundwater Quality FIGURE 6

\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Copy of Groundwater Levels and Field Chem figs_GW series mAHD_2023_CRD.xlsx]Fig 6 EC


Aluminium
Al (mg/L)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Jan-2007 Jan-2008 Jan-2009 Jan-2010 Jan-2011 Jan-2012 Jan-2013 Jan-2014 Jan-2015 Jan-2016 Jan-2017 Jan-2018 Jan-2019 Jan-2020 Jan-2021 Jan-2022 Jan-2023
MW1 MW2 MW5 MW6 MW7 MW8 MW9

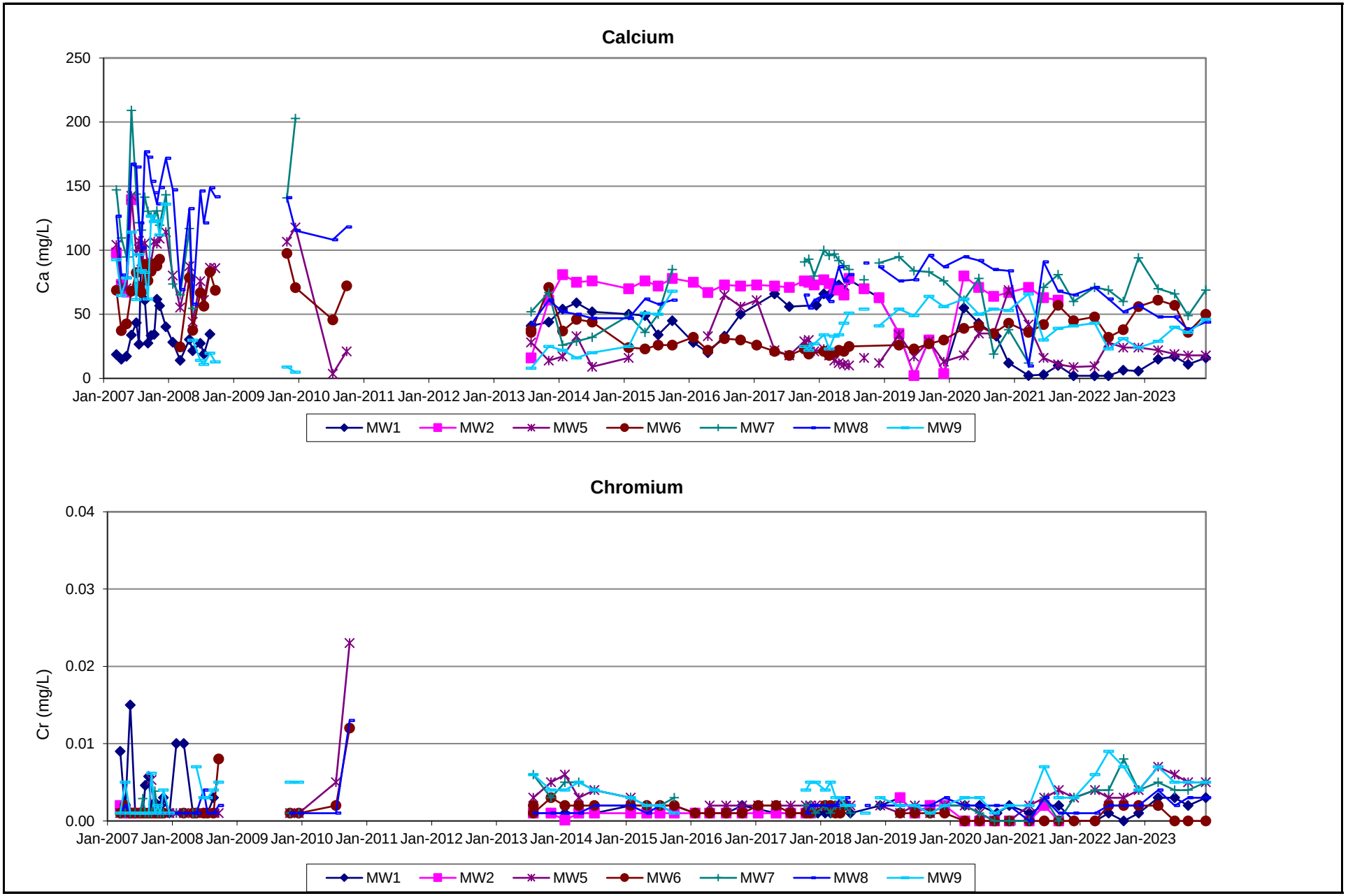

Arsenic
As (mg/L)
0.12
0.09
0.06
0.03
0.00
Jan-2007 Jan-2008 Jan-2009 Jan-2010 Jan-2011 Jan-2012 Jan-2013 Jan-2014 Jan-2015 Jan-2016 Jan-2017 Jan-2018 Jan-2019 Jan-2020 Jan-2021 Jan-2022 Jan-2023
MW1 MW2 MW5 MW6 MW7 MW8 MW9



Jacobs

BASELINE GROUNDWATER QUALITY [BORON CADMIUM] FIGURE 8

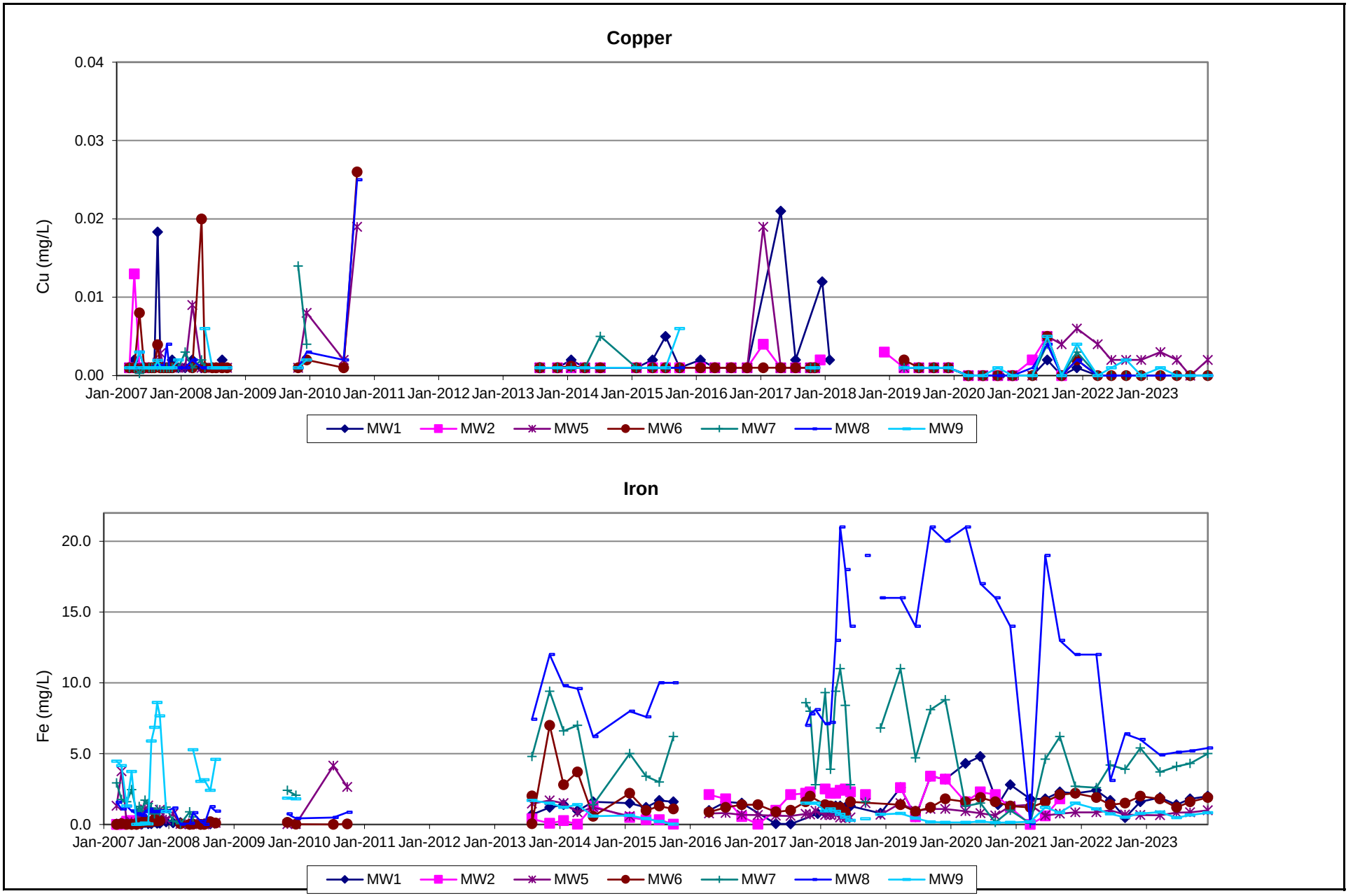
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]B Cd



Jacobs

BASELINE GROUNDWATER QUALITY [CALCIUM CHROMIUM] FIGURE 9

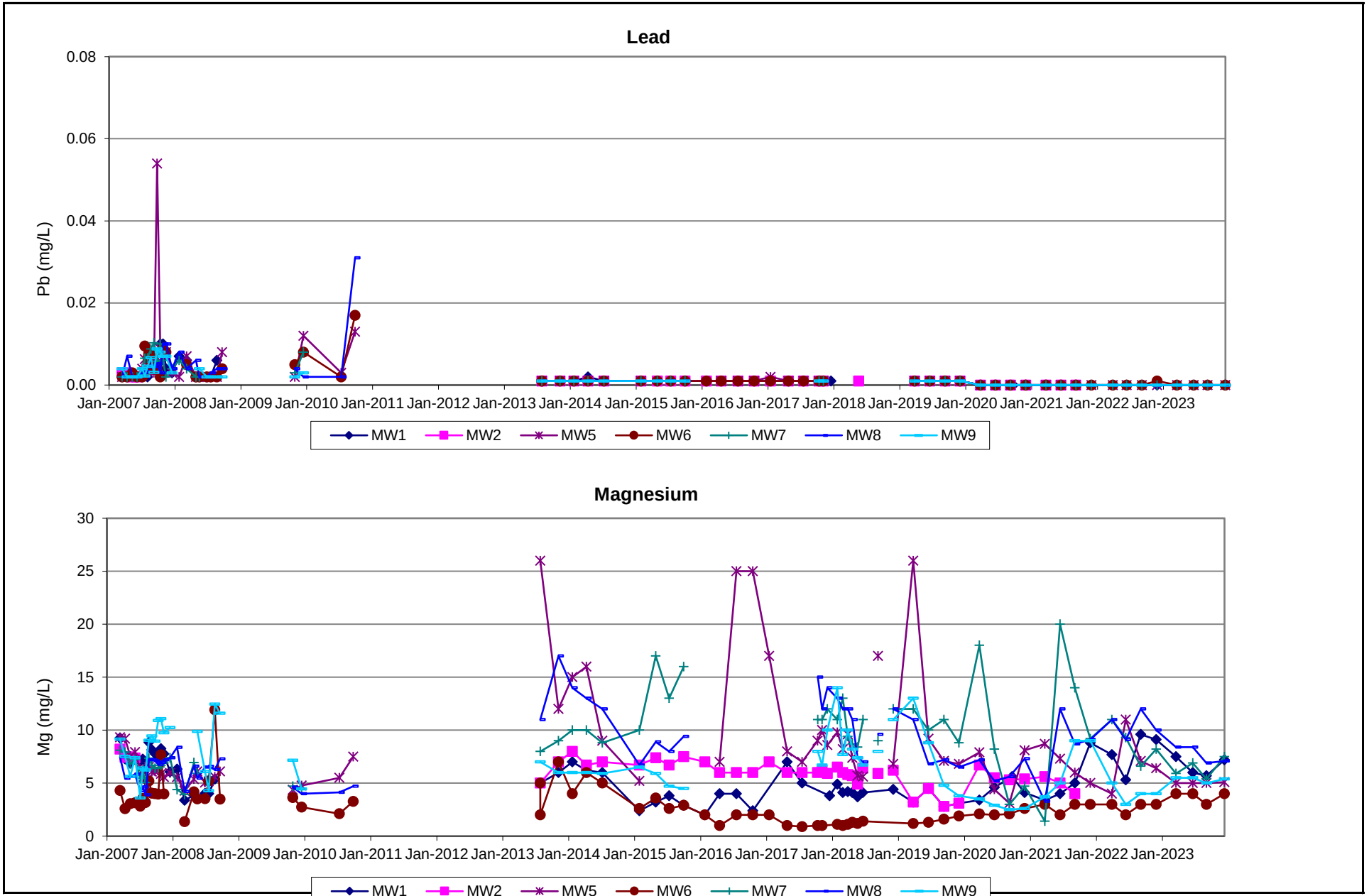
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]Ca Cr



Jacobs

BASELINE GROUNDWATER QUALITY [COPPER IRON] FIGURE 10

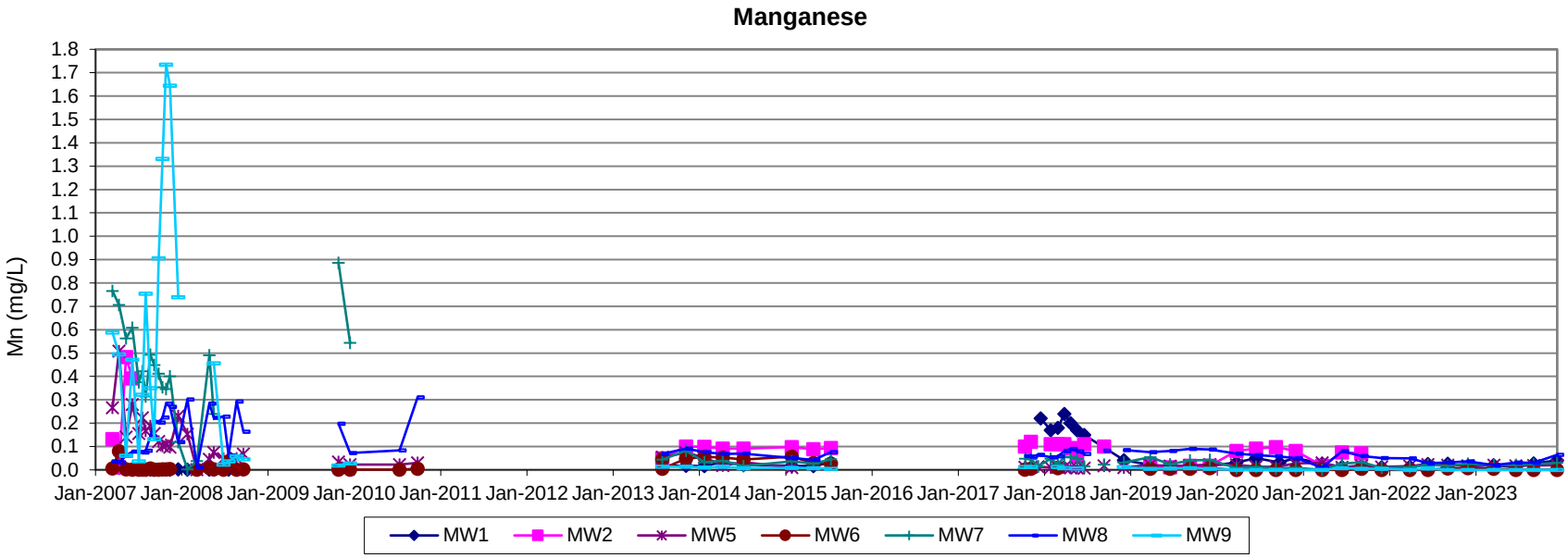
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]Fe Cu

