



GROUNDWATER MANAGEMENT PLAN

8 Oakvale Drive, Salt Ash, NSW 2318

Job Number: 250154

For:

Holcim Australia Pty Ltd

By:

ENV Services Pty Ltd

Date:

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1.3	07/08/2025	Update groundwater velocity to align with modelling.

SCOPE OF ENGAGEMENT AND LIMITATIONS

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TABLE OF CONTENTS

1	Introduction.....	1
1.1	Summary	1
1.2	Proposed Quarrying Operations	3
1.3	Objective	3
1.4	Technical and Regulatory Framework	4
2	Site Description and Existing Environment.....	6
2.1	Site Identification Details	6
2.2	Site Description and Topography	6
2.3	Surrounding Land Use.....	6
2.4	Geology and Acid Sulfate Soils	6
2.4.1	Regional Geology.....	7
2.4.2	Site-Specific Geology.....	7
2.4.3	Acid Sulfate Soils (ASS).....	7
2.4.4	Leachability of Contaminants and Buffering following ASS Oxidation	8
2.5	Surface Water Bodies.....	9
2.6	Hydrogeology.....	9
2.6.1	Hydrostratigraphic Units	9
2.6.2	Groundwater Depth.....	10
2.6.3	Hydraulic Conductivity, Migration and Flow Direction.....	10
2.6.4	Drainage and Interaction between Surface Water and Groundwater	11
2.6.5	Groundwater Quality	11
2.7	Historic Regional Issues.....	15
2.7.1	Impacts from Dredging at the Tomago Special Mining Area – Coffey (2001) AB03922415	
2.7.2	Potential Sources of Pyrite Oxidation at the RZM Site	16
3	Aspects Potentially Impacting Groundwater.....	18
3.1	Overview	18
3.2	Pyrite Oxidation Risks	18
3.2.1	Potential Risks from Short-Term Exposure During Washing.....	18
3.2.2	Oxidation Risk Posed by Elevated DO in the Pond and Down-Hydraulic Gradient Aquifer	19
3.2.3	DO Concentration at Existing Dredged Sand Quarries	20
3.3	Mobilisation of Metals and Metalloids	21

3.3.1	Processing and In-Pond Reactions.....	21
3.3.1	Down-Hydraulic Gradient Aquifer.....	22
3.4	Bacterial Reduction and Mobilisation of Iron.....	22
3.5	Leaks and Spills of Chemicals or Fuels.....	23
4	Beneficial Groundwater Uses	24
4.1	Beneficial Uses of Groundwater	24
4.1.1	Overview	24
4.1.2	Private Licensed Bores	24
4.1.3	Hunter Water Borefield.....	25
4.1.4	Aquatic Ecosystems	26
4.1.5	Surface water/Groundwater Dependent Ecosystems.....	26
4.1.6	Summary	26
5	Project Water Quality Criteria	28
5.1	Chemical and Physical Parameters of Interest	28
5.2	Baseline Groundwater Conditions.....	29
5.3	Information Sources for Derivation of Project Water Quality Criteria	29
5.4	Derivation of Site-Specific Guideline Values for Aquatic Ecosystems	30
5.4.1	Guidance.....	30
5.4.2	Adopted Approach	30
5.5	Guideline Values for Drinking Water	31
5.6	Guideline Values for Recreational Use	31
5.7	Guideline Values for Irrigation and Stock Watering.....	31
5.8	Comparison of Baseline Water Quality with WQO Criteria.....	35
5.9	Selection of Project Water Quality Criteria for Monitoring Purposes.....	36
6	Environmental Control measures	37
6.1	Overview	37
6.1.1	ASS Management Principles.....	37
6.2	Process Optimisation	38
6.2.1	Minimising Disturbance During Dredging	38
6.2.2	Minimising Opportunity for Pyrite Oxidation	39
6.3	Water Treatment (Lime Dosing).....	40
6.3.1	Dredging Water Treatment	40
6.3.2	Drained Water from Sand Stockpiles.....	41

6.4	Fines Management	42
6.4.1	Overview	42
6.4.2	Temporary Containment of Fines.....	43
6.4.3	Permanent Deep Interment of Fines	43
6.5	Long-Term Riparian Stabilisation and Restoration.....	50
6.6	Contingency Options.....	50
6.7	Justification of Environmental Controls.....	51
6.7.1	Compliance with Best-Practice ASS Guidelines	52
7	Water Quality Monitoring.....	54
7.1	Overview	54
7.2	Data Gap Analysis.....	54
7.3	Data Quality Objectives (DQOs).....	56
7.3.1	Objective	56
7.3.2	Identify the Decisions	56
7.3.3	Information Inputs for Decision Making	56
7.3.4	Study Boundaries.....	56
7.3.5	Decision Rules	57
7.3.6	Decision Errors and Performance/Acceptance Criteria	58
7.3.7	Optimisation	59
7.4	Sampling and Analysis Quality Plan.....	59
7.4.1	Installation of Additional Monitoring Wells	59
7.4.2	Groundwater Monitoring.....	59
7.4.3	Surface Water Monitoring.....	60
7.4.4	Quality Assurance and Quality Control (QA/QC)	62
7.5	Interpretation of Monitoring Results	69
7.5.1	Timing of Data Review	69
7.5.2	Data Quality Indicators (DQIs)	69
7.5.3	Performance Monitoring Results	71
7.5.4	Project Water Quality Criteria	73
7.6	Changes to Monitoring Frequency and Locations.....	74
7.7	Reporting Requirements	74
8	Trigger Action response Plans	76
9	Review of This Plan.....	77

10	References	78
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LIST OF TABLES

Table 1: Site Identification Details	6
Table 2: Summary of Major Ion Results (Geosyntec, 2025)	13
Table 3: Summary of Metal and Metalloid Results (Geosyntec, 2024)	14
Table 4: Summary of Total Phosphorus and Total Nitrogen Results (Geosyntec, 2024)	15
Table 5: Selected Details of Licensed Bores Installed Close to Site	25
Table 6: Summary of Baseline Groundwater Quality (Maximum Concentrations), Applicable Guideline Values for Beneficial Water Uses and Adopted Project Water Quality Criteria (mg/L) ..	32
Table 7: Lime Dosing Points and Their Advantages and Disadvantages	41
Table 8: Stockpile Pad Water Management Options	42
Table 9: Performance Indicators for Fines Interment	44
Table 10: Quality Assurance/Quality Control (QA/QC) Sampling and Laboratory Analysis Requirements	62
Table 11: Water Quality Monitoring Program Summary	63
Table 12: Example of Data Quality Indicators (DQIs)	70
Table 13: Trigger Levels for Performance Monitoring	71
Table 14: Groundwater Monitoring Reporting Requirements	75

LIST OF FIGURES

Figure 1: Surface water DO at Cudgen Lakes Sand Quarry	20
Figure 2: Hanson Tweed Sand Plant DO Levels	21
Figure 3: s60 Jaden Dredge Cutter (Neumann Equipment, 2021)	38
Figure 4: Underwater Reburial (Excerpt of Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines V5.1)	49

LIST OF APPENDICES

Appendix A	Figures
Appendix B	Baseline GW Quality Data
Appendix C	Statistical Analysis & Pro UCL Outputs
Appendix D	Settling Pond Calculations & Design Drawings
Appendix E	Trigger Action Response Plans
Appendix F	Technical Memorandum, Review of Hanson Tweed Sand Plant Groundwater Iron Concentrations (ENV, 2025)

LIST OF ACRONYMS

Below is a list of commonly used acronyms in this report:

AHD: Australian Height Datum

AMD: Acid Mine Drainage

ANC: Acid Neutralising Capacity

ANZECC: Australian and New Zealand Environment Conservation Council

ANZG: Australian and New Zealand Governments and Australian state and territory governments

ARD: Acid Rock Drainage

ARMCANZ: Agriculture and Resource Management Council of Australia and New Zealand

ASLP: Australian Standard Leaching Procedure

ASS: Acid Sulfate Soil

ASSMAC: Acid Sulfate Soil Management Advisory Committee

ASSMP: Acid Sulfate Soil Management Plan

COC: Chain of Custody

COI: Chemical of Interest

CRS: Chromium Reducible Sulfur

CSM: Conceptual Site Model

DCCEEW: NSW Department of Climate Change, Energy, the Environment and Water

DECCW: NSW Department of Environment, Climate Change and Water (now DCCEEW)

DGV: Default Guideline Value

DO: Dissolved Oxygen

DQI: Data Quality Indicator

DQO: Data Quality Objective

DSM: Deep Soil Mixing

EC: Electrical Conductivity

ENV: ENV Services Pty Ltd trading as ENV Solutions

GDE: Groundwater Dependent Ecosystem

GWMP: Groundwater Management Plan

HDS: High-Density Sludge

Holcim: Holcim (Australia) Pty Ltd

HWC: Hunter Water Corporation

IRB: Iron-Reducing Bacteria

LEAF: Leaching Environmental Assessment Framework

LOR: Limit of Reporting

MBOs: Monosulfidic Black Oozes

NASSIMM: National Acid Sulfate Soil Sampling and Investigation Methods Manual

NATA: National Association of Testing Authorities

NEPC: National Environment Protection Council

NEPM: National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013)