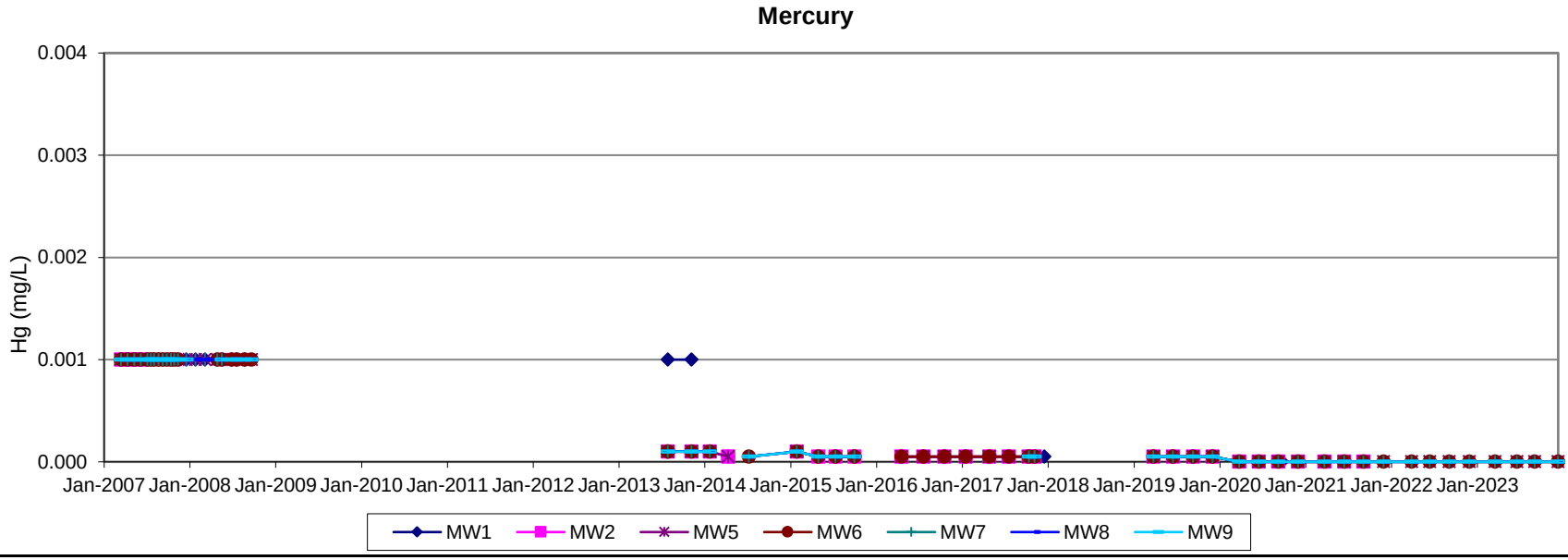


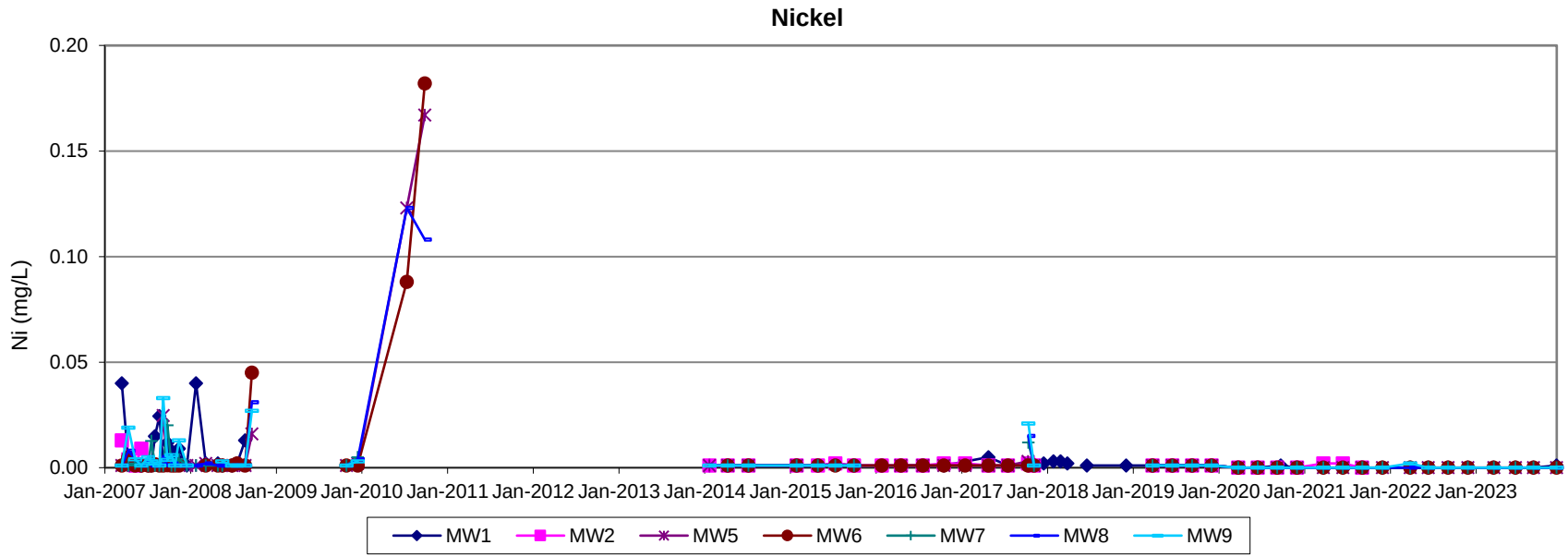
Jacobs

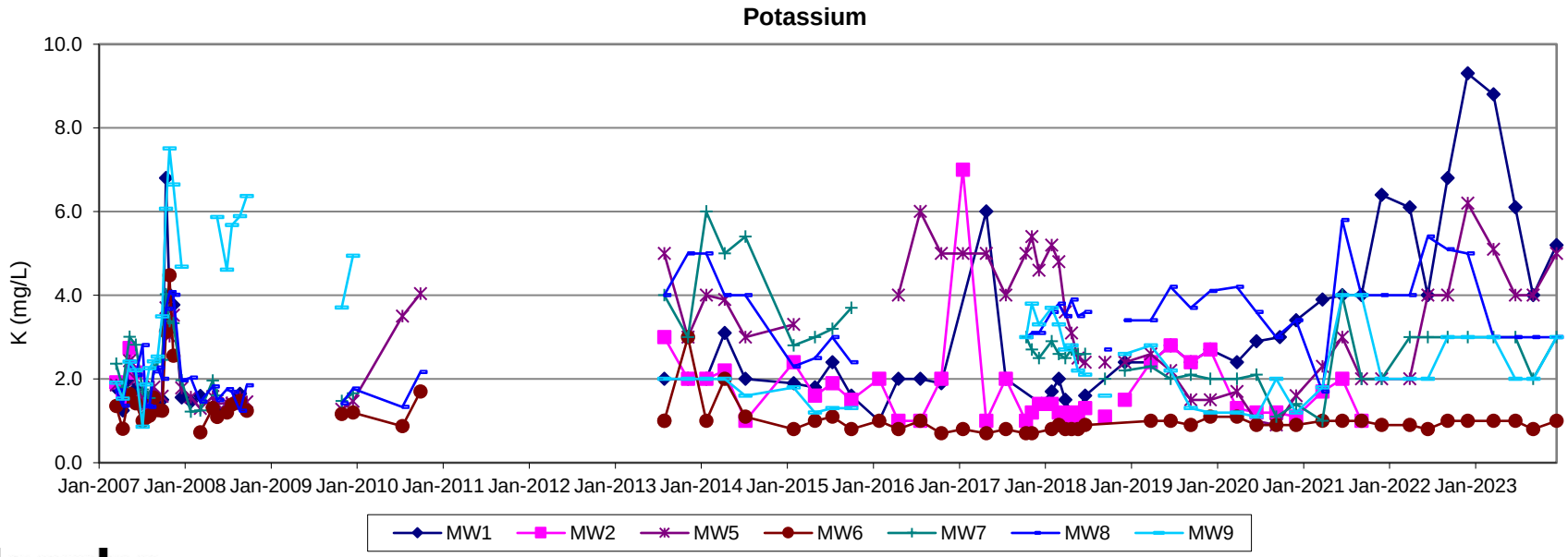
BASELINE GROUNDWATER QUALITY [LEAD MAGNESIUM] FIGURE 11

\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]Mg Pb


Manganese
Mn (mg/L)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jan-2007 Jan-2008 Jan-2009 Jan-2010 Jan-2011 Jan-2012 Jan-2013 Jan-2014 Jan-2015 Jan-2016 Jan-2017 Jan-2018 Jan-2019 Jan-2020 Jan-2021 Jan-2022 Jan-2023
MW1 MW2 MW5 MW6 MW7 MW8 MW9


Mercury
Hg (mg/L)
0.004
0.003
0.002
0.001
0.000
Jan-2007 Jan-2008 Jan-2009 Jan-2010 Jan-2011 Jan-2012 Jan-2013 Jan-2014 Jan-2015 Jan-2016 Jan-2017 Jan-2018 Jan-2019 Jan-2020 Jan-2021 Jan-2022 Jan-2023
MW1 MW2 MW5 MW6 MW7 MW8 MW9

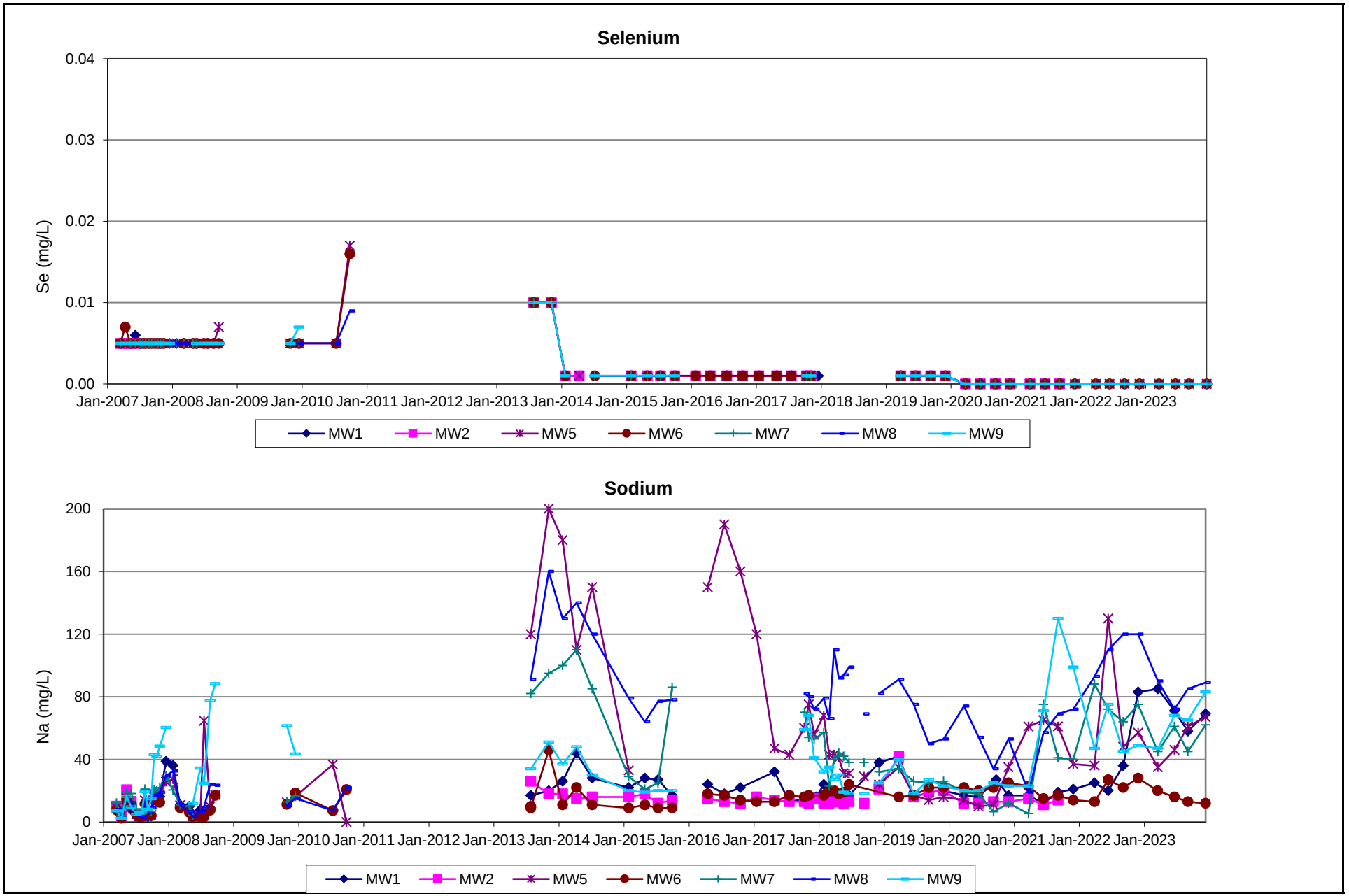


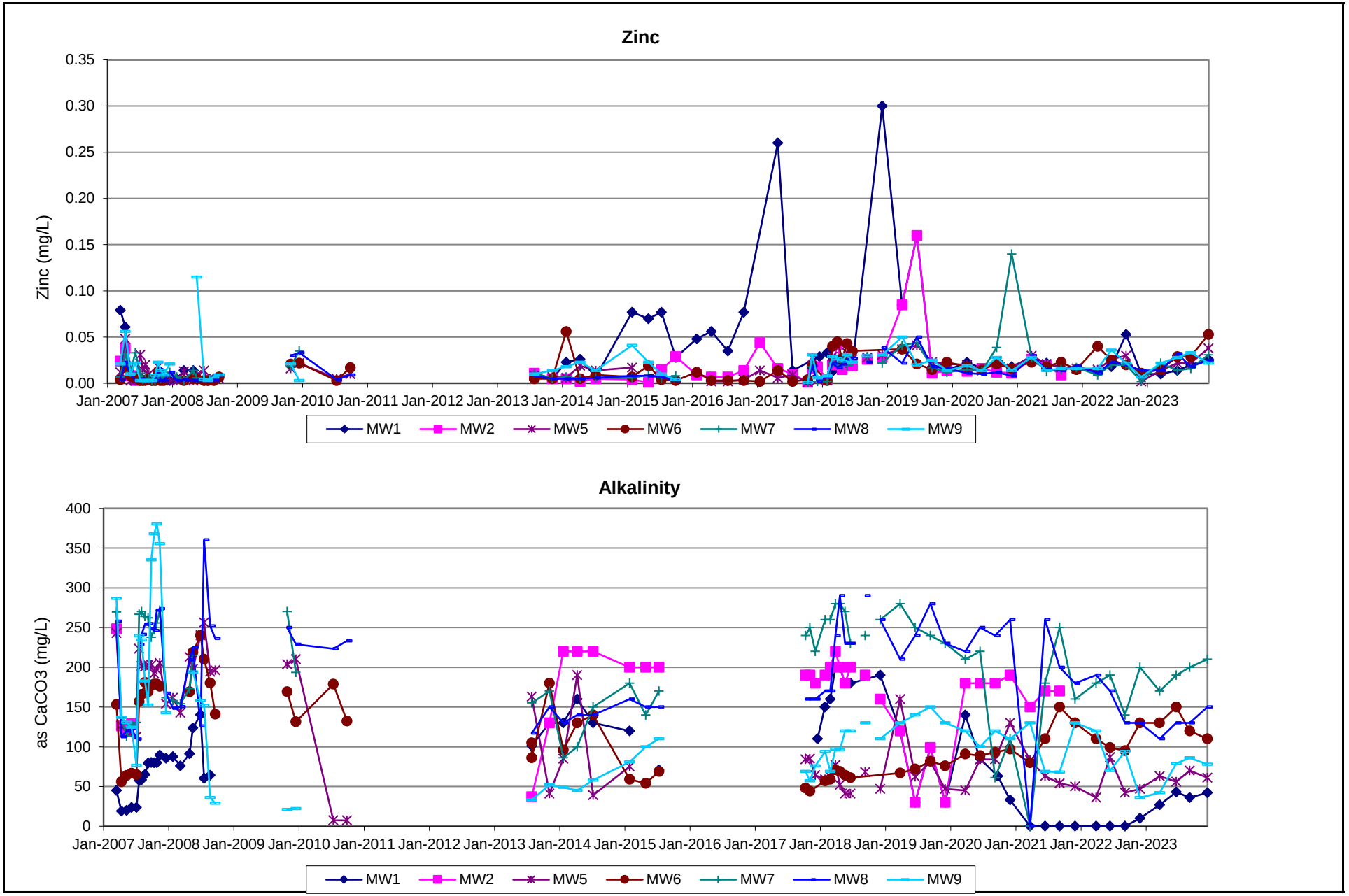


Jacobs

BASELINE GROUNDWATER QUALITY [NICKEL POTASSIUM] FIGURE 13

\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]K Ni

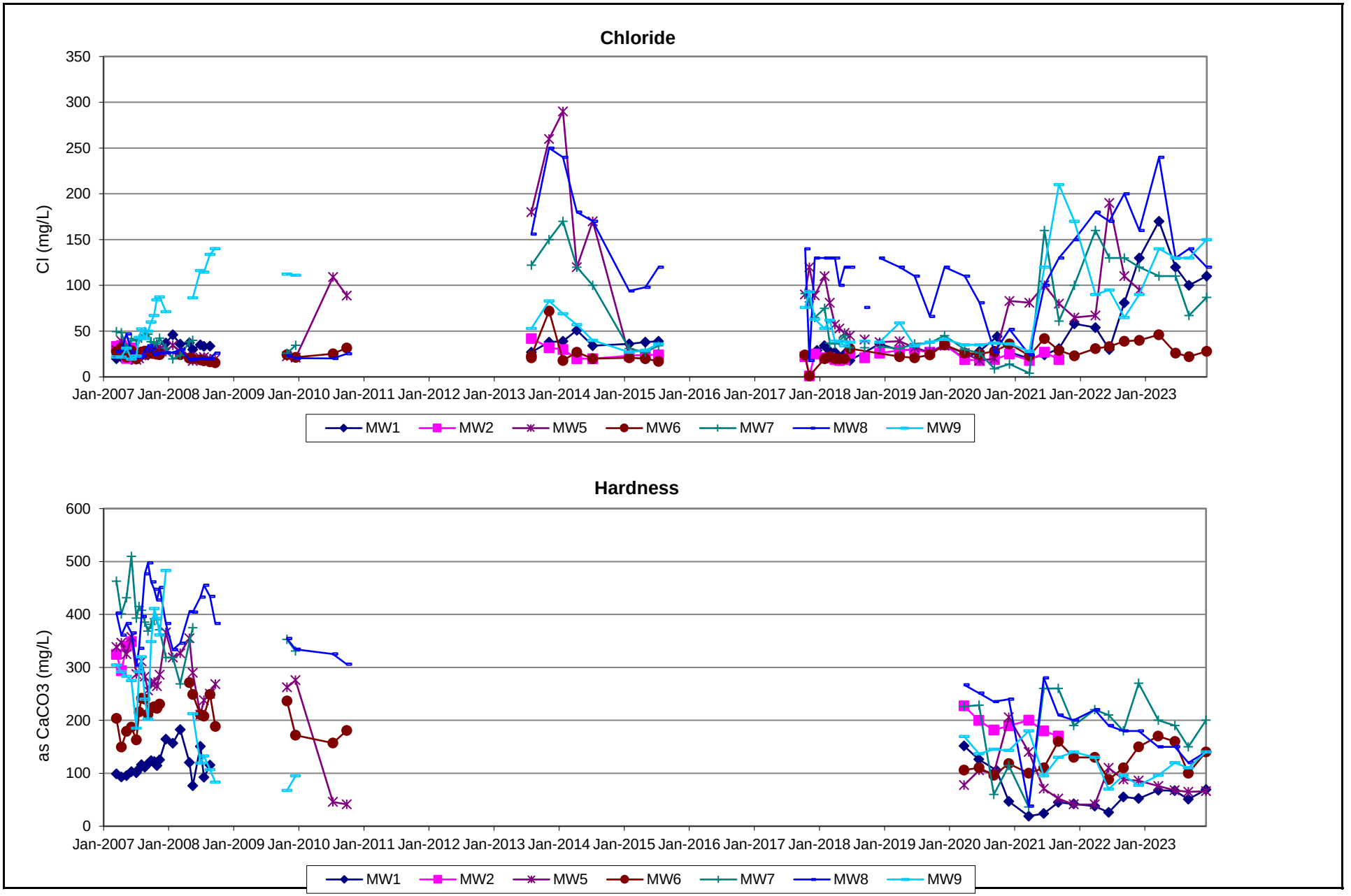

Selenium
0.04
0.03
0.02
0.01
0.00
Se (mg/L)
Jan-2007 Jan-2008 Jan-2009 Jan-2010 Jan-2011 Jan-2012 Jan-2013 Jan-2014 Jan-2015 Jan-2016 Jan-2017 Jan-2018 Jan-2019 Jan-2020 Jan-2021 Jan-2022 Jan-2023
MW1 MW2 MW5 MW6 MW7 MW8 MW9
Sodium
200
160
120
80
40
0
Na (mg/L)
Jan-2007 Jan-2008 Jan-2009 Jan-2010 Jan-2011 Jan-2012 Jan-2013 Jan-2014 Jan-2015 Jan-2016 Jan-2017 Jan-2018 Jan-2019 Jan-2020 Jan-2021 Jan-2022 Jan-2023
MW1 MW2 MW5 MW6 MW7 MW8 MW9