NHMRC: National Health and Medical Research Council

NSW EPA: New South Wales Environment Protection Authority

O&M: Operation and Maintenance

OPD: Oxygen Penetration Depth

ORP: Oxidation Reduction Potential

P&T: Pump and Treat

PASS: Potential Acid Sulfate Soils

PIRMP: Pollution Incident Response Management Plan

QC/QA: Quality Control / Quality Assurance

RZM: Rutile & Zircon Mines (Newcastle) Limited

SAQP: Sampling and Analysis Quality Plan

SRB: Sulfate-Reducing Bacteria

SWI: Sediment-Water Interface

TAA: Titratable Actual Acidity

TARPS: Trigger Action Response Plans

TDS: Total Dissolved Solids

tpa: tonnes per annum

UCL: Upper Confidence Limit

WQO: Water Quality Objective

ZVI: Zero-Valent Iron

1 INTRODUCTION

1.1 Summary

ENV Services Pty Ltd (ENV) has prepared this Groundwater Management Plan (GWMP) on behalf of Holcim Australia Pty Ltd (Holcim) for the proposed Salt Ash Sand Quarry at 8 Oakvale Drive, Salt Ash, NSW. This plan establishes a framework of environmental controls and monitoring protocols designed to protect local groundwater resources and ensure regulatory compliance throughout the project's life.

The project involves extracting up to 550,000 tonnes per annum (tpa) of sand from the site and processing up to 200,000 tpa from other local sources, for a total throughput of 750,000 tpa over a lifespan of up to 30 years. Extraction will begin with dry methods before transitioning to dredging once the water table is reached, extending to a maximum depth of -28 metres Australian Height Datum (AHD).

Site Environment and Key Risks The quarry is situated on the Tomago Sandbeds, which are comprised of highly permeable Quaternary Age sands that host a significant freshwater resource. The primary environmental risk stems from the presence of Acid Sulfate Soils (ASS) identified across the site's geological units. These soils contain pyrite, which, if exposed to oxygen during excavation and processing, can oxidise to form sulfuric acid. This process can lead to several impacts:

- **Acidification of Water:** A reduction in the pH of the dredge pond and surrounding groundwater.
- **Metal Mobilisation:** The acidic conditions can dissolve and release metals and metalloids—such as iron, aluminium, and arsenic—from the soil into the water, posing a risk to water quality.
- **Impacts on Beneficial Uses:** Degraded groundwater quality could potentially impact downstream receptors, which include private bores, aquatic ecosystems in Tilligerry Creek, and high-priority Groundwater Dependent Ecosystems (GDEs).

Historical dredging operations in the region, such as those by Rutile & Zircon Mines (RZM), have demonstrated the severe impacts of improper ASS management, resulting in significant and long-term iron contamination of the aquifer. This GWMP incorporates the lessons from these historical issues by adopting modern, best-practice ASS management principles to prevent similar outcomes.

Proposed Environmental Controls A multi-layered management strategy will be implemented to address the risks associated with ASS, focusing on preventing pyrite oxidation. The proposed controls are aligned with the latest national and state guidelines, including the *Queensland Acid Sulfate Soil Technical Manual*. Although there are NSW Guidelines directly applicable to acid sulfate soil (ASS) investigation and management in NSW, they are more than 25 years old and do not represent the most up-to-date knowledge on ASS. The *Queensland Acid Sulfate Soil Technical Manual* is the most recently published ASS guideline at the time of preparing this GWMP and is widely accepted in NSW as the best practice guideline (i.e. superseding information presented in the NSW guidelines).

- **Process Optimisation:** All dredging and processing will occur in saturated conditions to keep pyritic material in a low-oxygen (anoxic) state. The use of a modern Cutter Suction Dredge is

designed to minimise sediment disturbance, and rapid processing times in the wash plant will prevent the material from drying out and oxidising.

- **Water Treatment (Lime Dosing):** A lime dosing system will be integrated into the wash plant to actively manage water chemistry. By maintaining a near-neutral pH the system will neutralise any incidental acid generated and promote the precipitation of dissolved metals, effectively removing them from the water.
- **Fines Management and Strategic Reburial:** The management of fines (fine-grained sediment containing most of the pyrite) is a critical control measure. The strategy involves:
 - **Temporary Containment:** Initially, fines-laden water from the wash plant will be directed to a lined temporary settling pond. This isolates the fines from the groundwater environment while allowing for performance validation.
 - **Validation:** The captured fines will undergo rigorous testing to confirm that they have not oxidised and are chemically stable for permanent interment. If unsuitable for interment, options for fines extraction and processing for sale may be adopted in accordance with the ASSMP (PSK, 2025).
 - **Permanent Deep Interment:** Once validated, the fines will be permanently returned to a deep, completed section of the dredge pond. The material will be placed at least 4 m below the lowest seasonal water level, ensuring it remains permanently in an anoxic state. This method of sub-aqueous reburial is a best-practice technique for the safe, long-term disposal of potential acid sulfate soils (PASS).

Monitoring and Adaptive Management A comprehensive water quality monitoring program is central to the GWMP, providing the data needed to verify the performance of controls and enable proactive management.

- **Monitoring Network:** An extensive network of existing and proposed new groundwater monitoring wells will be used to track water quality up-gradient, down-gradient, and adjacent to the quarrying operations. Monitoring will also be conducted at key surface water locations, including the dredge pond, settling pond, and wash plant outflow.
- **Trigger Action Response Plans (TARPs):** The GWMP includes a detailed set of TARPs, which provide a clear, pre-defined framework for action. The TARPs link specific monitoring triggers (e.g., a change in pH or metal concentration) to a tiered set of responses, escalating from investigation and process review to the implementation of contingency measures. This adaptive management approach ensures that any potential issues are identified and addressed in a timely and effective manner.
- **Reporting:** Monitoring results will be regularly reviewed and reported to Holcim and the NSW EPA, ensuring transparency and accountability.

Contingency and Plan Review While the proposed controls are considered robust, this plan identifies several contingency options that can be implemented if required. These include broadscale lime dosing of the dredge pond, the installation of containment such as a “curtain” and hydraulic

containment (Pump and Treat). The feasibility of these options has been confirmed, providing a high degree of confidence in the site's ability to manage unforeseen circumstances.

This GWMP is a living document and will be reviewed periodically and updated as necessary in response to monitoring data, changes in operations, or regulatory requests.

1.2 Proposed Quarrying Operations

Holcim is seeking approval for the Salt Ash Sand Operations (the 'project'), which involves the extraction and processing of a minimum of 10 million tonnes of sand over a project lifespan of up to 30 years. The proposed development involves the extraction of up to 550,000 tonnes per annum (tpa) of sand from the site. Additionally, feed sand for the process plant will include up to 200,000 tpa of sand from offsite sources (other local extractive operations). This will result in a total of up to 750,000 tonnes of sand products processed and dispatched from the site per year.

The proposed disturbance footprint at Salt Ash Sand Operations covers an area of approximately 35.5 ha and encompasses all areas to be disturbed by sand extraction (dry extraction and dredging), internal access roadways (including slope batters) and processing operations, and all areas of vegetation clearing. The site location in Figure 1, Appendix A shows the approximate limits of the proposed development.

Sand extraction is proposed to be undertaken in seven phases, reaching a maximum depth of - 28 m Australian Height Datum (AHD). Extraction will commence with dry extraction methods to the extent practicable, utilising front-end loaders and excavators. Once the groundwater table is encountered, or for extraction from below the groundwater table, operations will utilise excavators and dredging (via a dredge plant).

The extracted sand will be processed through the following key stages:

- **Material Sourcing and Slurry Transport:** Sand sourced via dry extraction (utilising front-end loaders and excavators and trucks) or cut from below the groundwater table by excavator or dredged from the pond floor, will be transported to a shore-based wash plant as a slurry.
- **Screening:** Oversize particles (e.g., rocks, shells) will be removed from the slurry through a screening process.
- **Cyclone Separation:** Cyclone separators will then be utilised to segregate the saleable sand from a slurry containing fines.
- **Fines Management:** The wash plant outflow (containing fines) will be discharged (first to a dedicated settling pond, and later to the dredge pond (subject to validation)), allowing fine particles to settle out.
- **Water Recirculation:** Water from the settling pond will overflow and be returned to the dredge pond.
- **Sand Dewatering and Leachate Management:** The separated saleable sand will undergo dewatering on a bunded pad via natural drainage. Leachate collected from this pad will be returned to the dredge pond. Should the leachate not meet suitable water quality standards, it will require treatment by a designated water treatment system (such as lime dosing).

1.3 Objective

The primary objectives of this GWMP are to ensure that the dredging and associated sand processing operations are conducted in a manner that protects water resources and complies with all relevant

environmental regulations and minimises risk of environmental harm in the management of process waters. Where solids are removed from the dredging slurry (i.e. saleable sand), or sand is extracted prior to dredging operations, the material will be managed in accordance with an Acid Sulfate Soil Management Plan (ASSMP)

1.4 Technical and Regulatory Framework

The principal guidelines, specifications and policy documents relevant to this Plan include:

- Australian and New Zealand Governments (ANZG) (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Canberra: Australian and New Zealand Governments and Australian state and territory governments.
- Dear SE, Williams KM, McElnea AE, Ahern CR, Dobos SK, Moore NG, and O'Brien LE (2024). Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines, Version 5.1.
- Department of Environment Regulation, Western Australia (2015). Treatment and management of soil and water in acid sulfate soil landscapes.
- Department of Primary Industries (Office of Water) (2012). NSW Aquifer Interference Policy. NSW Government policy for the licensing and assessment of aquifer interference activities.
- Environment Protection Authority (EPA): Approved methods for Sampling and Analysis of Water Pollutants in NSW (EPA, 2004).
- Hunter Water (2017). Protecting our Drinking Water Catchments. Guidelines for Developments in the Drinking Water Catchments.
- Landcom 2004 and DECC (2008). Managing Urban Stormwater: Soils and Construction Volume 1 and Volumes 2A, 2C, 2D and 2E (the Blue Book).
- Shand, P, Appleyard, S, Simpson, SL, Degens, B, Mosley, LM (2018). National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments.
- Simpson, SL, Mosley, L, Batley, GE and Shand, P (2018). National Acid sulfate soils guidance: Guidelines for the dredging of acid sulfate soil sediments and associated dredge spoil management.
- Standards Australia, AS/NZS 5667.1:1998 Water Quality – Sampling – Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples.
- Standards Australia, AS/NZS 5667.10:1998 Water Quality – Sampling – Guidance on Sampling of Waste Waters.
- Stone, Y., Ahern, C.R., and Blunden, B. (Eds.). (1998). Acid Sulfate Soils Manual. Wollongbar, NSW: Acid Sulfate Soil Management Advisory Committee (ASSMAC).
- Sullivan, L, Ward, N, Toppler, N and Lancaster, G (2018). National Acid Sulfate Soils guidance: National acid sulfate soils sampling and identification methods manual.
- Sullivan, L, Ward, N, Toppler, N and Lancaster, G (2018). National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual.

With respect to the NSW Aquifer Interference Policy (2012), it is noted that Holcim has obtained the relevant water licences required by the Policy.

References used in this Plan for acid sulfate soil (ASS) investigation and management include guidance documents published by NSW and QLD governments, as well as national guidance published by Water Quality Australia. Although the NSW Guidelines are directly applicable to acid sulfate soil (ASS) investigation and management in NSW, they are more than 25 years old and do not represent the most up-to-date knowledge on ASS. The QLD guidance is the most recently published ASS guidance at the time of preparing this GWMP and is widely accepted in NSW as the best practice guideline (superseding information presented in the NSW guidelines).

2 SITE DESCRIPTION AND EXISTING ENVIRONMENT

2.1 Site Identification Details

Table 1 provides an overview of relevant identification details for the site. The site location is depicted in Figure 1, Appendix A.

Table 1: Site Identification Details

Site Address	8 Oakvale Drive, Salt Ash, NSW, 2318
Real Property Description	Lot 4, DP774726
Current Owner	Holcim (Australia) Pty Ltd
Site Area	47 ha
Proposed Extraction Footprint	35.4 ha
Local Government Area	Port Stephens Council
Zoning	RU2: Rural Landscape (Port Stephens Local Environmental Plan (LEP, 2013))
Existing Land Use	Dry sand extraction
Proposed Land Use	Continued sand extraction over a larger area, with extraction via dredging once dry extraction is no longer practicable.

2.2 Site Description and Topography

The site is approximately 20 kilometres (km) north-east of Newcastle. Access to the site is via Nelson Bay Road and Oakvale Drive. Oakvale Drive is a local roadway which terminates at the entrance to private property at 4 Oakvale Drive (Lot 8 DP833768). A private access road then runs south through the property to the entrance of the site.

2.3 Surrounding Land Use

The following land uses exist in areas adjacent to the site:

- North: Agricultural (livestock)
- East: Sand quarry
- South: Vegetated dunes, followed by Stockton Bay Beach and Stockton Bight
- West: Sand quarry.

2.4 Geology and Acid Sulfate Soils

Information relating to the regional geology and acid sulfate soils (ASS) has been derived from Geosyntec (2025) and publicly available information.

2.4.1 Regional Geology

The site and nearby surrounds are underlain by Quaternary Age deposits; comprising of sands, silts and clays of the Stockton Sandbeds. These consist of extensive barrier sand ridges, which extend from the Hunter River estuary in the west to Port Stephens to the north-east of the site (inland from the current coastline).

The Sandbeds contain fine to medium grained, well sorted quartzose beach sand with intermittent (discontinuous) indurated sand layers. The Sandbeds are highly permeable and contain a significant volume of fresh water derived from surface water (rainfall) infiltration.

2.4.2 Site-Specific Geology

Previous subsurface investigations at the site, as reported in Geosyntec (2025), have defined three key stratigraphic units:

- D1: fine to medium grained, grey sand and fine grained, grey silty sand with a thickness between 2 m and 8.6 m.
- D1/D2: dark grey, low to medium plasticity clay to sandy clay, containing fine to medium grained sand, shell fragments. Located at the interface of the D1 and D2 layers. In addition, fine to medium grained, dark grey clayey sand, with clay, also forms part of this layer. D1/D2 is situated below the water table and is 0.3 m to 4.2 m thick.
- D2: fine to medium grained, grey sand and medium grained, grey sand with trace fine dark grey gravel. D2 is located below the water table with a thickness between 2 m to 15 m.
- D3: fine grained, dark grey silty sands with trace gravel, and fine to medium grained, grey sand, with a thickness of more than 20 m.

2.4.3 Acid Sulfate Soils (ASS)

eSPADE, version 2.2 (State of NSW and Department of Planning, Industry and Environment, 2025) maps the site as being situated within an area classed as L4: Low probability of ASS >3 m below the ground surface. An area classed as H2: High probability of ASS 1-3 m below the ground surface occurs just to the west and north of the site.

The site is mapped as Class 4 with respect to ASS risk by the Port Stephens Local Environment Plan (LEP, 2013). Class 4 lands require that for works more than 2 m below the natural ground surface and/or works by which the water table is likely to be lowered more than 2 m below the natural ground surface; development consent must not be granted unless an ASS management plan has been prepared for the proposed works in accordance with the Acid Sulfate Soils Manual (1998) and has been provided to the consent authority, or a preliminary assessment of the proposed works indicates that an ASS management plan is not required for the works.

In 2024, Geosyntec drilled a total of 24 boreholes across the footprint of the proposed sand extraction area, ranging in depth from 8 to 36 m bgl, with a target depth of 1 m below the proposed extraction depth. These investigations followed earlier ASS investigations by Geoterra (2022), as described in Geosyntec (2025). Chromium suite analysis was undertaken on samples from the boreholes, in

accordance with the National Acid Sulfate Soil Guideline document set (various publications from 2018). The results of the investigations can be summarised as follows:

- Soils with a net acidity in excess of the adopted action criteria were identified in all stratigraphic units encountered at the site, meaning that ASS are present in each of these units.
- The highest sulfide contents were reported in soils from unit D1/D2 – an organic clay profile bridging units D1 and D2, acting as an aquitard beneath D1.
- ASS is present as potential ASS (PASS) and actual ASS (AASS). AASS, where encountered, is constrained to the soils above the water table or within the zone of water table fluctuation (primarily D1 and the upper portion of D1/D2). PASS, where encountered, occur within fully saturated soils.
- The spatial distribution of PASS across the site indicates that saturated soils in the centre of the proposed void in unit D3 have a lower net acidity than soils towards the proposed pit walls.

The extent of the presence of PASS and AASS within the proposed dredging area (void) was modelled by Geosyntec to provide a visual assessment of the spatial distribution, both vertically and horizontally, within the proposed void. The modelling confirmed that the highest net acidity values are concentrated around the D1/D2 contact, which is lithologically characterised by the presence of organic clay.

Geosyntec (2025) concluded that the ASS results indicate the soils contain acid sourced from the oxidation of sulfides, but considered it was likely there were multiple sources of acid within the soils, including the release of organic acids to groundwater from organic carbon forms.

A spatial distribution of the net acidity results is presented on vertical and horizontal sections in Geosyntec's (2024) ASS characterisation report.

2.4.4 Leachability of Contaminants and Buffering following ASS Oxidation

Geosyntec conducted kinetic column leach testing as part of their 2024 investigations to evaluate time-dependent oxidation of soils containing sulfide; and allow an assessment of leached trace elements generated through the oxidation process, and the resultant quality of the water in contact with the oxidised soil.