Jacobs

BASELINE GROUNDWATER QUALITY [ZINC ALKALINITY] FIGURE 15

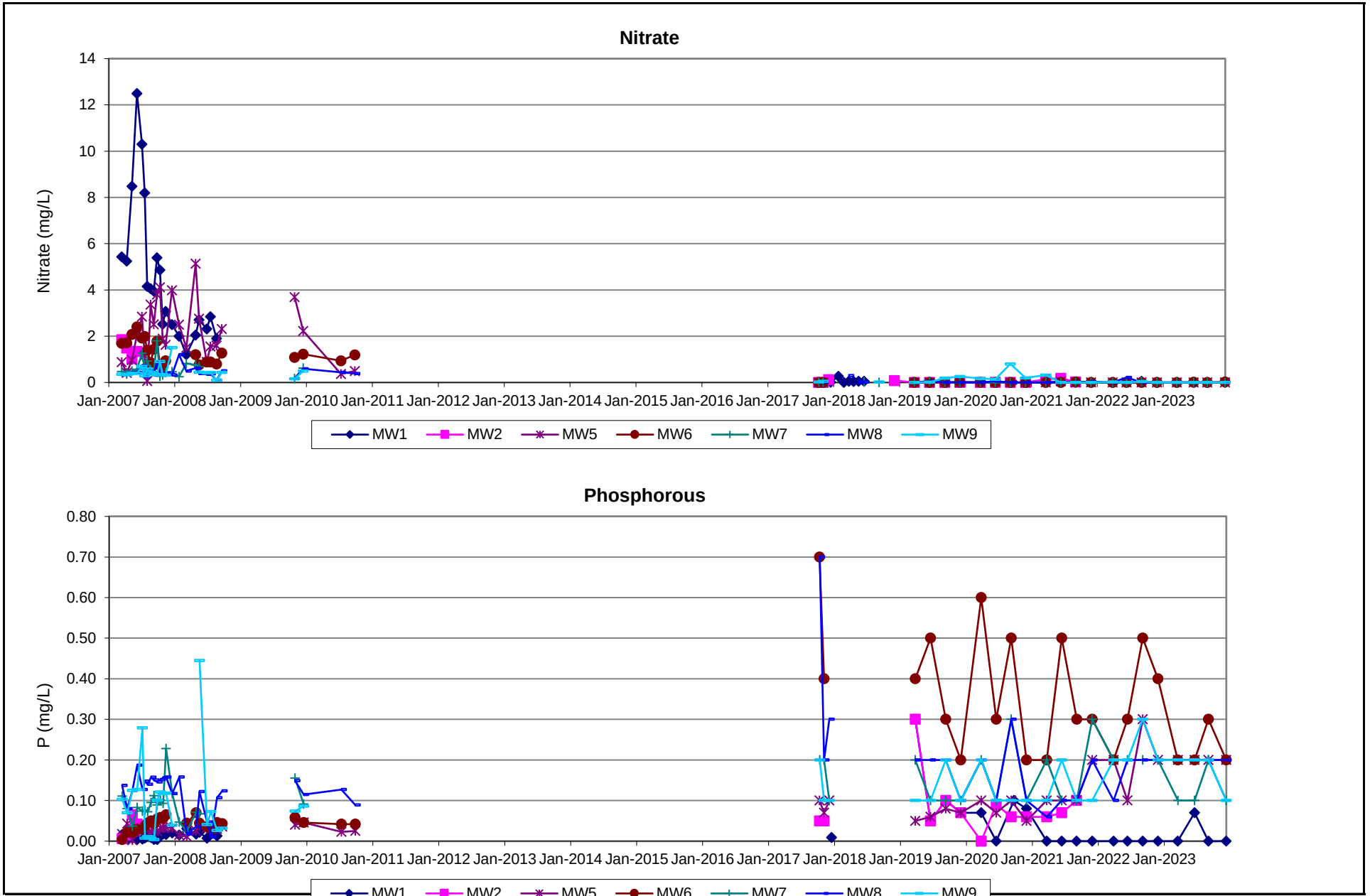
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]CaCO3 Zn



Jacobs

BASELINE GROUNDWATER QUALITY [CHLORIDE HARDNESS] FIGURE 16

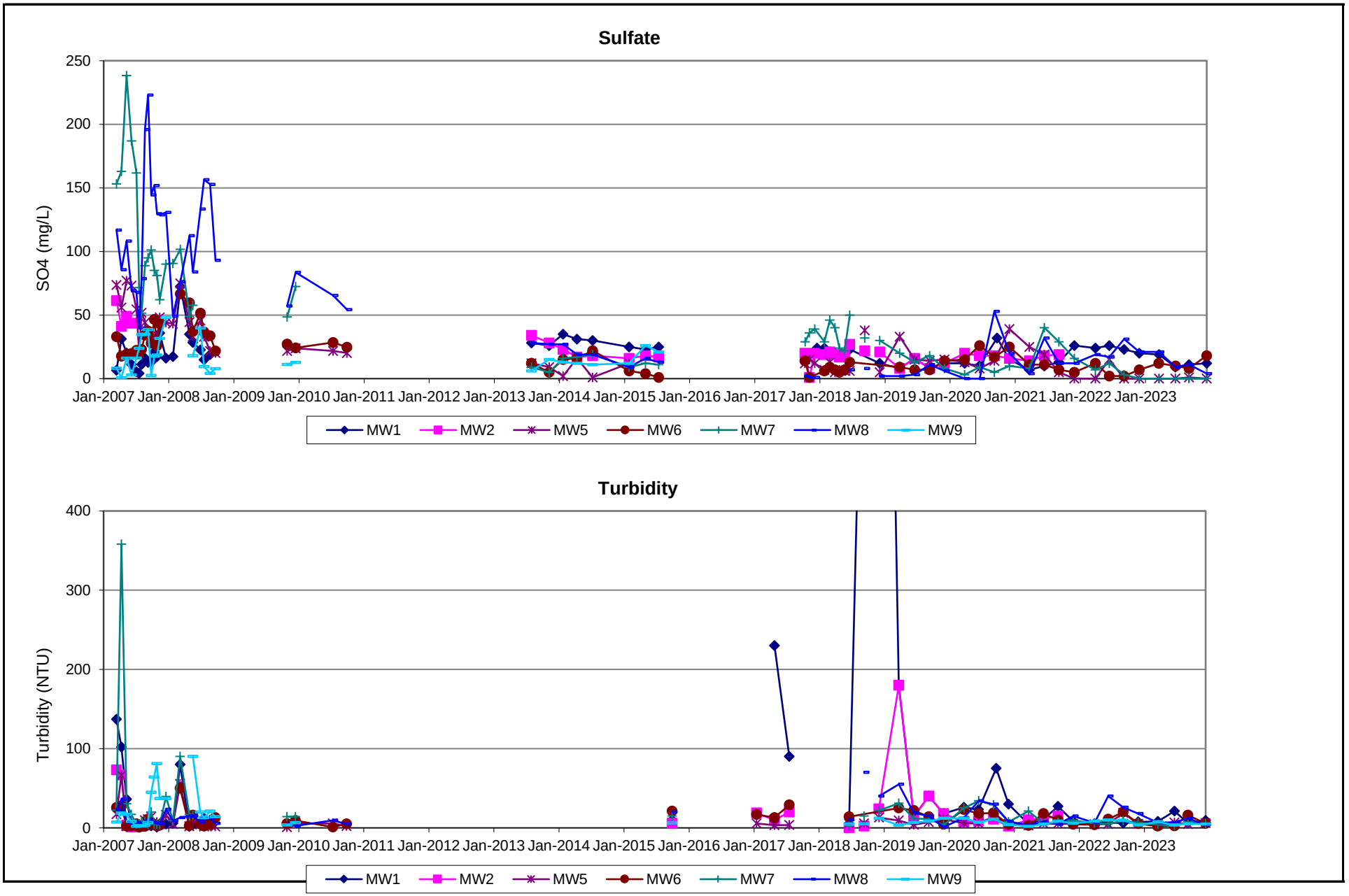
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]Hardness Cl



Jacobs

BASELINE GROUNDWATER QUALITY [NITRATE PHOSPHOROUS] FIGURE 17

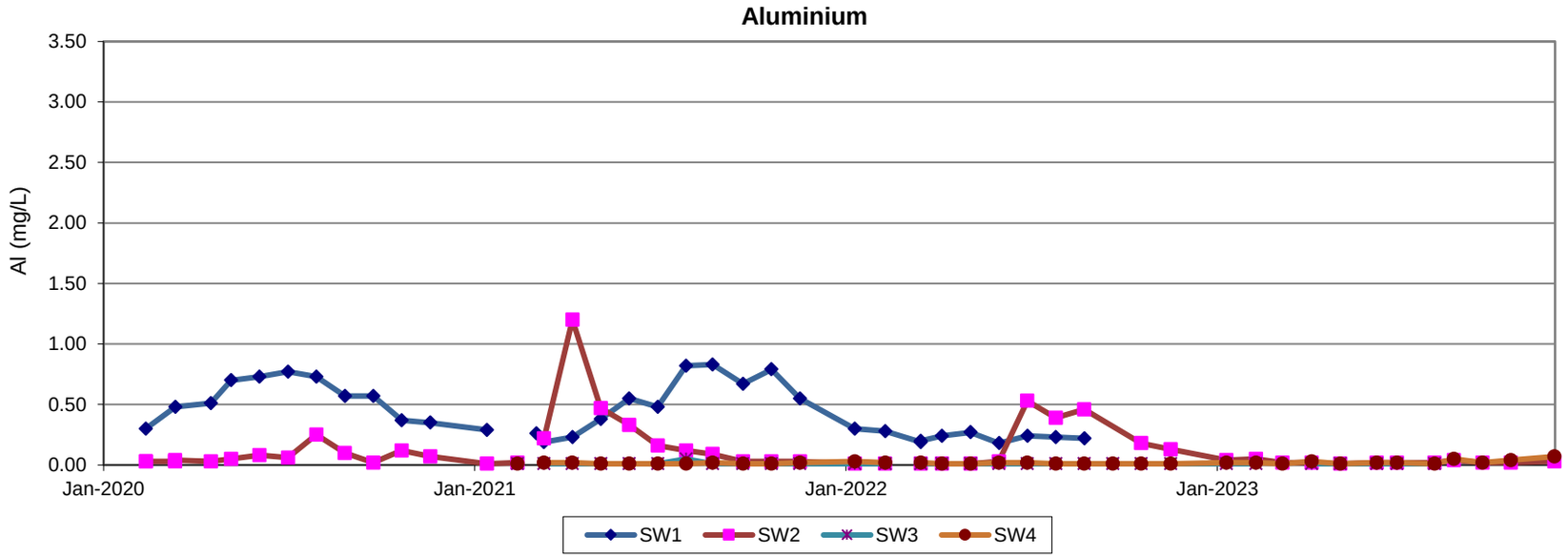
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]P Nitrate

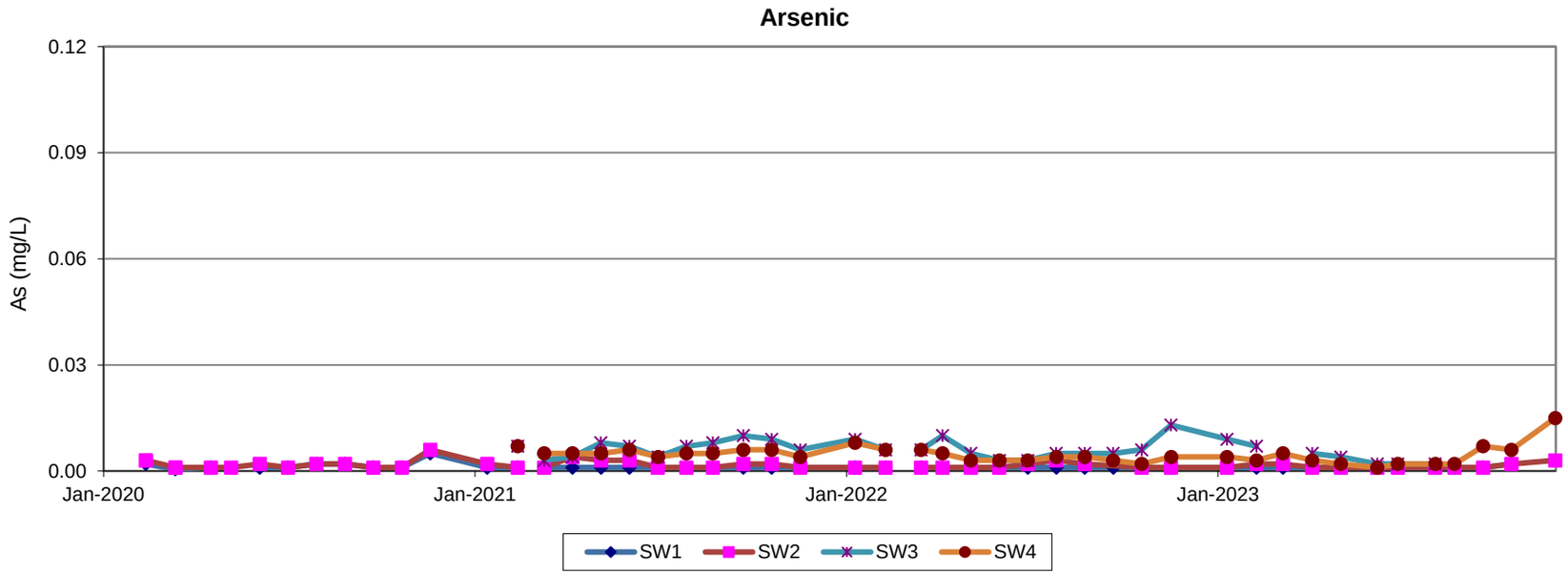


Jacobs

BASELINE GROUNDWATER QUALITY [SULPHATE TURBIDITY] FIGURE 18

\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Comprehensive Water Quality figs_2023.xlsx]NTU SO4

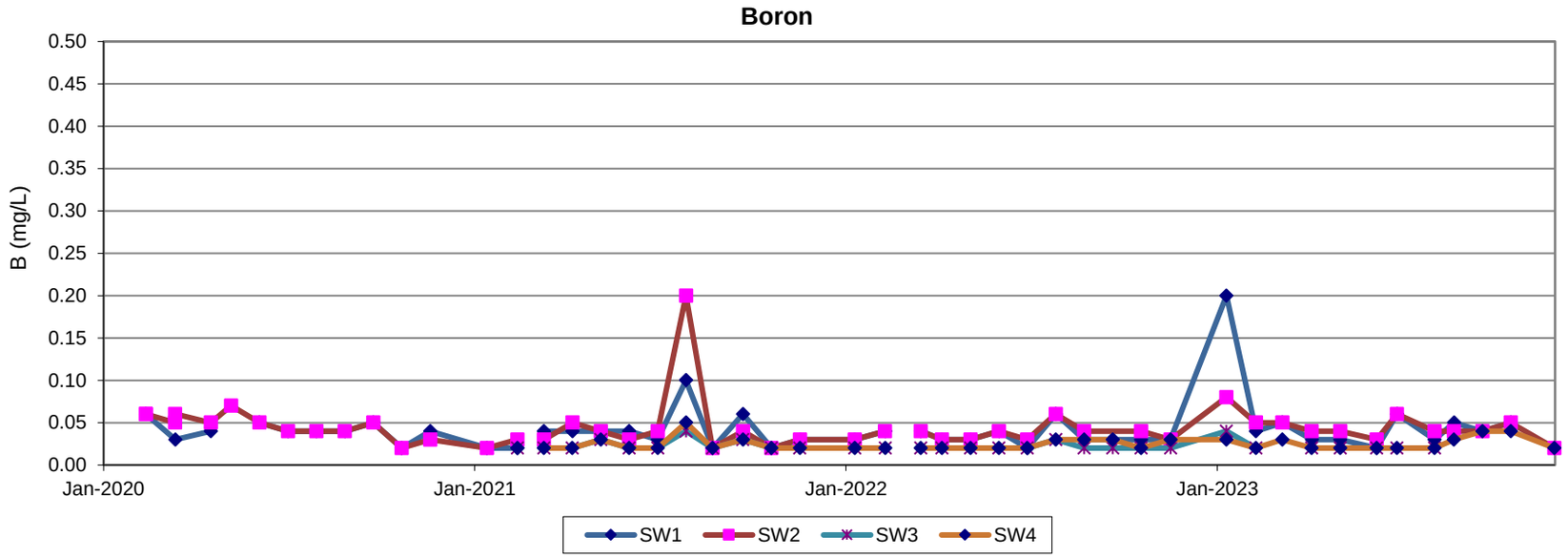


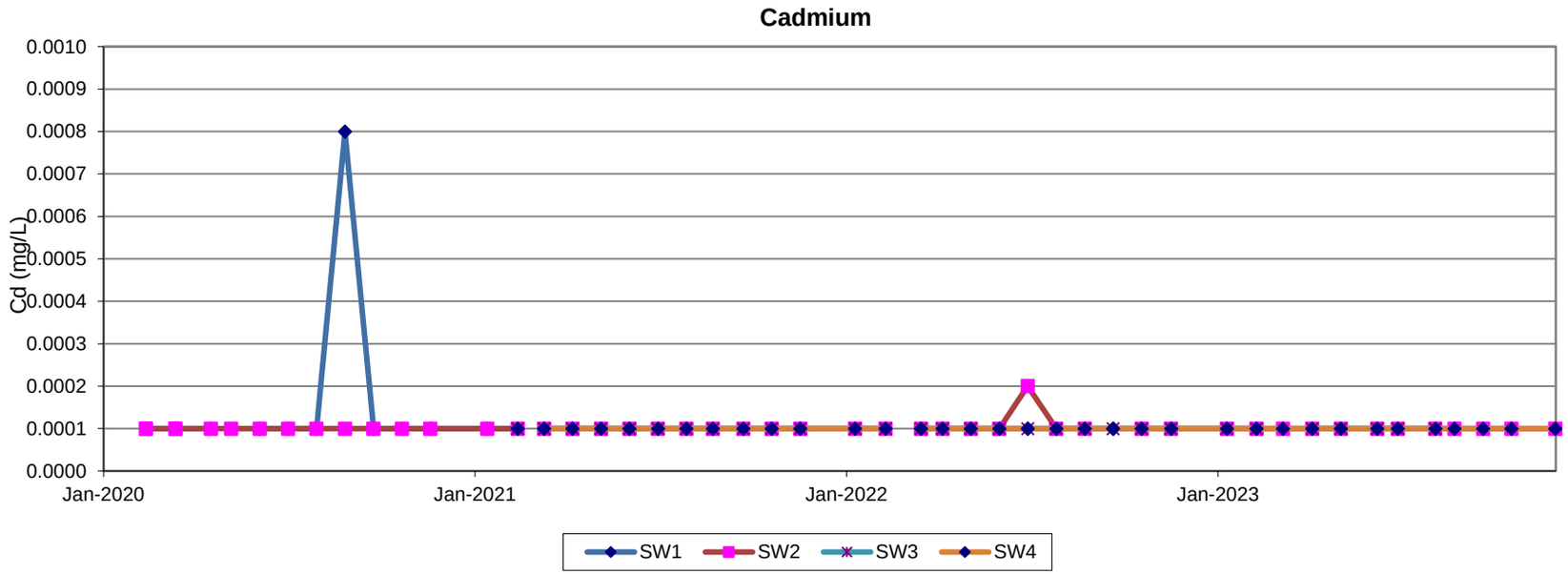


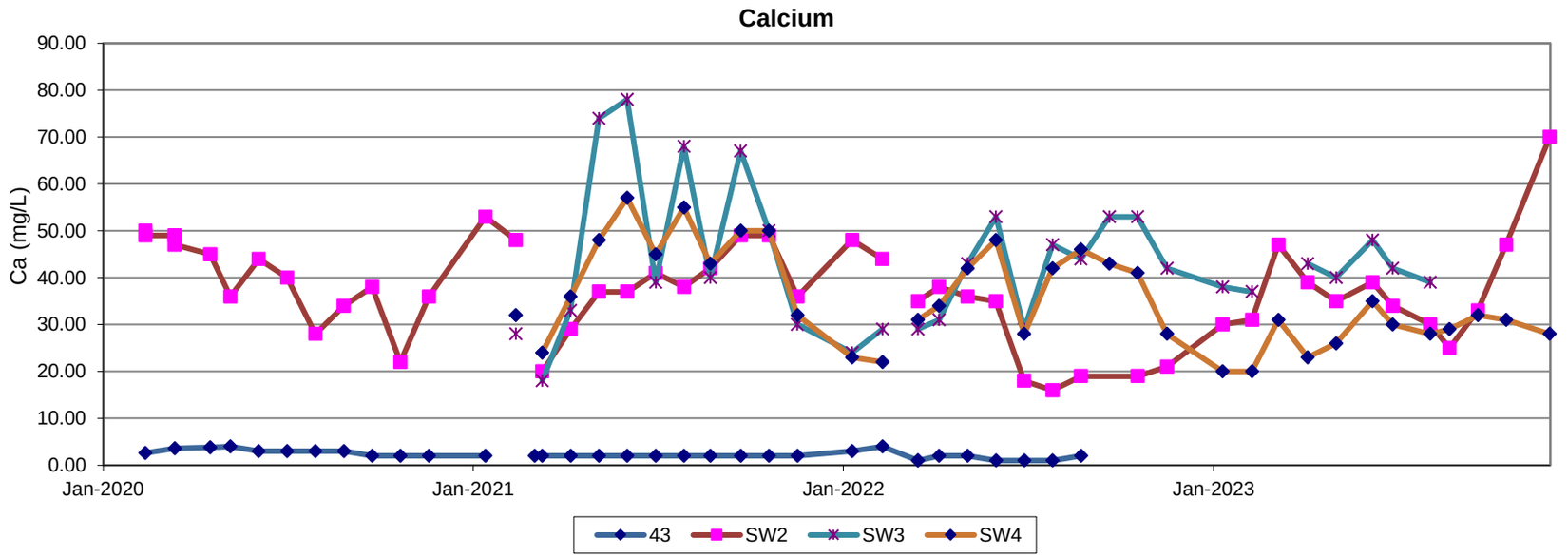
Jacobs

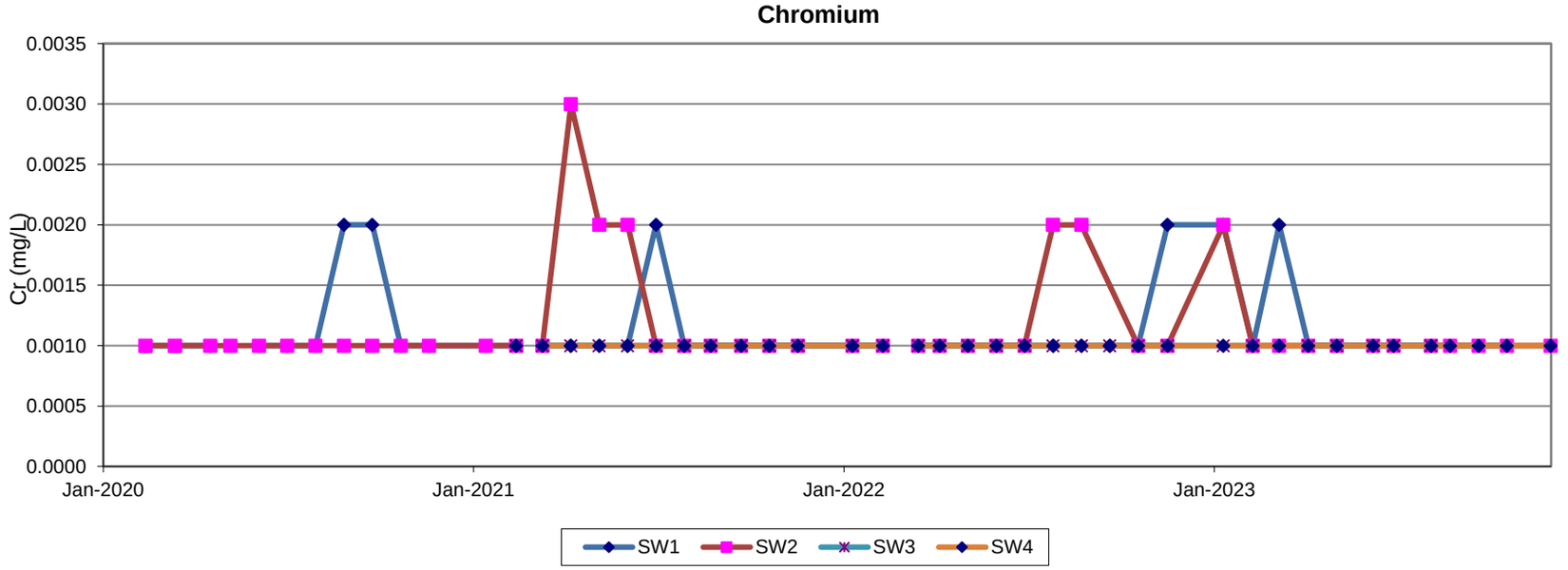
BASELINE SURFACE WATER QUALITY [ALUMINIUM ARSENIC] FIGURE 19

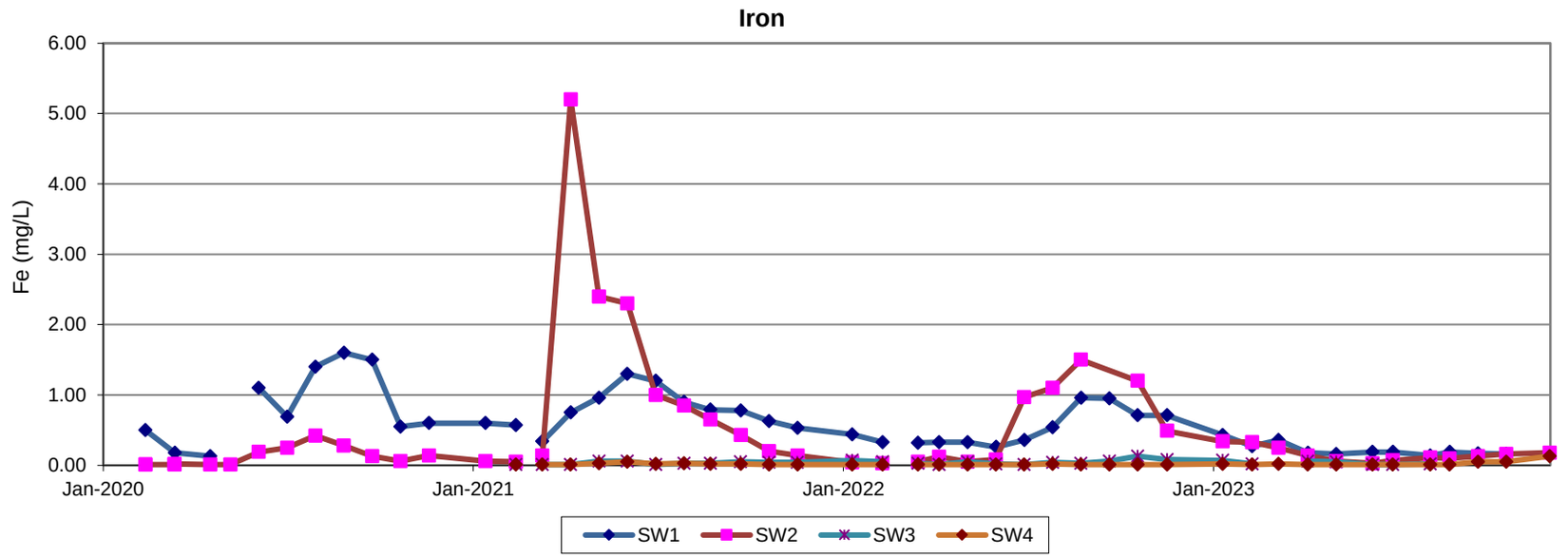
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Surfacewater_2020-2023_limitcalc_2023.xlsx]Al As

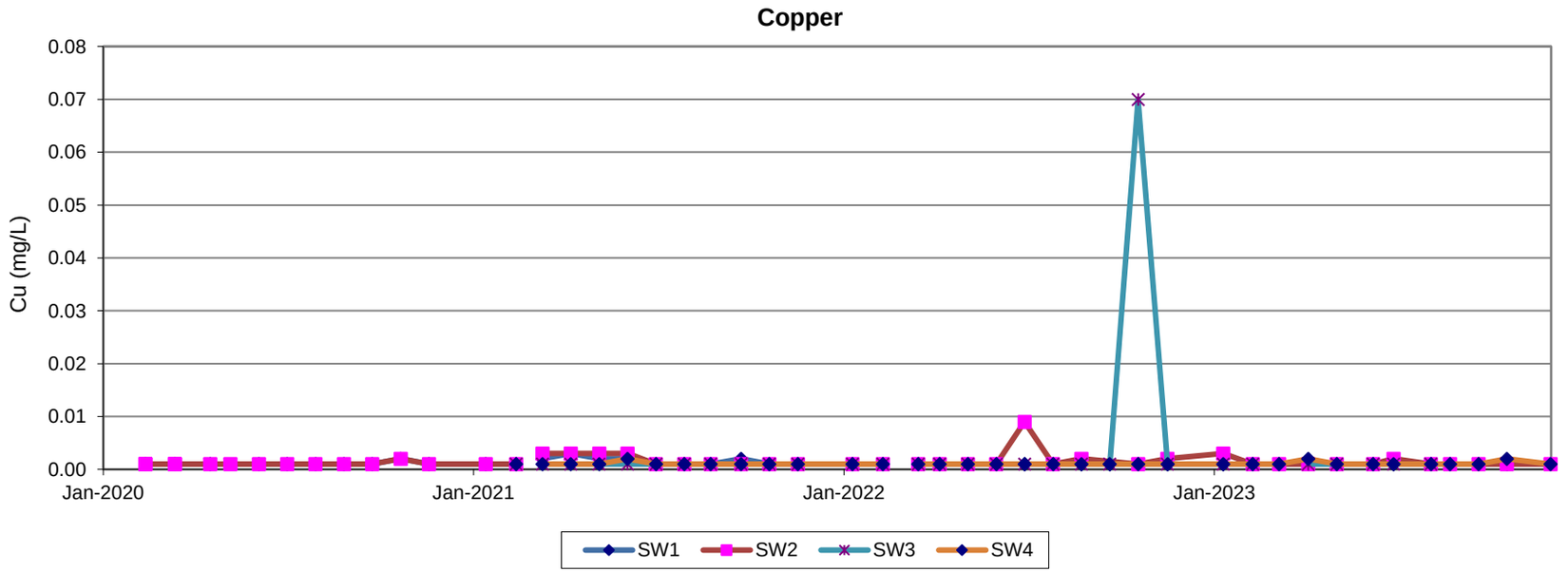

Boron
B (mg/L)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4

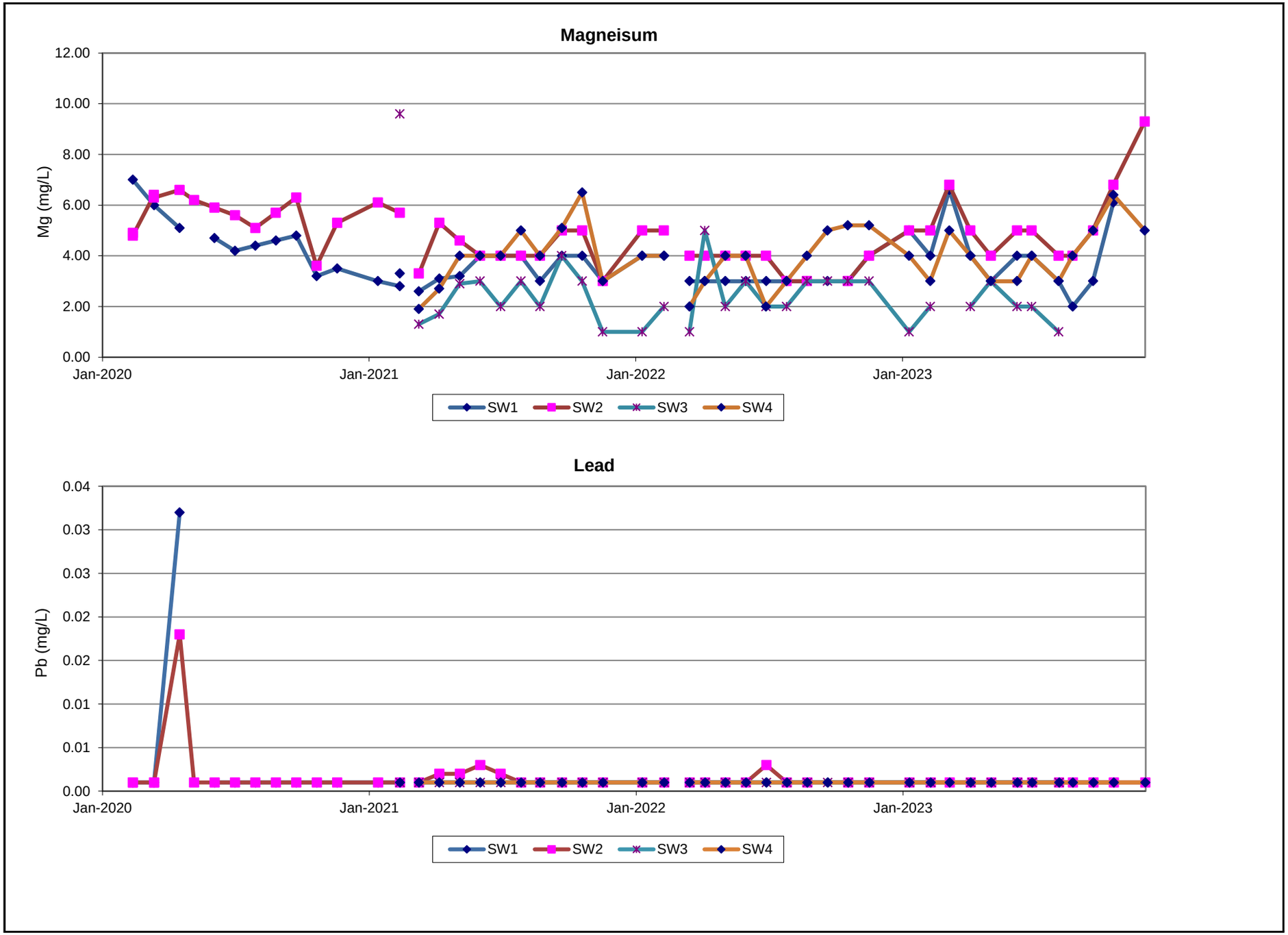

Cadmium
Cd (mg/L)
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4


Calcium
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Ca (mg/L)
Jan-2020
Jan-2021
Jan-2022
Jan-2023
43
SW2
SW3
SW4