The results confirmed that leaching of oxidised ASS (primarily the first flush) produces lower pH and higher dissolved constituent concentrations, which diminished once the sulfide minerals were fully oxidised (units D1 and D2). The higher sulfide content in unit D1/D2 correlated with sustained release of higher leached constituent concentrations, whereas natural alkalinity present in unit D3 improved the ability of the soils in this unit to buffer acidity produced by oxidised ASS and inhibit the leaching of chemical constituents.

Kinetic testing demonstrated that unit D3 has acid neutralising capacity (ANC) available to buffer acid generated by oxidation of this unit and maintain a neutral pH.

Kinetic column leachate analysis identified aluminium, arsenic, cadmium, chromium, cobalt, copper, iron, manganese, molybdenum, nickel, vanadium, and zinc as chemicals of interest (COI) from a leachability perspective; with elevated sulfate and iron concentrations as indicators of ASS oxidation.

Previous sampling of groundwater at the site shows it is neutral to acidic (pH values between 5 and 7 are typical), with a typically low alkalinity (<100 mg/L). The low alkalinity concentrations indicate a limited potential for buffering future acid inputs to the site, highlighting the importance of careful management of sulfidic soils to minimise ASS oxidation and acid generation to the extent practicable.

The principal risk associated with oxidation of ASS and leaching of chemical constituents into groundwater is the migration of those constituents with the flow of groundwater beyond the site boundary, towards downgradient sensitive receptors associated with the local groundwater resource, including water supply bores and groundwater dependent terrestrial and aquatic ecosystems.

To mitigate this risk in accordance with the National Acid Sulfate Soils Guidance (2018), Geosyntec recommended an ASS management plan be prepared to address management measures for disturbed soils to reduce the potential for ASS oxidation and to buffer incidental acid generated. A groundwater monitoring and management plan (this plan) was also recommended to assess the efficacy of the soil management measures with respect to maintaining baseline groundwater quality to the extent practicable, and to specify contingency actions to respond to adverse groundwater quality trends in a timely manner, should they occur.

2.5 Surface Water Bodies

Tilligerry Creek, a hydraulically ‘gaining’ creek and a receptor for regional groundwater discharge originating from both north and south of the creek, is situated approximately 900 m north-north-east of the site at its closest point. Near the site, Tilligerry Creek is expected to support predominantly freshwater ecosystems, being upstream of tidal influence from the lower estuary to which it connects (refer below).

Tilligerry Creek is a tributary of the Karuah River, with a confluence approximately 15 km to the north-east of the site. The Karuah River extends further inland from this confluence (to the north), with the confluence area defined by a large inlet (Port Stephens Bay) opening to the Pacific Ocean near the township of Shoal Bay.

2.6 Hydrogeology

Information relating to hydrogeology has been derived from Geosyntec (2025), including reports prepared by others which have been reviewed in this document. These are referenced where applicable.

2.6.1 Hydrostratigraphic Units

A previous study by Hydrominex (2022), summarised in Geosyntec (2025), described the regional hydrostratigraphic units as:

- Stockton Sandbeds - The dune sands of the outer barrier at the site are well sorted, rounded to sub-rounded, medium-fine to fine grained quartz sands which are generally free from shell, organics, sulfides and other deleterious materials.
- Coarser sands are present to the south towards Stockton on the coast and are finer towards Anna Bay in the north-east.
- Basal unit, being a mix of Estuarine marine sands and muds.

These units are generally recharged by rainwater as all outcrop at the surface.

Based on the stratigraphy described by Hydrominex (2022) and the results of soil and groundwater investigations conducted by Geosyntec (Geosyntec, 2025), the hydrostratigraphic units present at the site were described by Geosyntec as follows:

- **D1:** unconfined aquifer, vertically defined by an organic clay layer at the top of unit D2 that acts as a leaky aquitard between D1 and D2 (identified as 'D1/D2'), recharged by direct rainfall infiltration.
- **D2:** semi-confined aquifer, separated from unit D1 by the organic podsol clay layer at the top of the unit. Discrete clay lenses may cause local perched/confined aquifer conditions.
- **D3:** semi-confined aquifer, with variable hydraulic properties due to presence of sands and muds.

Geosyntec (2025) concludes that units D1 and D2 are partially separated by unit 'D1/D2', which acts as a leaky aquitard between the units. This unit comprises of organic clays, which also contain the strongest ASS of the stratigraphic units identified. Units D2 and D3 are not physically separated by a lower permeability geological unit and are therefore more accurately described as shallower and deeper portions of a contiguous aquifer, albeit with slightly different hydraulic properties due to differences in soil texture.

2.6.2 Groundwater Depth

Saturated conditions were encountered during the field investigations conducted by Geosyntec in 2024 at depths of between 0.5 and 6.6 m below ground level (m bgl). Therefore, the water table is understood to generally be within 5 m of the ground surface. In the areas of the site where dry extraction of sand has been completed in accordance with the site's current approval, the water table is generally closer to 1 m bgl.

2.6.3 Hydraulic Conductivity, Migration and Flow Direction

According to Geosyntec (2025), the coastal dune system acts as a regional divide for groundwater flows, with rainwater falling on the northern side of the dune ridge flowing to the north, towards Tilligerry Creek; and rainwater falling on the southern side of the dune ridge flowing towards Stockton Bight.

Groundwater flow in the intermediate aquifer (D2) and the deep aquifer (D3) is towards the north-west (Geosyntec, 2025). There were insufficient wells screened in unit D1 for Geosyntec to characterise flow direction, but they considered it reasonable to assume that it would mimic the flow

in the underlying D2 and D3 units. Topography at the site broadly slopes downward towards the north, and the water table and potentiometric surfaces appear to generally follow this topography.

Hydraulic head values reported by Geosyntec (2025) were progressively lower in co-located wells in units D1, D2 and D3, respectively, indicating a downward hydraulic gradient that is characteristic of groundwater recharge zones. Pressure transducer data from the three aquifer units, as reported in Geosyntec (2025), indicates that water levels are relatively responsive to rainfall events, which is typical of sand aquifers.

Effective porosity was estimated by Geosyntec (2025) at approximately 25% (stratigraphic unit not specified). Geosyntec (2025) describes the hydraulic conductivity (seepage velocity), as reported by Hydrominex (2022), to range between 1.5 and 13.3 m/day based on single well pumping tests; with an anomalously higher value of 82.6 m/d reported at BH6. Higher values corresponded to coarse sands in the south of the site. Geosyntec (2025) discusses updated seepage velocities based on further testing – these are presented in Section 7.2 of this document.

2.6.4 Drainage and Interaction between Surface Water and Groundwater

The site is a formed basin and has no direct surface flow connection to adjacent areas, apart from a small area along the northern perimeter of the site which drains to a drainage channel adjacent to the site's northern boundary. The drainage channel runs north alongside the private access road to the site where it meets Tilligerry Creek, approximately 500 m further north of the site. It is likely that this drainage channel was previously constructed as part of a series of irrigation channels for agricultural land uses to the north of the site. Overland run-off from a small portion of the site to adjacent surface water drainage infrastructure is unlikely to present a significant migration pathway for contamination derived from the project because: a) the area potentially draining to off-site areas is very small, relative to the project area; b) the area is away from the proposed extraction and processing areas and c) the (small volume of) overland run-off would occur simultaneously with vertical migration through the highly permeable vadose zone.

Other than two previously constructed process water ponds, there are no permanent streams or waterbodies within the site, indicating that surface runoff is minimal, and infiltration occurs quickly through porous sands contributing to high groundwater recharge. Some temporary ponding of water is evident in the site, particularly following significant and prolonged rain events. However, it is likely this ponding is associated with naturally low lying interdunal swales where there is interaction with shallow groundwater.

The existing process water ponds are inferred to not have a strong hydraulic connection to the aquifers below as they predominantly retain their water level, when monitored groundwater levels fluctuate.

2.6.5 Groundwater Quality

Holcim installed seven groundwater monitoring wells at the site in 2020 to gain an understanding of the biophysical properties of the aquifer below the quarry (BH1 to BH7). An additional six monitoring wells were installed in 2022 at BH1, BH2, BH3, BH5, BH6 and BH7 (identified as MW1 to MW3; MW4 to MW7) to sample the upper portion of the aquifer and distinguish any difference between water quality of the upper and lower sections of the aquifer. According to Geosyntec (2025), these wells

were later renamed (by Geosyntec) as BH1S to BH3S; and BH5S to BH7S, respectively. The location of the wells is indicated on Figure 2, Appendix A.