Chromium
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Cr (mg/L)
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4


Iron
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Fe (mg/L)
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4

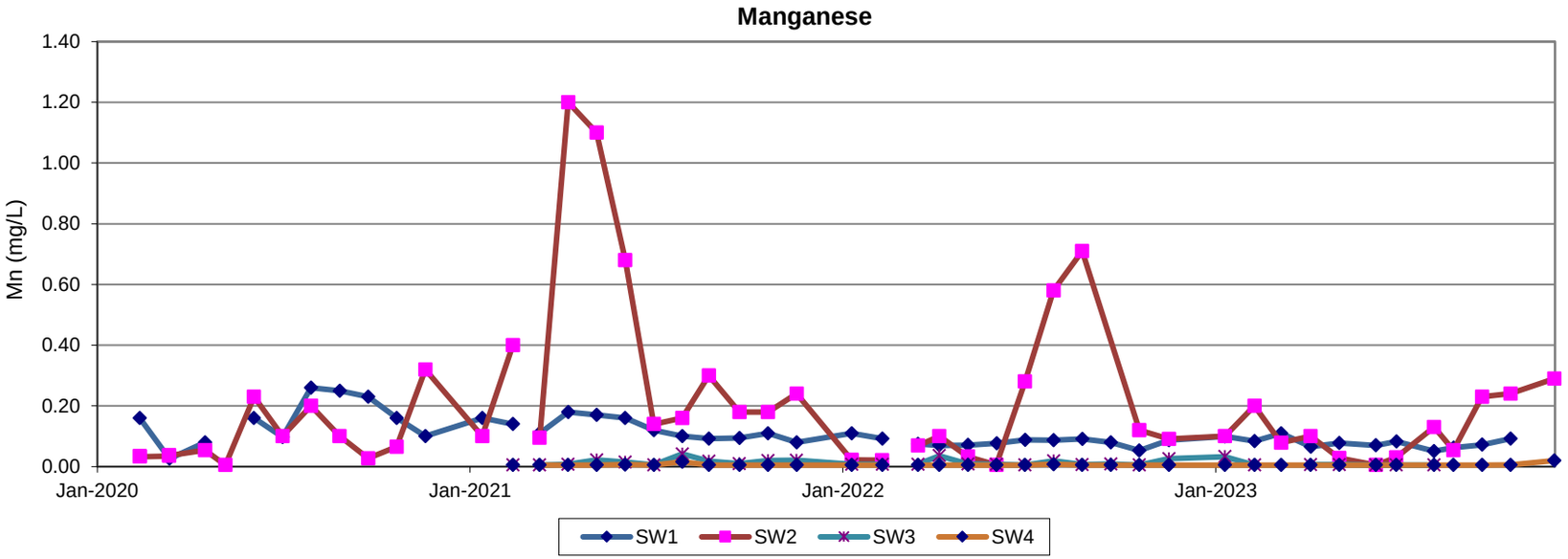

Copper
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Cu (mg/L)
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4

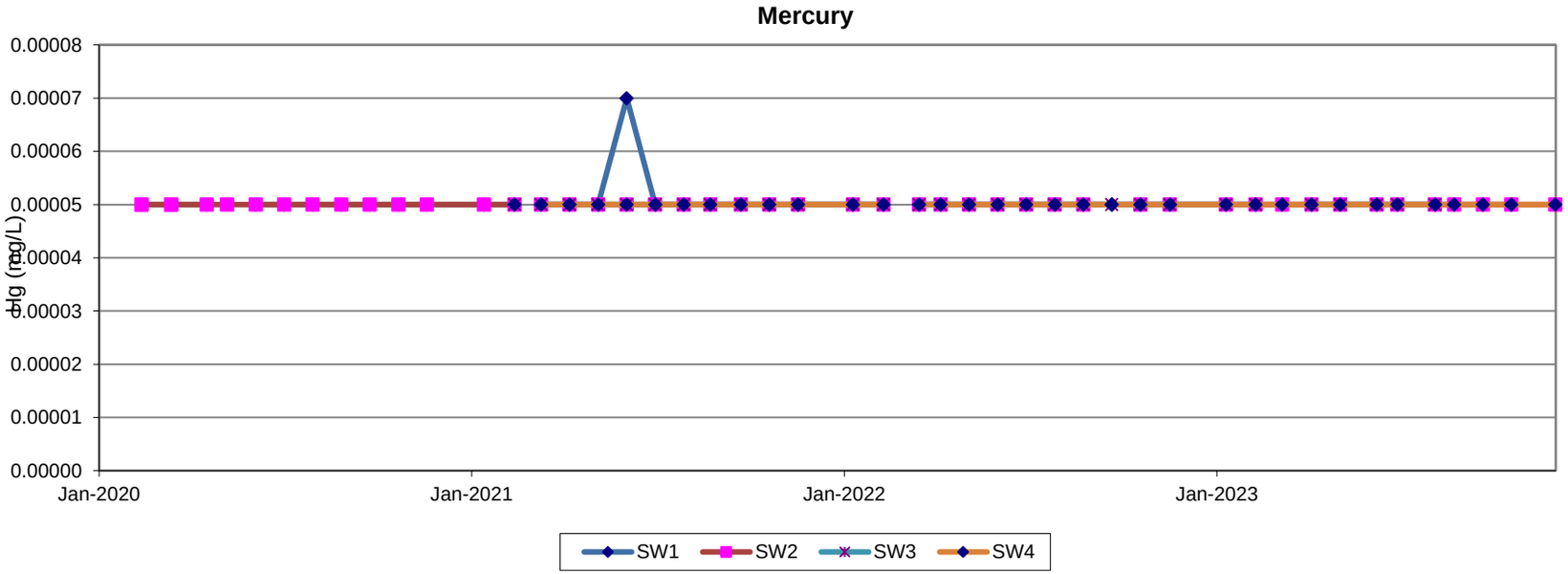


Jacobs

BASELINE SURFACE WATER QUALITY [MAGNESIUM LEAD] FIGURE 23

\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Surfacewater_2020-2023_limitcalc_2023.xlsx]Mg Pb

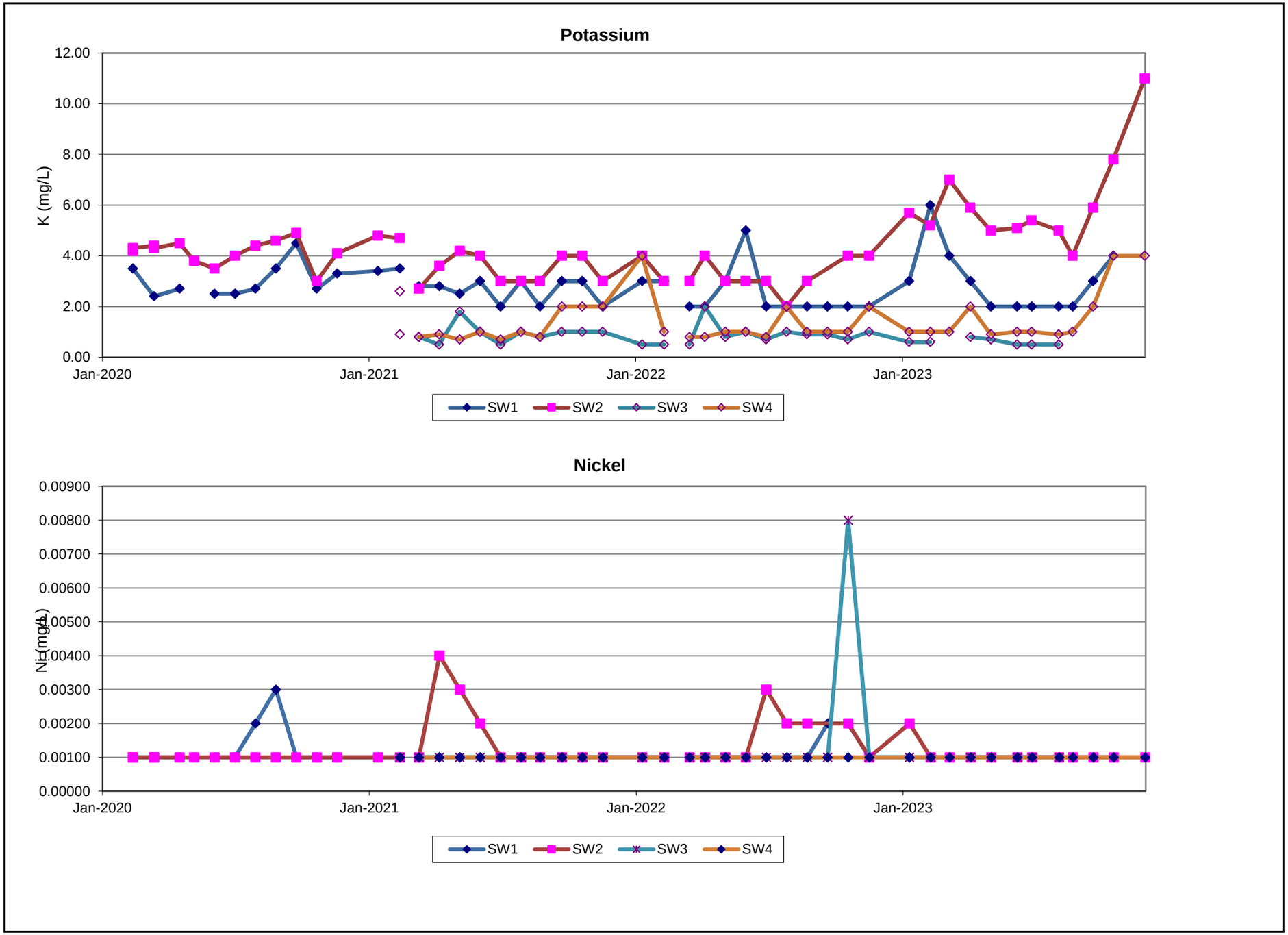


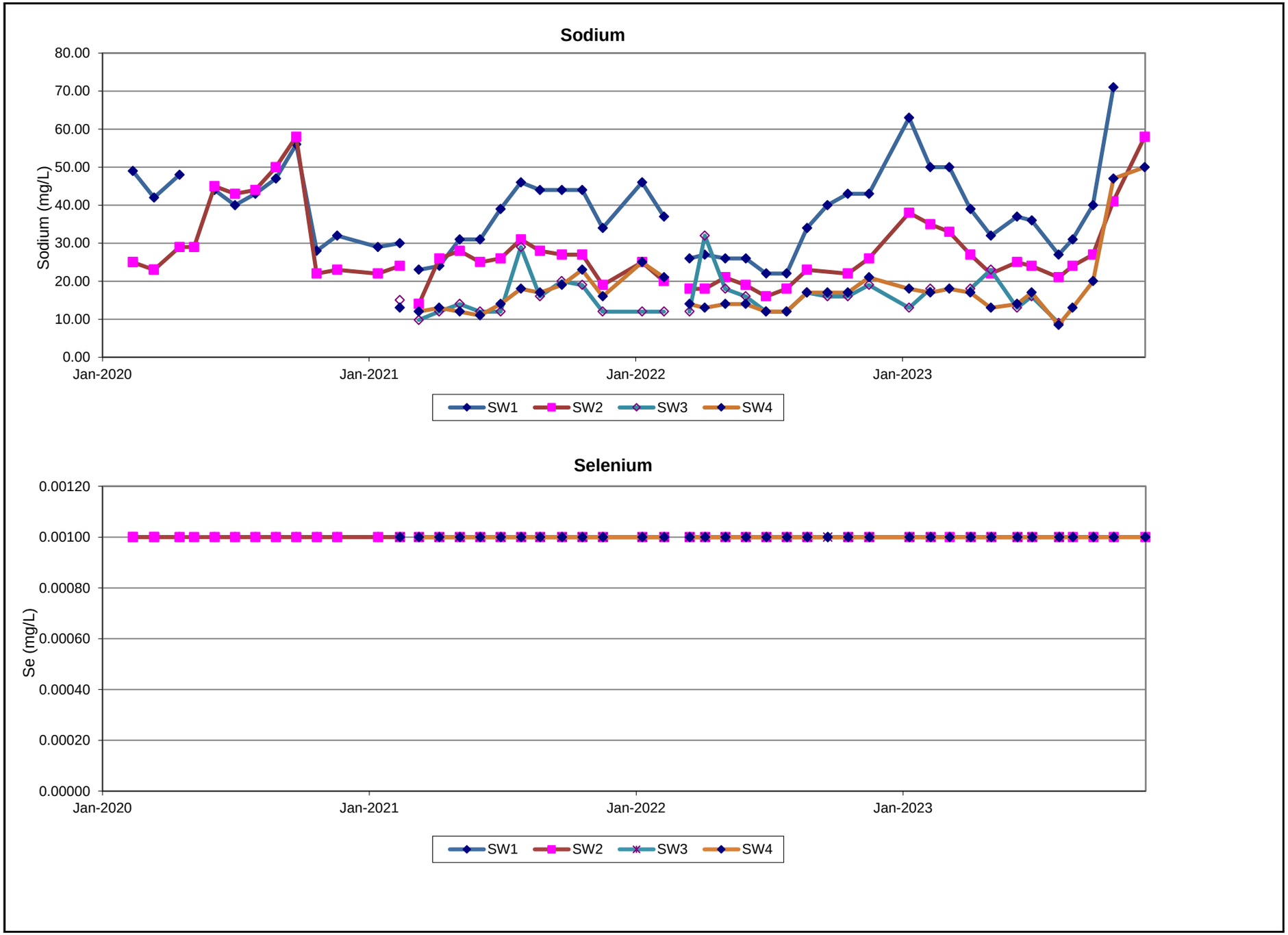


Jacobs

BASELINE SURFACE WATER QUALITY [MANGANESE MERCURY] FIGURE 24

\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Surfacewater_2020-2023_limitcalc_2023.xlsx]Hg Mn