Between September 2020 and January 2024, Kleinfelder conducted monthly monitoring of these wells. A summary of the most recent sampling results (January 2024) was provided in Geosyntec (2025) and is reproduced below:

- pH: 5.08 (BH3S) to 6.57 (BH1S)
- EC ($\mu\text{S}/\text{cm}$): 63 (BH3D) to 584 (BH6D)
- Total alkalinity (mg/L as CaCO_3): 4 (BH3D) to 252 (BH6D)
- Sulfate (mg/L as SO_4): <10 (various) to 29 (BH6S)
- Chloride (mg/L): 12 (BH3D) to 65 (BH7D)
- Calcium (mg/L): <1 (BH2D – BH5D)) to 66 (BH6D)
- Magnesium (mg/L): <1 (BH2D) to 17 (BH6D)
- Potassium (mg/L): 1 (BH2D & BH3) to 4 (BH6D)
- Sodium (mg/L): <1 (BH2D) to 17 (BH6D).
- PFAS ($\mu\text{g}/\text{L}$): predominantly non-detect, with detectable concentrations of PFOS, 6:2 FTS, PFHxS + PFOS and total PFAS compounds only. PFOS was only detected in one well – MW7 (BH7S) – located in the approximate centre of the site, while detectable concentrations of 6:2 FTS were reported in all wells except for MW5 (BH5S). Detectable PFAS concentrations have only been reported during a maximum of two monitoring events (of between 11 and 15 monitoring events) at any of the wells. Further discussion regarding these PFAS detects and implications for the monitoring program is presented in Section 5.1.

In 2024, Geosyntec installed an additional 18 wells across the site and conducted a sampling program which included these wells, together with 7 of the existing wells installed in 2020. The new monitoring wells were installed at 5 locations within the proposed extraction footprint (BH101, BH106, BH111, BH121 and BH122) and 5 locations around the periphery of the extraction footprint (two well pairs BH128 I/D and BH129 I/D and three clusters of three wells BH125 S/I/D, BH126 S/I/D, and BH127 S/I/D). The new and existing wells were sampled for a more comprehensive suite of analytes than the former analytical programs completed by Kleinfelder. The location of the additional wells installed by Geosyntec in 2024 is illustrated on Figure 3, Appendix A.

The groundwater sampling results are summarised in the following sub-sections.

2.6.5.1 Major Ions

A summary of major ion results reported by Geosyntec from its 2024 investigation is provided in Table 2. The results are presented by hydro-stratigraphic unit.

Table 2: Summary of Major Ion Results (Geosyntec, 2025)

Hydro-stratigraphic Unit	Monitoring Wells in Unit	Analyte	Minimum (mg/L)	Maximum (mg/L)
D1	BH1S, BH6S, BH125S, BH126S BH127S	Total alkalinity Sulfate Chloride	63 5 14	130 37 41
D2	BH7S, BH101, BH106, BH111, BH121, BH122, BH125I, BH126I, BH127I, BH128I, BH129I	Total alkalinity Sulfate Chloride	16 1 9	180 67 61
D3	BH1D, BH5D, BH6D, BH7D, BH125D, BH126D, BH127D, BH128D, BH129D	Total alkalinity Sulfate Chloride	11 <1 36	240 62 62

Geosyntec (2024) considered that the major ion chemistry generally identified two distinct water types present at the site: an Na-Cl signature, and a Ca-HCO₃ signature. Na-Cl water types are generally associated with recent rainfall recharge, and Ca-HCO₃ water types generally reflect dissolution of carbonate minerals in the aquifer. While there is some variability in the distribution of these water types laterally and vertically, most of the upgradient wells have a Na-Cl signature and most of the downgradient wells have a Ca-HCO₃ signature.

2.6.5.2 Metals and Metalloids

A summary of metal and metalloid results reported by Geosyntec from its 2024 investigation is provided in Table 3. The results are also presented by hydro-stratigraphic unit.

Table 3: Summary of Metal and Metalloid Results (Geosyntec, 2024)

Hydro-stratigraphic Unit	Monitoring Wells in Unit	Analyte	Minimum (mg/L)	Maximum (mg/L)	Average (mg/L)
D1	BH1S	Aluminium	110	260	192
	BH6S	Dissolved total iron	960	8,000	3,832
	BH125S	Ferrous iron	1,100	5,000	2,640
	BH126S	Arsenic	2	78	26.6
	BH127S	Manganese	42	320	196
		Copper	<1	1	-
		Lead	<1	<1	-
		Chromium	<1	2	-
		Nickel	<1	1	-
		Zinc	1	7	4.2
D2	BH7S BH101	Aluminium	20	1,200	422
	BH106 BH111	Dissolved total iron	240	8,600	1,613
	BH121	Ferrous iron	130	8,100	1,509
	BH122 BH125I	Arsenic	<1	7	-
	BH126I BH127I	Manganese	10	200	90.3
	BH128I BH129I	Copper	<1	3	-
		Lead	<1	2	-
		Chromium	<1	4	1.8
		Nickel	<1	2	-
		Zinc	<1	19	5.6
D3	BH1D BH5D BH6D	Aluminium	<10	240	117
	BH7D BH125D	Dissolved total iron	180	13,000	4,599
	BH126D BH127D	Ferrous iron	240	13,000	4,423
	BH128D BH129D	Arsenic	<1	5	2
		Manganese	7	400	159
		Copper	<1	<1	-
		Lead	<1	<1	-
		Chromium	<1	2	1.1
		Nickel	<1	<1	-
		Zinc	<1	4	1.8

2.6.5.3 Phosphorus and Nitrogen

A summary of phosphorus and nitrogen results reported by Geosyntec from its 2024 investigation is provided in Table 4. The results are again presented by hydro-stratigraphic unit.

Table 4: Summary of Total Phosphorus and Total Nitrogen Results (Geosyntec, 2024)

Hydro-stratigraphic Unit	Monitoring Wells in Unit	Analyte	Minimum (mg/L)	Maximum (mg/L)
D1	BH1S, BH6S, BH125S, BH126S BH127S	Total phosphorus Total nitrogen	<0.05 0.4	0.1 1.5
D2	BH7S, BH101, BH106, BH111, BH121, BH122, BH125I, BH126I, BH127I, BH128I, BH129I	Total phosphorus Total nitrogen	<0.05 0.3	0.6 4.8
D3	BH1D, BH5D, BH6D, BH7D, BH125D, BH126D, BH127D, BH128D, BH129D	Total phosphorus Total nitrogen	<0.05 0.2	0.1 4.2

Total nitrogen was generally dominated (nearly 100%) by total Kjeldahl nitrogen (TKN), indicating that nearly all nitrogen is present in organic forms.

2.7 Historic Regional Issues

2.7.1 Impacts from Dredging at the Tomago Special Mining Area – Coffey (2001) AB039224

Coffey (2001) AB039224 (Titled: Data review & assessment of hydrogeological and hydrogeochemical impacts of heavy mineral mining on the Tomago Sandbeds, Newcastle, NSW).

The report documents that Rutile & Zircon Mines (Newcastle) Limited (RZM), conducted dredging activities for the extraction of heavy minerals in the Tomago Special Mining Area between 1972 and 1999, with the dredge operation impacting water quality of the Tomago Sandbeds.

The Report details the impact of mining on iron concentration, stating how different stages of mining (shallow, re-mining, deep mining) led to significant increases in dissolved iron levels, sometimes reaching 100-200 mg/L after deep mining. The source of increased iron is attributed directly to oxidation of pyrite present in the sand bed, with pyrite being exposed to an oxygen rich environment to facilitate this reaction.

The chemical reaction for pyrite oxidation inherently produces acidity (H⁺ ions), which lowers pH. The groundwater in the Tomago Sandbeds is also noted as being naturally acidic (pH 3.3-6.4 in Hunter Water Corporation (HWC) bore field extractions). While the chemical processes initiated by mining that increased dissolved iron also produce acidity, the report focuses on the elevated iron concentration as the most significant water quality impact for the aquifer.

It is noted that ASS investigations/information for the RZM site is not presented, and the soil chemistry and stratigraphy of the Tomago Special Mining Area is likely to vary from the subject site.

In the following sub-section, fines management and associated adverse consequences occurring at the RZM site are compared with the proposed activities and characteristics of the project site at Salt Ash, and relevant differences noted.

2.7.2 Potential Sources of Pyrite Oxidation at the RZM Site

2.7.2.1 Tailings

The Coffey report (2021) identifies that processing separated heavy minerals (saleable product), coarse sand (identified as tailings), and a fines slime. The tailings were ejected from a pipe at the rear of the concentrator to a point near the back of the dredge pond, where tailings were piled to 4m above the dredge pond level, before being spread by bulldozer to create a post-mining landform.

It is unknown if any testing of the tailings piles was undertaken; but given the period of extraction, it is unlikely that ASS was considered or the tailings piles validated as suitable for beneficial reuse.

It is likely that a percentage of fines (including pyrite) remained present in the tailings, which are likely to have oxidised as the stockpiles dried and continued to do so after placement above the water table, leading to leaching of sulfuric acid, iron, sulfate and other mobilised trace elements into groundwater.

This theory is supported by the Coffey report (2021), which proposes the following remediation measures:

“Deposition of the Grey Sand tailings back into the bottom of the dredge pond, is likely to eliminate 90% of pyrite oxidation due to the elimination of oxygen. Therefore, iron release to the aquifer should be only about 10% of the current level. Tailings from the other benches should be placed on top of the Grey Sand, preferably with the same approximate stratification. Synchronisation between mining a particular bench and movement of the tailings disposal system, allowing for concentrator time lags, will help achieve re-burial of most of the pyrite. Single point stationary discharge, building steep cones of tailings is unsuitable for achieving a sub-horizontal stratification.”