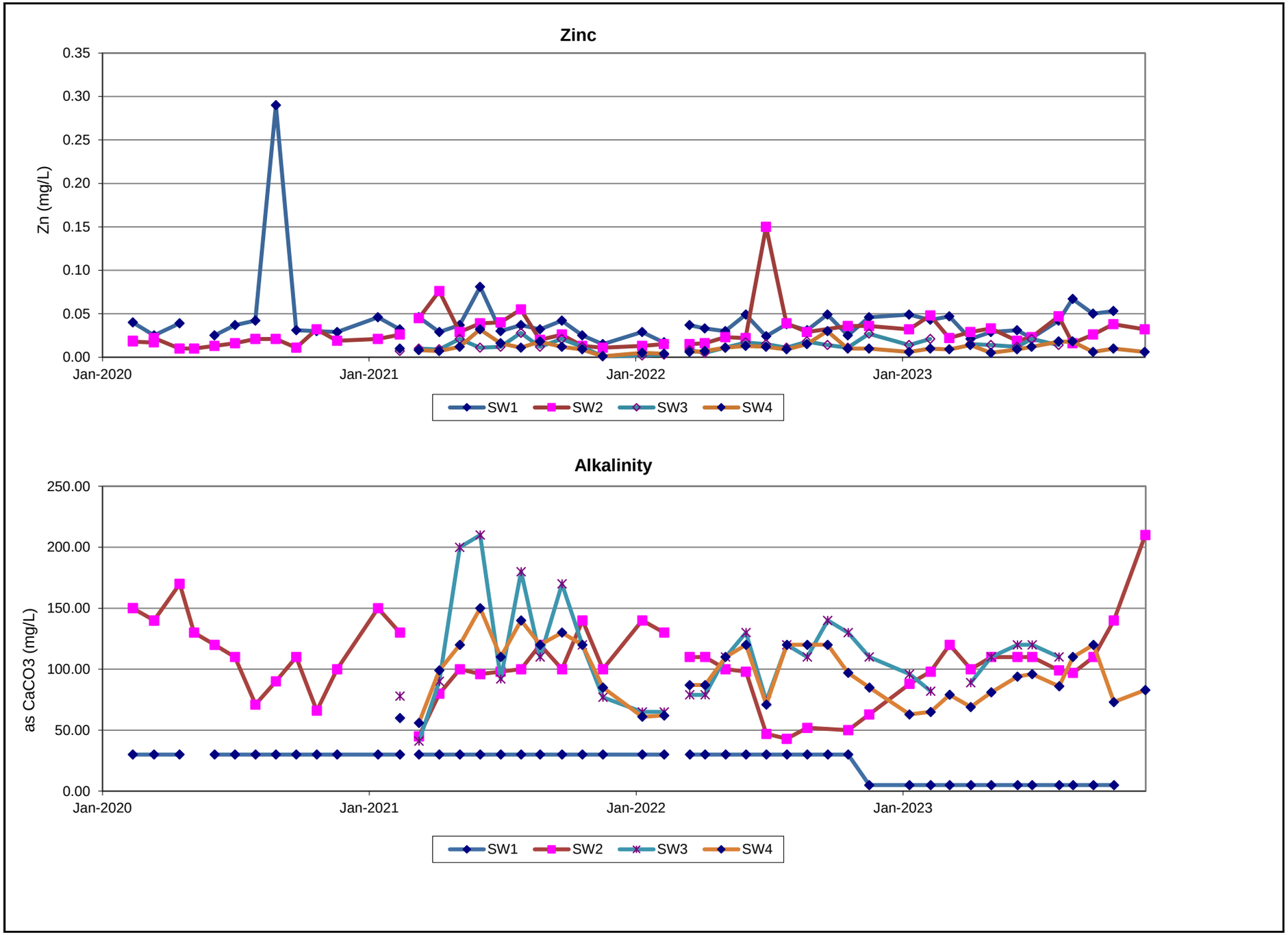

Potassium
12.00
10.00
8.00
6.00
4.00
2.00
0.00
K (mg/L)
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4
Nickel
0.00900
0.00800
0.00700
0.00600
0.00500
0.00400
0.00300
0.00200
0.00100
0.00000
Ni (mg/L)
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4



Jacobs

BASELINE SURFACE WATER QUALITY [SODIUM SELENIUM] FIGURE 26

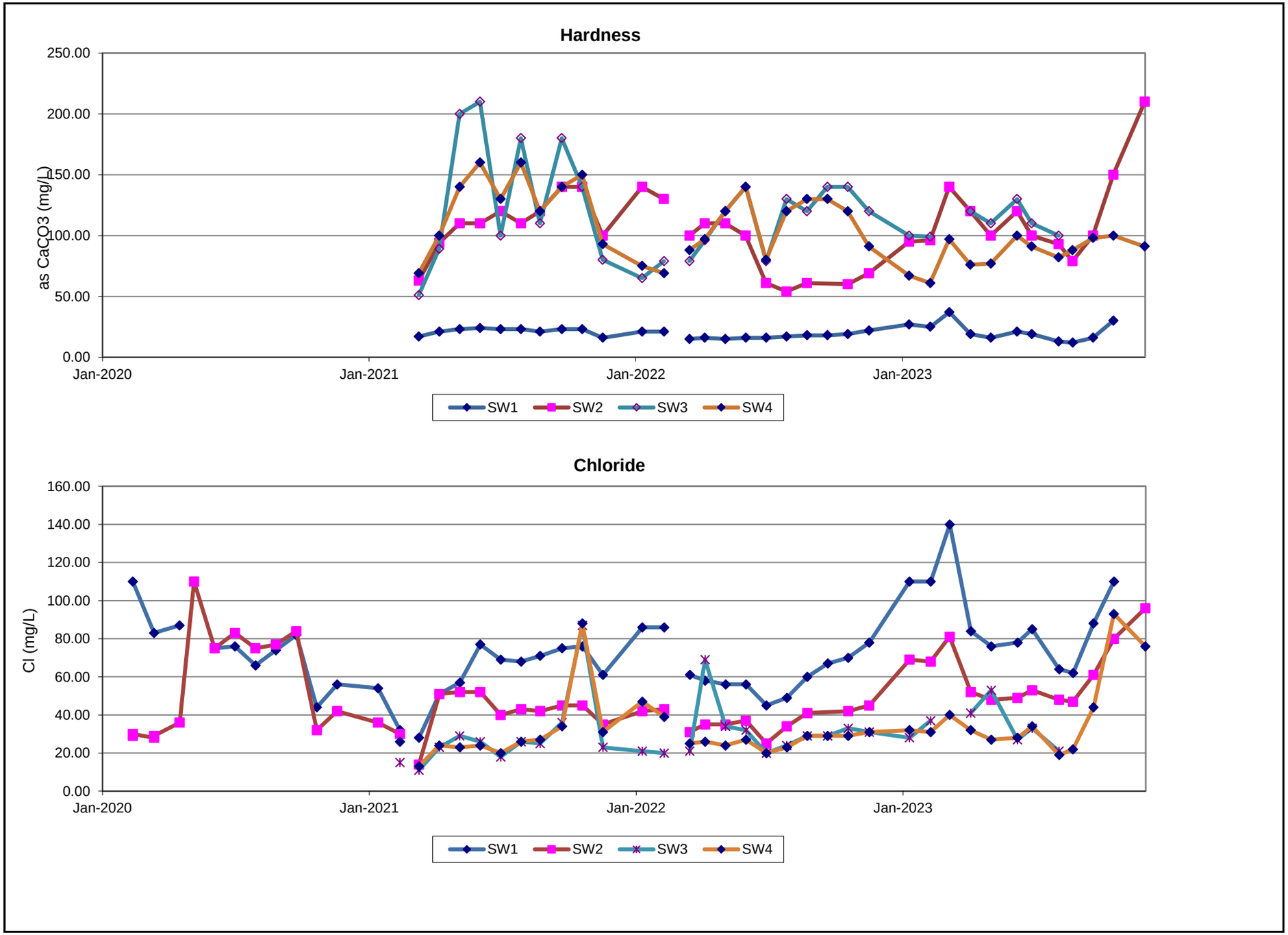
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Surfacewater_2020-2023_limitcalc_2023.xlsx]Na Se



Jacobs

BASELINE SURFACE WATER QUALITY [ZINC ALKALINITY] FIGURE 27

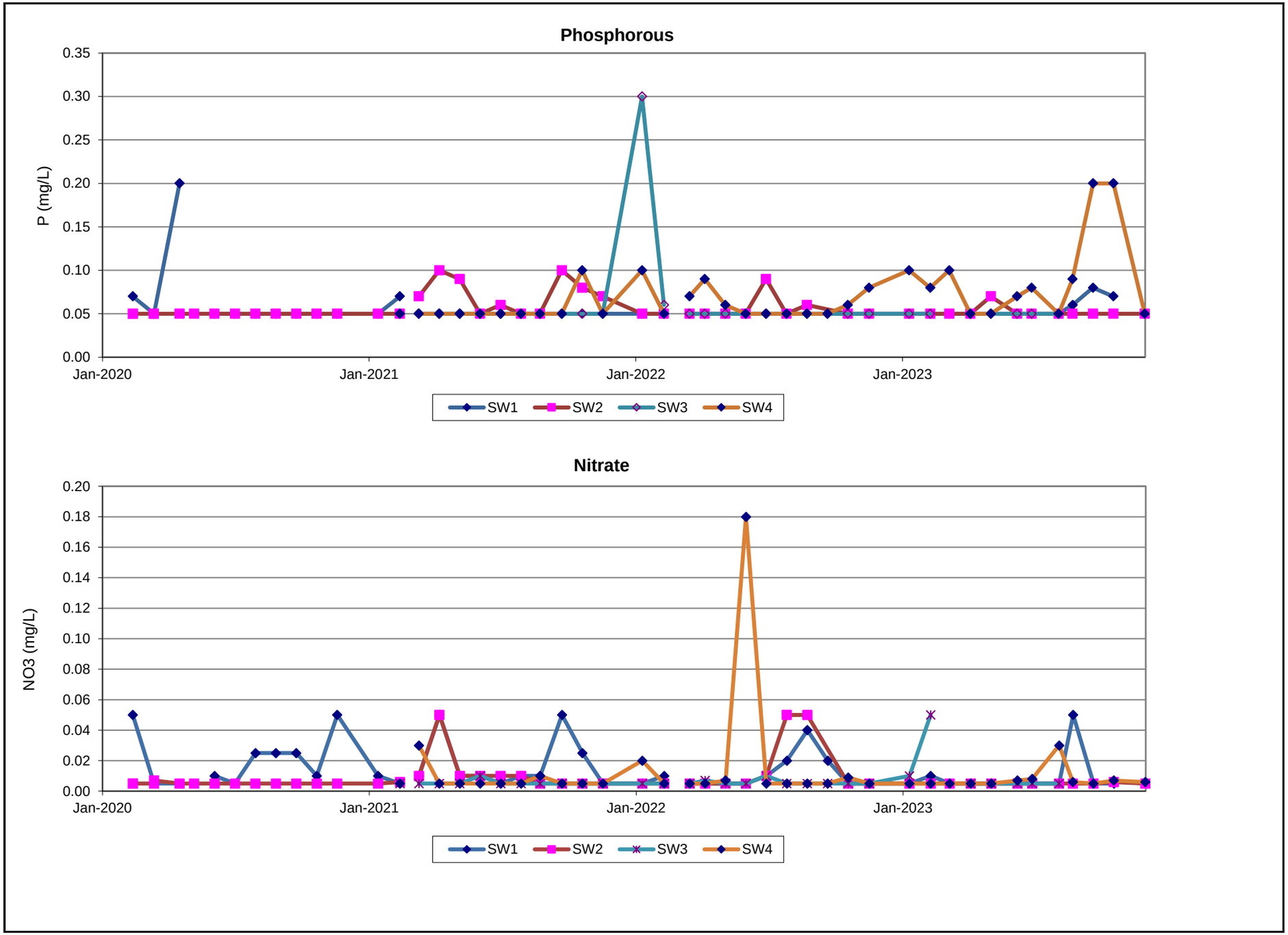
\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Surfacewater_2020-2023_limitcalc_2023.xlsx]CaCO3 Zn

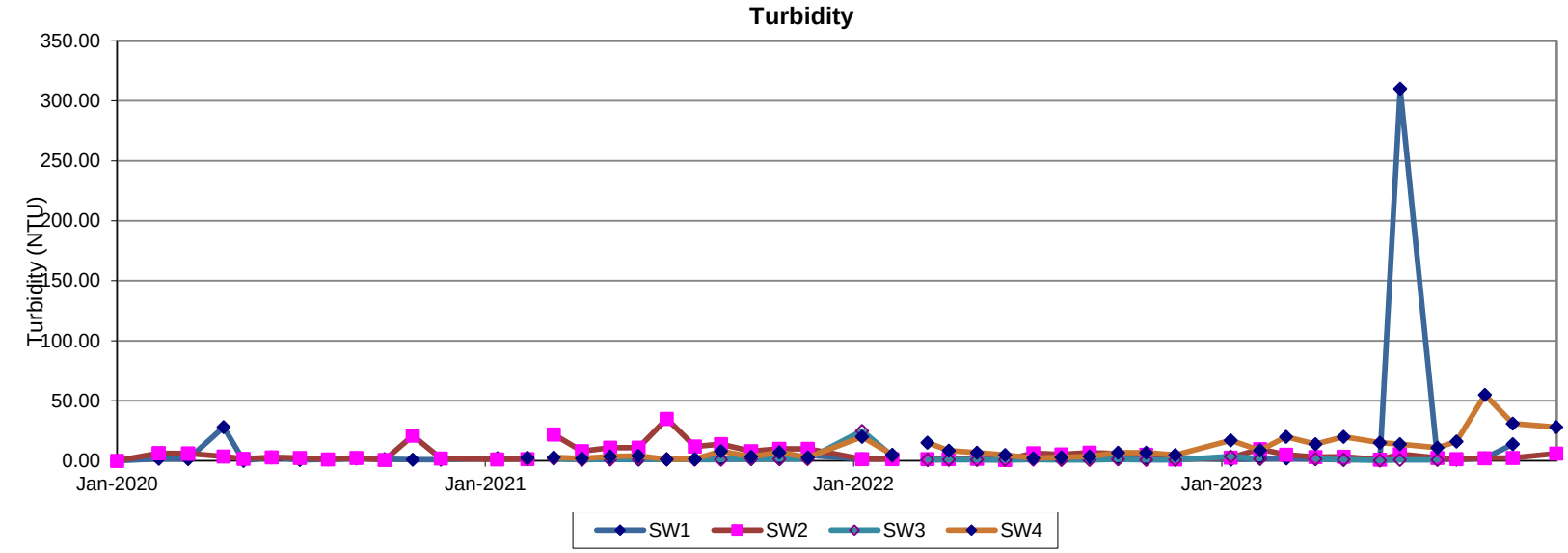


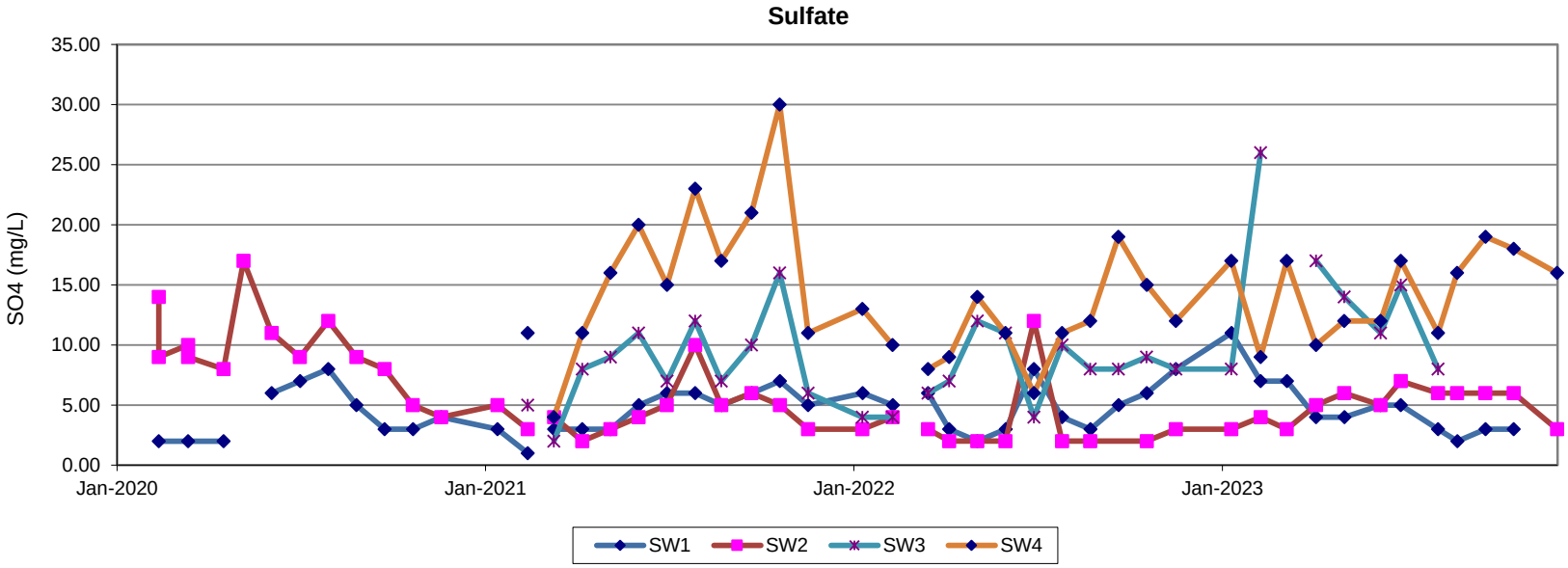
Jacobs

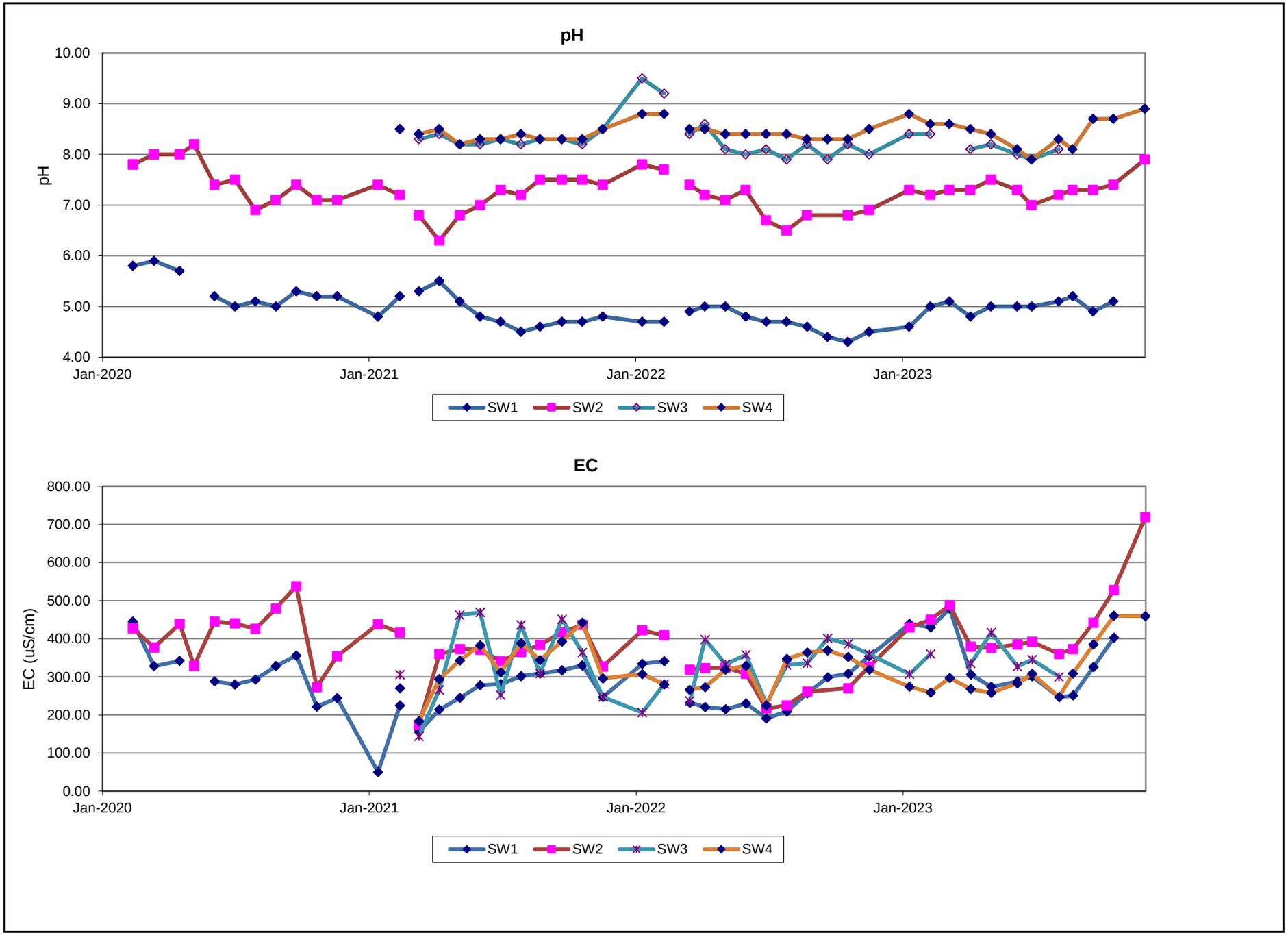
BASELINE SURFACE WATER QUALITY [HARDNESS CHLORIDE] FIGURE 28

\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Surfacewater_2020-2023_limitcalc_2023.xlsx]Hardness Cl