With respect to the proposed project at Salt Ash, tailings containing sulfides will be in contact with, or otherwise be underwater during the entire processing program – rather than being stockpiled and kept in contact with oxygen (RZM site). That is, the sulfides will be effectively prevented from oxidising and forming sulfuric acid throughout all processing activities.

2.7.2.2 Slime (Fines)

During early shallow mining (up until 1986), fines were separated in the wash plant and pumped to dedicated settlement ponds at Fullerton Cove (approximately 7km from the Salt Ash site subject of this report)). Post 1986, when re-mining and deeper mining occurred, the tailings were incorporated into the tailings waste stream and allowed to dry. The report indicates that trials were conducted whereby dried slimes were mixed with tailings. Sampling at the time showed that this was environmentally acceptable (although it is unclear what criteria were adopted), however is noted that the focus of any studies referred to in the report related primarily to the hydraulic conductivity / infiltration properties of the soils, rather than soil chemistry (indicating there is potential that the sampling did not consider soil chemistry in great detail, if at all).

The oxidation of slimes, which were noted to be allowed to dry, likely resulted in oxidation of pyrite, with subsequent leaching to groundwater during rain events.

With respect to the proposed project at Salt Ash, fines containing sulfides will be in contact with, or otherwise be underwater during the entire extraction and processing program, which will effectively prevent oxidation and formation of sulfuric acid throughout all project activities.

2.7.2.3 Summary of RZM Acid Sulfate Soil Management Issues

It appears from the information available that there was little to no consideration of ASS and the potential oxidation of pyrite as a result of the spoil management practices implemented.

The following aspects of ASS management do NOT appear to have occurred, based on the information available:

- Characterisation of the ore body with respect to ASS
- Minimising potential for oxidation of pyrite
- Neutralisation of materials that will, or potentially will be oxidised
- Disposal in a sub-aquatic environment.

2.7.2.4 Improvements and Mitigation of RZM Issues

The present-day available knowledgebase on ASS, and published national and state technical guidance, provides opportunity for the environmental impacts of the RZM operation to be avoided by implementing best practice ASS management measures, whereby the potential for oxidation of pyrite is greatly mitigated. Such measures have been adopted for this project and are described within this Plan.

3 ASPECTS POTENTIALLY IMPACTING GROUNDWATER

3.1 Overview

Aspects of the dredging process with potential to impact groundwater quality have been identified based on Geosyntec (2025), and available documentation on impacts of heavy mineral mining by Rutile & Zircon Mines (Newcastle) Limited (RZM), on the Tomago Sandbeds. The RZM project has been identified by the regulator as a regional 'problem site' representative of potential groundwater impacts associated with dredging in the nearby aquifer system that may be comparable to The Salt Ash Quarry site (noting that Salt Ash Quarry will intersect the Stockton Sandbeds, not the Tomago Sandbeds); Coffey (2001) AB039224 (Titled: Data review & assessment of hydrogeological and hydrogeochemical impacts of heavy mineral mining on the Tomago Sandbeds, Newcastle, NSW). It is understood that the regulators have identified the RZM site to support development of management options that avoid the material handling practices which resulted in groundwater issues at that site.

Key aspects identified where the dredging process has potential to impact water quality include:

- Exposing pyrite to atmospheric or elevated dissolved oxygen (DO)), either during sand extraction and processing, or in the dredge pond and down-hydraulic gradient aquifer.
- Release of readily dissociable metals or dissolved metals trapped in in-situ soils when disturbed during dredge cutting, washing and discharged suspended sediments.
- Chemical processes in the dredge pond and down-hydraulic gradient aquifer (mobilisation of metals as a result of increased acidity).
- Biological reactions in settled fines (slime), including Iron Reducing Bacteria (IRB).
- Leaks and spills of chemicals or fuels.

These aspects are further discussed in the following sub-sections.

3.2 Pyrite Oxidation Risks

This section explores potential pyrite oxidation risks from exposure to atmospheric oxygen / oxygenated water while moving through the wash plant, and exposure to oxygen as DO after discharge from the wash plant; including during settling, in the pond, or in in-situ soils downgradient of the pond, with groundwater migration leading to a plume of elevated DO interacting with pyrite.

3.2.1 Potential Risks from Short-Term Exposure During Washing

While oxygen is readily available in wash water, pyrite oxidation is a relatively slow chemical process compared to other sulfides like iron monosulfides (FeS) or Monosulfidic Black Oozes (MBOs). The critical factor in a wash plant is the extremely short duration of exposure, typically minutes, as fines are rapidly processed and returned to a submerged, anoxic environment. While oxidation cannot be ruled out categorically, this limited timeframe does not allow for drying and oxygen penetration to facilitate reaction kinetics, preventing the oxidation reaction from progressing substantially.

Australian guidelines, including the National Dredging Guidelines (2018), support this view; explicitly noting the slower pyrite kinetics and the unlikelihood of significant oxidation during the short entrainment times typical of dredging.

While the Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines, Version 5.1) and NSW Acid Sulfate Soils Management and Advisory Committee (ASSMAC) guidelines emphasise minimising disturbance and preventing oxidation (e.g., by keeping material wet and returning it quickly to anoxic conditions), their specific time limits for managing stockpiled PASS (hours to days) are not directly applicable to the fundamentally different, transient conditions within a wash plant. The wash process maintains saturation, preventing the accelerated oxidation associated with drying cycles common in stockpiles. Furthermore, the ambient wash water would likely dilute any minimal acidity or dissolved iron produced during the brief transit.

Therefore, the assessment concludes that pyrite oxidation during the short-term, saturated exposure within the wash plant is unlikely to produce acidity in a quantity that would materially impact the water quality of the pond. The primary management focus should be on ensuring the efficiency of the process (minimising residence time), and the prompt and effective return of the fines to a stable, anoxic environment to prevent more prolonged oxidation (or treatment and validation).

3.2.2 Oxidation Risk Posed by Elevated DO in the Pond and Down-Hydraulic Gradient Aquifer

While PASS / pyrites are generally stable when maintained under deeply saturated, anaerobic conditions, the presence of elevated DO in the overlying water column of the pond does present a theoretical risk for pyrite oxidation at the sediment-water interface (SWI) at the base of the pond, and laterally down-gradient. However, this risk is likely localised and limited.

3.2.2.1 In-Pond / Aquifer DO Exposure Risk

The extremely slow rate of molecular diffusion of oxygen through the water-saturated sediment matrix is the primary factor limiting oxidation below the immediate SWI (José Neira, Mauricio Ortiz, Luis Morales, and Edmundo Acevedo, 2015). Consequently, widespread oxidation of deep saturated PASS deposits, solely via DO diffusing from the overlying pond water, is considered highly improbable. The risk is confined to a thin reactive layer (likely millimetres to centimetres thick) at the SWI, corresponding to the oxygen penetration depth (OPD).

The significance of oxidation within this thin layer depends on a site-specific balance of factors. Conditions that increase the risk include:

- High and sustained DO concentrations directly at the SWI.
- The presence of highly reactive forms of pyrite located at, or very near the SWI (within the OPD).
- Physical processes like sediment resuspension (due to dredging, wind-waves, etc.) that bypass diffusion limitations.

In summary, the risks of DO migration through the aquifer are considered relatively low, unless the dredging process leads to prolonged high DO migration which, based on case studies described in Section 3.2.3, would appear unlikely.

3.2.3 DO Concentration at Existing Dredged Sand Quarries

3.2.3.1 Case Study 1: Cudgen Lakes Sand Quarry (Annual Review (RW Corkery, 2024))

Cudgen sand quarry (operated as Kingscliff Sands) features a sand dredge with wash plant. The wash plant effluent (slurry with fines) flows into a contained pond (surface water monitoring point DP2) for fines settlement before overflowing to the main pond. If the wash plant process was increasing DO to a problematic level, it would be expected that from the commencement of extraction, DP2 would immediately support consistently high DO levels, trailed by increases to the main dredge pond (monitoring points DP 1, 3, 4).

Contrary to this, annual return data from 2015 to 2024 indicated that DO remained stable in surface water (dredge pond and the fines return pond) at commencement of dredging (daily monitoring for first 2 weeks and then weekly monitoring between November 2017 and February 2018) – refer to Figure 1. For later monitoring rounds, DO at DP2 typically increases first, which can likely be attributed to its shallow depth (minimal stratification or mixing of the water column) with limited buffering for atmospheric oxygen diffusing into the water column. In summary, it appears that the DO levels are primarily driven by natural process, pond depth and climate conditions; rather than as a result of dredge operations.