Phosphorous
P (mg/L)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4
Nitrate
NO3 (mg/L)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4


Turbidity
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Turbidity (NTU)
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4


Sulfate
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
SO4 (mg/L)
Jan-2020
Jan-2021
Jan-2022
Jan-2023
SW1
SW2
SW3
SW4



Jacobs

BASELINE SURFACE WATER QUALITY [PH EC] FIGURE 31

\\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA133800\02 Documents\Groundwater Analysis\2023 Groundwater Data\AK analysis\[Surfacewater_2020-2023_limitcalc_2023.xlsx]pH EC

Appendix B – 2023 Groundwater quality monitoring results (MW series bores)

	MW1				
Units	Date	21/03/2023	22/06/2023	6/09/2023	14/12/2023
[NTU]	Turbidity	8.2	21	6.1	9.4
[mg/L]	Chloride	170	120	100	110
[mg/L]	Sulphate as SO4	19	9	11	12
[mg/L]	Al	1.2	1.5	1.4	1.1
[mg/L]	As	<0.001	<0.001	<0.001	<0.001
[mg/L]	B	0.03	0.03	0.04	<0.02
[mg/L]	Ca	15	17	11	16
[mg/L]	Cd	<0.0001	<0.0001	<0.0001	<0.0001
[mg/L]	Cr	0.003	0.003	0.002	0.003
[mg/L]	Cu	<0.001	<0.001	<0.001	<0.001
[mg/L]	Fe	1.9	1.4	1.8	2
[mg/L]	K	8.8	6.1	4	5.2
[mg/L]	Mg	7.5	6	5.7	7.2
[mg/L]	Mn	0.02	0.011	0.028	0.04
[mg/L]	N				
[mg/L]	Na	85	71	58	69
[mg/L]	Ni	<0.001	<0.001	<0.001	0.001
[mg/L]	Pb	<0.001	<0.001	<0.001	<0.001
[mg/L]	Se	<0.001	<0.001	<0.001	<0.001
[mg/L]	Zn	0.01	0.014	0.02	0.026
[mg/L]	Filtrable P	<0.05	0.07	<0.05	<0.05
[mg/L]	Nitrate -N	0.006	<0.005	<0.005	<0.005
[mg CaCO3/L]	Alkalinity	27	43	36	42
[mg/L]	Hardness as CaCO3	68	67	51	69
[mg/L]	Hg	<0.00005	<0.00005	<0.00005	<0.00005
[mg/L]	Fluoride	<0.1	<0.005	<0.1	<0.1

Note: trigger exceedances highlighted red

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

	MW5				
Units	**Date**	**21/03/2023**	**22/06/2023**	**6/09/2023**	**14/12/2023**
[NTU]	Turbidity	4	6.7	4.8	5.9
[mg/L]	Chloride	72	85	96	85
[mg/L]	Sulphate as SO4	<1	<1	1	<1
[mg/L]	Al	3.9	3.5	2.8	3.5
[mg/L]	As	0.003	0.002	0.003	0.003
[mg/L]	B	0.05	0.05	0.07	<0.02
[mg/L]	Ca	22	19	18	18
[mg/L]	Cd	<0.0001	<0.0001	<0.0001	0.0001
[mg/L]	Cr	0.007	0.006	0.005	0.005
[mg/L]	Cu	0.003	0.002	<0.001	0.002
[mg/L]	Fe	0.65	0.84	0.85	1
[mg/L]	K	5.1	4	4	5
[mg/L]	Mg	5	5	5	5.1
[mg/L]	Mn	0.02	0.018	0.019	0.02
[mg/L]	Na	35	46	61	67
[mg/L]	Ni	<0.001	<0.001	<0.001	<0.001
[mg/L]	Pb	<0.001	<0.001	<0.001	<0.001
[mg/L]	Se	<0.001	<0.001	<0.001	<0.001
[mg/L]	Zn	0.014	0.022	0.022	0.038
[mg/L]	Filtrable P	0.2	0.2	0.2	0.2
[mg/L]	Nitrate as N	<0.00005	<0.00005	<0.00005	<0.00005
[mg CaCO3/L]	Alkalinity	63	56	70	61
[mg/L]	Hardness as CaCO3	76	68	65	66
[mg/L]	Hg	<0.005	<0.050	<0.050	<0.005
[mg/L]	Fluoride	<0.1	<0.05	<0.1	<0.1

Note: trigger exceedances highlighted red

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

	MW6				
Units	**Date**	21/03/2023	22/06/2023	6/09/2023	14/12/2023
[NTU]	Turbidity	2.3	2.5	16	5.6
[mg/L]	Chloride	46	26	22	28
[mg/L]	Sulphate as SO4	12	10	8	18
[mg/L]	Al	0.14	0.08	0.1	0.04
[mg/L]	As	0.013	0.014	0.025	0.032
[mg/L]	B	0.02	<0.02	<0.02	<0.02
[mg/L]	Ca	61	57	36	50
[mg/L]	Cd	<0.0001	<0.0001	<0.0001	<0.0001
[mg/L]	Cr	0.002	<0.001	<0.001	<0.001
[mg/L]	Cu	<0.001	<0.001	<0.001	<0.001
[mg/L]	Fe	1.8	1.2	1.6	1.9
[mg/L]	K	1	1	0.8	1
[mg/L]	Mg	4	4	3	4
[mg/L]	Mn	0.005	<0.005	<0.005	<0.005
[mg/L]	N				
[mg/L]	Na	20	16	13	12
[mg/L]	Ni	<0.001	<0.001	<0.001	<0.001
[mg/L]	Pb	<0.001	<0.001	<0.001	<0.001
[mg/L]	Se	<0.001	<0.001	<0.001	<0.001
[mg/L]	Zn	0.015	0.029	0.029	0.053
[mg/L]	Filtrable P	0.2	0.2	0.3	0.2
[mg/L]	Nitrate -N	<0.005	0.01	<0.005	0.02
[mg CaCO3/L]	Alkalinity	130	150	120	110
[mg/L]	Hardness as CaCO3	170	160	100	140
[mg/L]	Hg	<0.00005	<0.00005	<0.00005	<0.00005
[mg/L]	Fluoride	0.1	<0.1	0.2	0.2

Note: trigger exceedances highlighted red

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

	MW7				
Units	Date	21/03/2023	22/06/2023	6/09/2023	14/12/2023
[NTU]	Turbidity	4.3	2.5	7.6	5.2
[mg/L]	Chloride	110	110	67	87
[mg/L]	Sulphate as SO4	<1	<1	<1	<1
[mg/L]	Al	0.29	0.27	0.22	0.26
[mg/L]	As	0.004	0.004	0.005	0.006
[mg/L]	B	0.04	0.03	0.05	<0.02
[mg/L]	Ca	70	66	49	69
[mg/L]	Cd	<0.0001	<0.0001	<0.0001	<0.0001
[mg/L]	Cr	0.005	0.004	0.004	0.005
[mg/L]	Cu	<0.001	<0.001	<0.001	<0.001
[mg/L]	Fe	3.7	4.1	4.3	5
[mg/L]	K	3	3	2	3
[mg/L]	Mg	5.9	6.9	5.4	7.5
[mg/L]	Mn	0.02	0.021	0.024	0.03
	N				
[mg/L]	Na	45	61	45	62
[mg/L]	Ni	<0.001	<0.001	<0.001	<0.001
[mg/L]	Pb	<0.001	<0.001	<0.001	<0.001
[mg/L]	Se	<0.001	<0.001	<0.001	<0.001
[mg/L]	Zn	0.022	0.014	0.016	0.031
[mg/L]	Filtrable P	0.1	0.1	0.2	0.1
[mg/L]	Nitrate -N	<0.005	<0.005	<0.010	<0.005
[mg CaCO3/L]	Alkalinity	170	190	200	210
[mg/L]	Hardness as CaCO3	200	190	150	200
[mg/L]	Hg	<0.00005	<0.00005	<0.00005	<0.00005
[mg/L]	Fluoride	<0.1	<0.005	<0.1	<0.1

Note: trigger exceedances highlighted red

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

	MW8				
Units	**Date**	**21/03/2023**	**22/06/2023**	**6/09/2023**	**14/12/2023**
[NTU]	Turbidity	6.4	7.4	12	4
[mg/L]	Chloride	240	130	140	120
[mg/L]	Sulphate as SO4	21	9	11	4
[mg/L]	Al	0.05	0.03	0.06	0.04
[mg/L]	As	0.001	0.002	0.001	0.002
[mg/L]	B	0.04	0.02	0.04	<0.02
[mg/L]	Ca	48	48	38	44
[mg/L]	Cd	<0.0001	<0.0001	<0.0001	<0.0001
[mg/L]	Cr	0.004	0.002	0.003	0.003
[mg/L]	Cu	<0.001	<0.001	<0.001	<0.001
[mg/L]	Fe	4.9	5.1	5.2	5.4
[mg/L]	K	3	3	3	3
[mg/L]	Mg	8.4	8.4	6.9	7.1
[mg/L]	Mn	0.02	0.031	0.03	0.064
	N				
[mg/L]	Na	90	72	85	89
[mg/L]	Ni	<0.001	<0.001	<0.001	<0.001
[mg/L]	Pb	<0.001	<0.001	<0.001	<0.001
[mg/L]	Se	<0.001	<0.001	<0.001	<0.001
[mg/L]	Zn	0.014	0.032	0.018	0.025
[mg/L]	Filtrable P	0.2	0.2	0.2	0.2
[mg/L]	Nitrate -N	<0.005	<0.005	<0.050	<0.005
[mg CaCO3/L]	Alkalinity	110	130	130	150
[mg/L]	Hardness as CaCO3	150	150	120	140
[mg/L]	Hg	<0.00005	<0.00005	<0.00005	<0.00005
[mg/L]	Fluoride	<0.1	<0.005	<0.1	<0.1

Note: trigger exceedances highlighted red

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

	MW9				
Units	Date	21/03/2023	22/06/2023	6/09/2023	14/12/2023
[NTU]	Turbidity	7.5	3.7	5	4.7
[mg/L]	Chloride	140	130	130	150
[mg/L]	Sulphate as SO4	<1	5	3	<1
[mg/L]	Al	2.1	1.1	0.88	1.3
[mg/L]	As	0.003	0.005	0.005	0.005
[mg/L]	B	0.03	<0.02	0.03	0.03
[mg/L]	Ca	29	40	36	46
[mg/L]	Cd	<0.0001	0.0003	<0.0001	<0.0001
[mg/L]	Cr	0.007	0.005	0.005	0.005
[mg/L]	Cu	0.001	<0.001	<0.001	<0.001
[mg/L]	Fe	0.87	0.47	0.66	0.83
[mg/L]	K	3	2	2	3
[mg/L]	Mg	5.5	5.5	5	5.4
[mg/L]	Mn	<0.005	<0.005	<0.005	<0.005
	N				
[mg/L]	Na	47	68	65	83
[mg/L]	Ni	<0.001	<0.001	<0.001	<0.001
[mg/L]	Pb	<0.001	<0.001	<0.001	<0.001
[mg/L]	Se	<0.001	<0.001	<0.001	<0.001
[mg/L]	Zn	0.022	0.028	0.033	0.022
[mg/L]	Filtrable P	0.2	0.2	0.2	0.1
[mg/L]	Nitrate -N	<0.005	<0.010	<0.020	<0.005
[mg CaCO3/L]	Alkalinity	42	79	86	78
[mg/L]	Hardness as CaCO3	96	120	110	140
[mg/L]	Hg	<0.00005	<0.00005	<0.00005	<0.00005
[mg/L]	Fluoride	<0.1	<0.01	<0.1	<0.1

Note: trigger exceedances highlighted red

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

Appendix C – 2021 Surface water quality monitoring results

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

Reference			14093/1	14202/1	14340/1	14475/1	14610/1	14718/1	14793/1	14927/1	15066/1	15141/1	15284/1	15463/1
Description			Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam	Stockton Dam
Sample name			SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi	SW1 (MDL Soi
Sample date			25/01/2023	23/02/2023	21/03/2023	19/04/2023	17/05/2023	22/06/2023	12/07/2023	18/08/2023	06/09/2023	04/10/2023	01/11/2023	14/12/2023
Pre-treatment/Preservation			AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	
Sampling Method			AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake	AS5667.4 Lake, Grab	
Sampling Comments			No Visible Oil	No Visible Oil	No Visible Oil	No Visible Oil and Grease, Ver		Clear					Shallow, decor	Dry, no sample
Matrix			Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
	Units	PQL												
Temperature	°C	0.1	27.4	25.1	23.8	22	16	11.1	12.4	16.6	19.2	21.4	24.8	[NT]
pH	pH Units	0.1	4.6	5	5.1	4.8	5	5	5	5.1	5.2	4.9	5.1	[NT]
Electrical Conductivity	µS/cm	50	439	430	479	306	274	288	301	247	251	326	403	[NT]
Dissolved Oxygen	mg/L	0.1	5.1	5.4	4.4	7.7	8.7	7.3	5.3	6	5.6	4.1	5.8	[NT]
Oxidation Reduction Potential#	mV		346	226	164	331	283	103	335	272	54	357	305	[NT]
Turbidity	NTU	0.1	0.9	1.7	2	1.3	0.8	1.7	310	1.4	0.9	2.1	14	[NT]
Total Dissolved Solids	mg/L	20	310	270	320	220	200	220	250	160	200	260	230	
Aluminium	mg/L	0.01	0.55	0.3	0.28	0.19	0.2	0.24	0.27	0.18	0.24	0.23	0.22	
Arsenic	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	
Boron	mg/L	0.02	0.2	0.04	0.05	0.03	0.03	<0.02	0.06	0.03	0.05	0.04	0.05	
Cadmium[1]	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Chromium[1]	mg/L	0.001	0.002	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Copper[1]	mg/L	0.001	0.001	0.001	<0.001	0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	
Iron	mg/L	0.01	0.43	0.27	0.36	0.18	0.16	0.19	0.19	0.14	0.19	0.17	0.16	
Lead[1]	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Manganese	mg/L	0.005	0.039	0.084	0.11	0.065	0.078	0.07	0.083	0.051	0.062	0.072	0.092	
Nickel[1]	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Selenium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Zinc[1]	mg/L	0.001	0.043	0.043	0.047	0.021	0.023	0.031	0.022	0.042	0.067	0.05	0.053	
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	
Chloride, Cl	mg/L	1	110	110	140	84	76	78	85	64	62	88	110	
Sulphate, SO_4	mg/L	1	11	7	7	4	4	5	5	3	2	3	3	
Fluoride, F	mg/L	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	
Sodium-Dissolved	mg/L	0.5	63	50	50	39	32	37	36	27	31	40	71	
Potassium-Dissolved	mg/L	0.5	3	6	4	3	2	2	2	2	2	3	4	
Calcium-Dissolved	mg/L	0.5	2	3	4	1	1	2	2	1	1	1	2	
Magnesium-Dissolved	mg/L	0.5	5	4	6.6	4	3	4	4	3	2	3	6.1	
Total Alkalinity#	mg CaCO3/L	30	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5	
Nitrate as N	mg/L	0.005	<0.005	<0.010	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.050	<0.005	<0.005	
Total Phosphorus	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.08	0.07	
Total Hardness	mg CaCO3/L	1	27	25	37	19	16	21	19	13	12	16	30	
Benzene	µg/L	1			<1									
Toluene	µg/L	1			<1									
Ethylbenzene	µg/L	1			<1									
m+p-xylene	µg/L	2			<2									
o-xylene	µg/L	1			<1									
Total Xylenes	µg/L	2			<2									
Sum of BTEX	µg/L	2			<2									
Naphthalene	µg/L	1			<1.0									
TRH C6 - C9	µg/L	10			<10									
TRH C6 - C10	µg/L	10			<10									
TRH C6 - C10 less BTEX (F1)	µg/L	10			<10									
TRH C10 - C14	µg/L	50			<50									
TRH C15 - C28	µg/L	100			<100									
TRH C29 - C36	µg/L	100			<100									
TRH C10 - C36 (sum)	µg/L	100			<100									
TRH >C10 - C16	µg/L	50			<50									
TRH >C16 - C34	µg/L	100			<100									
TRH >C34 - C40	µg/L	100			<100									
TRH >C10 - C40 (sum)	µg/L	100			<100									

Note: SW1 trigger exceedances highlighted in red

[1]Adjusted trigger values apply for selected metals in freshwaters of varying water hardness as per the ANZECC 2000

Jacobs

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

Reference			14093/2	14202/2	14340/2	14475/2	14610/2	14718/2	14799/2	14927/2	15066/2	15141/2	15284/2	15463/2
Description			Stockton Dar	Stockton Dar	Stockton Dar	Stockton Dar	Stockton Dar	Stockton Dar	Stockton Dar	Stockton Dar	Stockton Dan	Stockton Dan	Stockton Dams - I	Stockton Dan
Sample name			SW2 (MDL N	SW2 (MDL N	SW2 (MDL N	SW2 (MDL N	SW2 (MDL N	SW2 (MDL N	SW2 (MDL N	SW2 (MDL N	SW2 (MDL N	SW2 (MDL N	SW2 (MDL North	SW2 (MDL N
Sample date			25/01/2023	23/02/2023	21/03/2023	19/04/2023	17/05/2023	22/06/2023	12/07/2023	16/08/2023	06/09/2023	04/10/2023	01/11/2023	14/12/2023
Pre-treatment/Preservation			AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1	AS5667.1
Sampling Method			AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lal	AS5667.4 La	AS5667.4 Lak	AS5667.4 Lak	AS5667.4 Lake, G	AS5667.4 Lak
Sampling Comments			No Visible Oi	No Visible Oi	No Visible Oi	No Visible Oi	Aquatic vege	Clear						Shallow
Matrix			Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
	Units	PQL												
Temperature	°C	0.1	24	22.3	22.6	19	14.8	9.6	10.3	15.1	15.5	21.1	20.3	27.4
pH	pH Units	0.1	7.3	7.2	7.3	7.3	7.5	7.3	7	7.2	7.3	7.3	7.4	7.9
Electrical Conductivity	µS/cm	50	430	450	488	379	376	385	332	360	373	442	528	719
Dissolved Oxygen	mg/L	0.1	4.6	3.5	3.5	3.8	6.9	7.1	5.8	6.9	5.9	3.7	3.9	5.4
Oxidation Reduction Potential#	mV		267	181	233	227	249	269	277	254	240	339	298	304
Turbidity	NTU	0.1	2.6	9.7	5.1	3.1	3.3	1	5.6	2.4	1.3	2.1	2.3	6
Total Dissolved Solids	mg/L	20	300	290	330	250	240	270	260	220	240	290	330	460
Aluminium	mg/L	0.01	0.04	0.05	0.02	0.02	<0.01	0.02	0.02	0.02	0.04	0.02	0.02	0.03
Arsenic	mg/L	0.001	0.001	0.002	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	0.003
Boron	mg/L	0.02	0.08	0.05	0.05	0.04	0.04	0.03	0.06	0.04	0.04	0.04	0.05	0.02
Cadmium[1]	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium[1]	mg/L	0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper[1]	mg/L	0.001	0.003	<0.001	<0.001	0.001	0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	mg/L	0.01	0.34	0.33	0.25	0.14	0.06	0.03	0.07	0.11	0.1	0.13	0.16	0.18
Lead[1]	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.005	0.1	0.2	0.079	0.1	0.028	<0.005	0.03	0.13	0.054	0.23	0.24	0.29
Nickel[1]	mg/L	0.001	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc[1]	mg/L	0.001	0.032	0.048	0.022	0.029	0.033	0.019	0.023	0.047	0.016	0.026	0.038	0.032
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Chloride, Cl	mg/L	1	69	68	81	52	48	49	53	48	47	61	80	96
Sulphate, SO_4	mg/L	1	3	4	3	5	6	5	7	6	6	6	6	3
Fluoride, F	mg/L	0.1	0.3	0.3	0.4	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6
Sodium-Dissolved	mg/L	0.5	38	35	33	27	22	25	24	21	24	27	41	58
Potassium-Dissolved	mg/L	0.5	5.7	5.2	7	5.9	5	5.1	5.4	5	4	5.9	7.8	11
Calcium-Dissolved	mg/L	0.5	30	31	47	39	35	39	34	30	25	33	47	70
Magnesium-Dissolved	mg/L	0.5	5	5	6.8	5	4	5	5	4	4	5	6.8	9.3
Total Alkalinity#	mg CaCO3/L	30	88	98	120	100	110	110	110	99	97	110	140	210
Nitrate as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	<0.005
Total Phosphorus	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Hardness	mg CaCO3/L	1	95	96	140	120	100	120	100	93	79	100	150	210
Benzene	µg/L	1			<1									
Toluene	µg/L	1			<1									
Ethylbenzene	µg/L	1			<1									
m+p-xylene	µg/L	2			<2									
o-xylene	µg/L	1			<1									
Total Xylenes	µg/L	2			<2									
Sum of BTEX	µg/L	2			<2									
Naphthalene	µg/L	1			<1.0									
TRH C6 - C9	µg/L	10			<10									
TRH C6 - C10	µg/L	10			<10									
TRH C6 - C10 less BTEX (F1)	µg/L	10			<10									
TRH C10 - C14	µg/L	50			<50									
TRH C15 - C28	µg/L	100			<100									
TRH C29 - C36	µg/L	100			<100									
TRH C10 - C36 (sum)	µg/L	100			<100									
TRH >C10 - C16	µg/L	50			<50									
TRH >C16 - C34	µg/L	100			<100									
TRH >C34 - C40	µg/L	100			<100									
TRH >C10 - C40 (sum)	µg/L	100			<100									

Note: SW2 trigger exceedances highlighted in red

[1]Adjusted trigger values apply for selected metals in freshwaters of varying water hardness as per the ANZECC 2000

Jacobs

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

Reference			14093/3	14202/3	14340/3	14475/3	14610/3	14718/3	14799/3	14927/3	15066/3	15141/3	15284/3	15463/3
Description			Stockton Dams - Mor	Stockton Dams - I	Stockton Dar	Stockton Dams -	Stockton Dams	Stockton Dams - I	Stockton Dams - M	Stockton Dams - Mo	Stockton Dr	Stockton Dams - N	Stockton Dr	Stockton Dan
Alternative sample name			SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW3	SW3
Sample date			25/01/2023	23/02/2023	21/03/2023	19/04/2023	17/05/2023	22/06/2023	12/07/2023	18/08/2023	6/09/2023	4/10/2023	1/11/2023	14/12/2023
Sampling Method			AS5667.4 Lake, Grab	AS5667.4 Lake, Grab		AS5667.4 Lake,	AS5667.4 Lake,	AS5667.4 Lake, G	AS5667.4 Lake, Gra	AS5667.4 Lake, Grab	AS5667.4 L	AS5667.4 Lake, Grab		
Sampling Comments			No Visible Oil and Gr	No Visible Oil and	Dry - no samp	No Visible Oil ar	Algae	Clear			Dry - no sam	Insufficient water t	Dry - No sa	Dry, no sampl
Matrix			Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
	Units	PQL												
Temperature	°C	0.1	27.9	24.6	[NT]	21.2	15.3	11	11.2	17.1	[NT]	[NT]	[NT]	[NT]
pH	pH Units	0.1	8.4	8.4	[NT]	8.1	8.2	8	7.9	8.1	[NT]	[NT]	[NT]	[NT]
Electrical Conductivity	µS/cm	50	307	360	[NT]	335	416	327	345	300	[NT]	[NT]	[NT]	[NT]
Dissolved Oxygen	mg/L	0.1	11.7	9.8	[NT]	10.9	10.6	10.6	11.2	10.6	[NT]	[NT]	[NT]	[NT]
Oxidation Reduction Potential#	mV		226	193	[NT]	259	94	255	231	258	[NT]	[NT]	[NT]	[NT]
Turbidity	NTU	0.1	3.7	1.7	[NT]	1.5	1	0.3	0.8	0.7	[NT]	[NT]	[NT]	[NT]
Total Dissolved Solids	mg/L	20	200	230		220	250	220	220	170				
Aluminium	mg/L	0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01				
Arsenic	mg/L	0.001	0.009	0.007		0.005	0.004	0.002	0.002	0.002				
Boron	mg/L	0.02	0.04	<0.02		<0.02	0.02	<0.02	<0.02	<0.02				
Cadmium[1]	mg/L	0.0001	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001				
Chromium[1]	mg/L	0.001	0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001				
Copper[1]	mg/L	0.001	0.001	<0.001		0.001	<0.001	<0.001	<0.001	<0.001				
Iron	mg/L	0.01	0.07	0.02		0.06	0.05	<0.01	0.01	0.02				
Lead[1]	mg/L	0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001				
Manganese	mg/L	0.005	0.033	<0.005		0.007	0.007	0.005	<0.005	<0.005				
Nickel[1]	mg/L	0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001				
Selenium	mg/L	0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001				
Zinc[1]	mg/L	0.001	0.014	0.021		0.015	0.014	0.012	0.021	0.014				
Mercury	mg/L	0.00005	<0.00005	<0.00005		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005				
Chloride, Cl	mg/L	1	28	37		41	53	27	33	21				
Sulphate, SO_4	mg/L	1	8	26		17	14	11	15	8				
Fluoride, F	mg/L	0.1	0.1	<0.1		0.1	0.1	0.1	0.2	0.1				
Sodium-Dissolved	mg/L	0.5	13	18		18	23	13	16	9				
Potassium-Dissolved	mg/L	0.5	0.6	0.6		0.8	0.7	<0.5	<0.5	<0.5				
Calcium-Dissolved	mg/L	0.5	38	37		43	40	48	42	39				
Magnesium-Dissolved	mg/L	0.5	1	2		2	3	2	2	1				
Total Alkalinity#	mg CaCO3/L	30	36	82		83	110	120	120	110				
Nitrate as N	mg/L	0.005	0.01	0.05		<0.005	<0.005	<0.005	<0.005	0.005				
Total Phosphorus	mg/L	0.05	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05	<0.05				
Total Hardness	mg CaCO3/L	1	100	99		120	110	130	110	100				
Benzene	µg/L	1												
Toluene	µg/L	1												
Ethylbenzene	µg/L	1												
m+p-xylene	µg/L	2												
o-xylene	µg/L	1												
Total Xylenes	µg/L	2												
Sum of BTEX	µg/L	2												
Naphthalene	µg/L	1												
TRH C6 - C9	µg/L	10												
TRH C6 - C10	µg/L	10												
TRH C6 - C10 less BTEX (F1)	µg/L	10												
TRH C10 - C14	µg/L	50												
TRH C15 - C28	µg/L	100												
TRH C29 - C36	µg/L	100												
TRH C10 - C36 (sum)	µg/L	100												
TRH >C10 - C16	µg/L	50												
TRH >C16 - C34	µg/L	100												
TRH >C34 - C40	µg/L	100												
TRH >C10 - C40 (sum)	µg/L	100												

Note: SW3 trigger exceedances highlighted in red

[1]Adjusted trigger values apply for selected metals in freshwaters of varying water hardness as per the ANZECC 2000

02 April 2024

Subject: Groundwater assessment for 2023 AEMR

Reference			14093/4	14202/4	14340/4	14475/4	14610/4	14718/4	14799/4	14927/4	15066/4	15141/4	15284/4	15463/4
Sample name			SW4 (Beach	SW4 (Beach	SW4 (Beach	SW4 (Beach	SW4 (Beach	SW4 (Beach S	SW4 (Beach S	SW4 (Beach S	SW4 (Beach S	SW4 (Beach S	SW4 (Beach So	SW4 (Beach S
Sample date			25/01/2023	23/02/2023	21/03/2023	19/04/2023	17/05/2023	22/06/2023	12/07/2023	16/08/2023	06/09/2023	04/10/2023	01/11/2023	14/12/2023
Sampling Method			AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lal	AS5667.4 Lak	AS5667.4 Lak	AS5667.4 Lak	AS5667.4 Lak	AS5667.4 Lak	AS5667.4 Lake,	AS5667.4 Lak
Sampling Comments			No Visible Oi	No Visible Oi	No Visible Oi	No Visible Oi	Algae	Minor algae					Shallow, algae	Almost dry
Matrix			Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
	Units	PQL												
Temperature	°C	0.1	27.1	23.4	21.2	21.5	15.4	10.6	10.5	16.8	17	26.2	21.5	27.8
pH	pH Units	0.1	8.8	8.6	8.6	8.5	8.4	8.1	7.9	8.3	8.1	8.7	8.7	8.9
Electrical Conductivity	µS/cm	50	274	259	297	268	258	283	308	247	309	385	460	459
Dissolved Oxygen	mg/L	0.1	8.6	9.9	10.5	10.9	10.2	11.4	11.4	10.1	10.5	9.4	10.8	11.5
Oxidation Reduction Potential#	mV		131	168	234	229	66	247	275	238	232	305	257	228
Turbidity	NTU	0.1	17	8.7	20	14	20	15	14	11	16	55	31	28
Total Dissolved Solids	mg/L	20	160	150	170	150	170	200	190	130	190	250	290	300
Aluminium	mg/L	0.01	0.02	0.02	0.01	0.03	<0.01	0.02	0.02	0.01	0.05	0.02	0.04	0.07
Arsenic	mg/L	0.001	0.004	0.003	0.005	0.003	0.002	0.001	0.002	0.002	0.002	0.007	0.006	0.015
Boron	mg/L	0.02	0.03	<0.02	0.03	0.02	0.02	<0.02	<0.02	<0.02	0.03	0.04	0.04	<0.02
Cadmium[1]	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium[1]	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper[1]	mg/L	0.001	0.001	<0.001	<0.001	0.002	<0.001	0.001	0.001	<0.001	<0.001	<0.001	0.002	0.001
Iron	mg/L	0.01	0.02	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.05	0.05	0.13
Lead[1]	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	0.006	0.02
Nickel[1]	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Selenium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc[1]	mg/L	0.001	0.006	0.01	0.003	0.014	0.005	0.003	0.012	0.018	0.018	0.006	0.01	0.006
Mercury	mg/L	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Chloride, Cl	mg/L	1	32	31	40	32	27	28	34	19	22	44	93	76
Sulphate, SO_4	mg/L	1	17	9	17	10	12	12	17	11	16	19	18	16
Fluoride, F	mg/L	0.1	0.1	<0.1	0.1	0.1	0.1	0.2	0.2	0.1	<0.1	0.2	0.2	0.2
Sodium-Dissolved	mg/L	0.5	18	17	18	17	13	14	17	8.5	13	20	47	50
Potassium-Dissolved	mg/L	0.5	1	1	1	2	0.9	1	1	0.9	1	2	4	4
Calcium-Dissolved	mg/L	0.5	20	20	31	23	26	35	30	28	29	32	31	28
Magnesium-Dissolved	mg/L	0.5	4	3	5	4	3	3	4	3	4	5	6.4	5
Total Alkalinity#	mg CaCO3/L	30	63	65	79	63	81	94	96	86	110	120	73	83
Nitrate as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.007	0.008	0.03	0.006	<0.005	0.007	0.006
Total Phosphorus	mg/L	0.05	0.1	0.08	0.1	<0.05	<0.05	0.07	0.08	<0.05	0.03	0.2	0.2	0.05
Total Hardness	mg CaCO3/L	1	67	61	97	76	77	100	91	82	88	98	100	91
Benzene	µg/L	1			<1									
Toluene	µg/L	1			<1									
Ethylbenzene	µg/L	1			<1									
m+p-xylene	µg/L	2			<2									
o-xylene	µg/L	1			<1									
Total Xylenes	µg/L	2			<2									
Sum of BTEX	µg/L	2			<2									
Naphthalene	µg/L	1			<1.0									
TRH C6 - C9	µg/L	10			<10									
TRH C6 - C10	µg/L	10			<10									
TRH C6 - C10 less BTEX (F1)	µg/L	10			<10									
TRH C10 - C14	µg/L	50			<50									
TRH C15 - C28	µg/L	100			<100									
TRH C29 - C36	µg/L	100			<100									
TRH C10 - C36 (sum)	µg/L	100			<100									
TRH >C10 - C16	µg/L	50			<50									
TRH >C16 - C34	µg/L	100			<100									
TRH >C34 - C40	µg/L	100			<100									
TRH >C10 - C40 (sum)	µg/L	100			<100									

Note: SW4 trigger exceedances highlighted in red

[1]Adjusted trigger values apply for selected metals in freshwaters of varying water hardness as per the ANZECC 2000