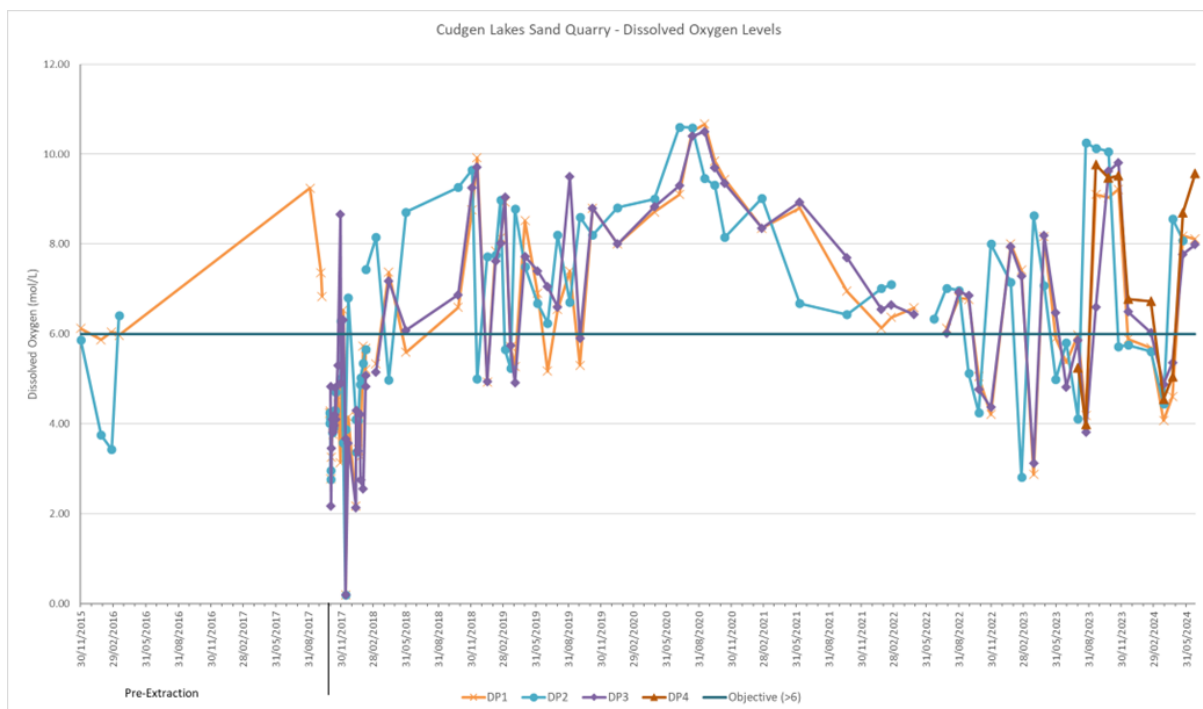


Figure 1: Surface water DO at Cudgen Lakes Sand Quarry

3.2.3.2 Case Study 2: Hanson Tweed Sand Plant (ANNUAL REVIEW TWEED SAND PLANT CUDGEN, NEW SOUTH WALES (Gilbert and Sutherland, 2024))

Figure 2 below shows surface water monitoring for dissolved oxygen across monitoring points SW1, SW2 and SW3 at Hanson's Tweed Sand Plant. SW1 and SW2 commenced monitoring in 2001, with SW3 being monitored from January 2007 onwards. Most results are above the adopted criteria of >6 mg/L. Fluctuations in data were also observed as shown in Figure 2, which appear to follow a

seasonal pattern, indicating DO levels are primarily influenced by natural process and climate conditions.

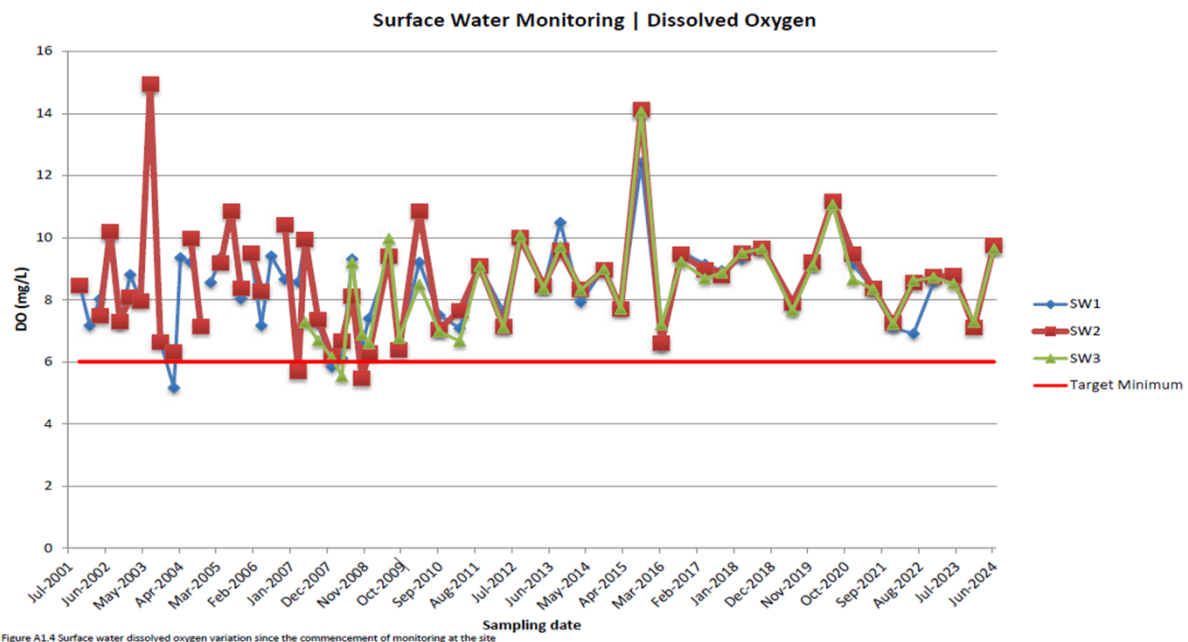


Figure 2: Hanson Tweed Sand Plant DO Levels

3.3 Mobilisation of Metals and Metalloids

3.3.1 Processing and In-Pond Reactions

During disturbance of in situ soils, there is potential for release of readily dissociable metals or dissolved metals trapped in in-situ soils when disturbed during dredge cutting, washing and discharged suspended sediments.

The potential for release of metals is elevated in low pH environments. Laboratory leachate testing in Geosyntec (2025) (ASLP and LEAF 1313) confirmed that under acidic conditions; Al, Fe, Mn, Zn, and other metals are released. However, it is noted that the samples supporting the greatest release of metals were acidic (either having become acidic prior to or during the analysis), increasing the release kinetics and solubility. In acidic conditions, metals can be mobilised via hydrolysis and desorption from mineral surfaces.

It is anticipated that mobilisation of metals can primarily be mitigated by controlling the pH of waters moving through the dredge and wash plant processing and maintaining a near-neutral pH in the dredge pond.

It is noted that both low and high pH can mobilise select metals. Water quality objectives (WQOs) should therefore aim for a near neutral pH to best manage release of metals and metalloids.

During pre-lodgement meetings between Holcim and DCCEEW, Holcim was advised that it should review water quality testing and management protocols currently in place at the Hanson Tweed sand plant, with particular reference to elevated iron concentrations. A review of data published by the

sand plant was undertaken and a technical memorandum prepared which presents the results of the review, in the context of appropriate management protocols for elevated iron concentrations in water. A copy of the memorandum is presented as Appendix F.

3.3.1 Down-Hydraulic Gradient Aquifer

The migration of an acidic groundwater plume presents the potential for a broader scale impact if substantially altered water chemistry was discharged from the site, that could lead to a chain reaction. Groundwater monitoring data (Kleinfelder, 2024) indicated that there are already substantial variations in groundwater quality in the area of the site, with a pH as low as 3.11 having been recorded during monitoring completed between May 2022 and October 2024.

The development of WQOs should consider the baseline data and set realistic target criteria based on the existing groundwater conditions for the site. If water quality in the pond was observed to degrade, control measures should be implemented to minimise risk of a plume of acidic (or contaminated) water causing off-site impacts.

3.4 Bacterial Reduction and Mobilisation of Iron

During wash plant separation, there is potential for concentration of organic carbon (present in in-situ soils as detritus). The deposition of fines with concentrated detritus into the dredge pond has potential to impact water quality. As fines settle, they can establish anoxic, reducing conditions, where Iron-Reducing Bacteria (IRB) can thrive. IRB utilise organic matter as they consume Fe^{3+} , producing soluble Fe^{2+} which can be mobilised in the water column (Lovley, D. R. (1991)).

However, these same anoxic conditions can also support Sulfate-Reducing Bacteria (SRB), provided sufficient sulfate (SO_4^{2-}) is present. SRB produce hydrogen sulfide (H_2S), which rapidly reacts with any available Fe^{2+} to form highly insoluble iron sulfides (FeS). This process acts to immobilise the iron, locking it back into a solid form within the sediments and thus counteracting the mobilisation driven by IRB (Burton, E. D., Bush, R. T., & Sullivan, L. A. (2008)).

While the potential mobilisation of iron via IRB process has been considered, it is noted that pyrite is a very stable and insoluble mineral. The iron in pyrite occurs in the ferrous state (Fe^{2+}), but is tightly bound within a crystalline structure with disulfide (S_2^{2-}). Breaking these bonds to release Fe^{2+} is a more complex and energetically demanding process than the simple reduction of Fe^{3+} to Fe^{2+} (Rickard, D. (2015)). Thus, the primary mitigation measure for IRB impacts should focus on limiting the potential for pyrite oxidation and release of bound iron into the water column; whereby even if precipitated as Fe^{3+} , IRB may re-mobilise iron as soluble Fe^{2+} .

The organic matter content of the fines slime, and prevalence of IRB and SRB in settled fines, cannot be determined without study of the slime produced during dredging operations. The early project fines separation and groundwater monitoring program should be prepared to consider potential for IRB to mobilise soluble iron; and allowance for mitigation measures should be considered in the event that dissolved iron concentrations become elevated.

The water quality monitoring program described in Section 7 provides for testing of water within the temporary settlement pond. The fines present within the settlement pond will also be tested for the

presence of IRB and other indicators of the potential for iron dissolution, prior to their relocation within the dredge pond. This testing is also described in Section 7.

3.5 Leaks and Spills of Chemicals or Fuels

Quarry operations routinely involve the storage and handling of various potentially hazardous substances; including diesel, petrol, oils, lubricants, and chemicals such as those used for alkaline dosing. Accidental releases of these materials, whether from storage tank failures, equipment malfunctions, refuelling incidents, or improper handling, can lead to contamination of groundwater resources.

Any chemicals or fuels stored onsite should be done so in accordance with applicable Australian Standards, and in accordance with the chemical-specific Safety Data Sheets (SDS).

On-site storage and handling procedures should be documented and incorporate elements such as appropriately bunded and covered storage areas, regular integrity testing of tanks and pipework, provision of readily accessible spill kits, and the application of the project's Pollution Incident Response Management Plan (PRIMP).

4 BENEFICIAL GROUNDWATER USES

4.1 Beneficial Uses of Groundwater

4.1.1 Overview

The NSW Department of Environment, Climate Change and Water (DECCW; now the Department for Climate Change, Energy, the Environment and Water (DCCEEW)) has published a list of WQOs for surface water catchments in NSW. The WQOs are the agreed environmental values and long-term goals for NSW's surface waters. They set out the community's values and uses for NSW rivers, creeks, estuaries and lakes and a range of water quality indicators to assess whether the current condition of the waterways supports those values and uses. The WQOs have been agreed for fresh and estuarine surface water bodies and are consistent with the national framework for assessing water quality, as set out in the ANZECC 2000 Guidelines and ANZG (2018) update to these Guidelines.

The site is located within the Hunter River catchment (within the 'Uncontrolled Streams' sub-area). According to the DECCW, the following WQOs are applicable to this sub-area of the Hunter River catchment:

- Aquatic ecosystems
- Visual amenity
- Primary and secondary recreational contact
- Livestock watering
- Irrigation
- Domestic (homestead) supply
- Potable use
- Aquatic foods (cooked).

These WQOs have been considered by this plan.

To further evaluate potential groundwater use, a review of current and potential uses of groundwater in the vicinity of the site is presented in the following sub-sections.

4.1.2 Private Licensed Bores

Geosyntec (2025) describes the potential for private extraction of groundwater for stock watering and irrigation uses to the north of the site – on the southern and northern sides of Tilligerry Creek. Licensed bore users may be affected by changes in groundwater levels and/or changes to groundwater quality.

A search was conducted of the WaterNSW online database for licensed bores in June 2025, to identify relevant details for licensed bores situated down-hydraulic gradient from the site (north, north-west or north-east from it). The details are provided in Table 5.

Table 5: Selected Details of Licensed Bores Installed Close to Site

Bore ID	Distance from nearest Site Boundary (m)	Direction from Site	Depth (m)	Aquifer Screened (inferred)	Listed Purpose
GW080185	On-site		10	D1	Industrial
GW080186			10	D1	
GW080187			No details	No details	
GW080188			10	D1	
GW080189			10	D1	
GW079399	800	North-west	No details	No details	No details
GW079680	800	North-west	No details	No details	No details
GW080370	800	North (north of Tilligerry Creek)	No details	No details	Stock watering / Domestic

Very few details are available from WaterNSW for the licensed bores, with details only provided for those located on-site; which are understood to be used for washing sand as part of the site's existing operations. Bore GW080370 is located to the north of Tilligerry Creek and is therefore considered unlikely to intercept groundwater deriving from the site area.

Aside from the licensed bores described in Table 2, it is also possible that unlicensed bores exist in the area down-hydraulic gradient from the site.

4.1.3 Hunter Water Borefield

Hunter Water Corporation (HWC) owns a drinking water supply borefield near the site, located to the south – on the opposite side of the groundwater flow divide associated with the dune system (that is, the borefield is up-hydraulic gradient from the site and does not receive groundwater from the site vicinity).

It is understood from information provided in Geosyntec (2025) that this borefield is not currently instrumented with pumps and has never been used for water supply extraction, but that HWC reserves the right to activate the borefield for water supply security when required. It is understood from Geosyntec (2025) that this borefield, as with HWC's other borefields in the region, would only be activated for emergency water supply in extreme drought conditions, and does not otherwise contribute to the standard HWC water supply scheme. If activated, the borefield has the potential to draw groundwater from the site towards it, despite its location on the opposite side of the groundwater flow divide (to the site). Although never having been used, it represents a potential beneficial use of one or more of the regional aquifers and must be recognised as such for the purposes of this plan.

HWC has published a guideline relevant for all developments in the water catchments it is responsible for, entitled *Protecting our Drinking Water Catchments: Guidelines for Development in the Drinking Water Catchments* (HWC, 2017). The Guidelines present minimum expectations for developments within the catchments, which include management of potentially contaminating or hazardous materials or goods. Extractive industries including quarries are recognised in the Guidelines as developments involving potentially contaminating or hazardous materials. The Guidelines recommend that all hazardous and toxic materials are dealt with in accordance with the relevant legislation and where applicable, an Environment Protection Licence (EPL) issued by the EPA. The Guidelines follow on to say that robust management systems and contingency/emergency plans will be required for such developments in any drinking water catchment.

In the case of the subject site and project, all proposed activities would be conducted in accordance with an EPL issued by the NSW Government. This Plan, together with the ASSMP, set out the proposed management measures for preventing acid generation associated with the project and subsequent adverse effects on water quality, which may otherwise impact on Hunter Water's borefield. This Plan includes TARPS, which will allow a rapid response to adverse changes in process water, before it interacts with groundwater.

4.1.4 Aquatic Ecosystems

Tilligerry Creek is assumed to support freshwater ecosystems. It is located approximately 900 m north-north-east of the site at its closest point and has been designated as a gaining stream, therefore likely to receive water from the vicinity of the site (south).

4.1.5 Surface water/Groundwater Dependent Ecosystems

Geosyntec (2025) identified the following high priority groundwater dependent ecosystems (GDEs) close to the site:

- Coastal wetlands.
- Wetland vegetation.
- Swamp-Heath woodland.

The nearby Worimi National Park and Regional Park, located to the south and west of the site, also support terrestrial ecosystems that may depend on groundwater from the site area.

4.1.6 Summary

The information presented in this section indicates that the following potential beneficial uses of groundwater are applicable to this plan:

- Visual amenity.
- Potable use.
- Other domestic uses, including irrigation and stock watering.
- Freshwater aquatic ecosystems.

- GDEs, including aquatic and terrestrial ecosystems.
- Recreational contact with surface water.

These are consistent with the WQOs published by DECCW.

Recreational use has been included on the basis that Tilligerry Creek and downstream areas may be used by members of the public for activities such as swimming, boating and other aquatic activities involving direct contact with the surface water.

5 PROJECT WATER QUALITY CRITERIA

5.1 Chemical and Physical Parameters of Interest

Previous water quality monitoring at the site has focused on chemicals and physical parameters which are important in monitoring water quality changes resulting from acid inputs to the groundwater system. Other parameters measured provide information on the ability of the groundwater system to balance out or buffer acid generation, and the composition and source of groundwater entering the system.

The same chemicals and physical parameters have been adopted for water quality monitoring during the proposed extraction project. These are:

- Anions and cations: sodium, calcium, magnesium, potassium, sulfate, chloride, fluoride, nitrate and nitrite, ammonia total; Kjeldahl nitrogen (TKN).
- Physical and other inorganic parameters: pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity and total acidity.
- Metals: aluminium, arsenic, boron, cadmium, chromium (total), copper, iron, lead, manganese, mercury, nickel and zinc.

These chemicals and physical parameters are included in Table 6, together with the adopted project water quality criteria. Cyanobacteria associated with blue green algal blooms have been included as a parameter to monitor visually, given their presence has potential implications for worker safety at the site during the life of the project. It is noted that these bacteria (and other algal forms) are more commonly encountered when there are nutrient inputs to surface water. In the case of the project site, there is little to no interaction of site-derived surface water with surrounding drainage areas; and where these interactions are present, surface water containing nutrients is unlikely to enter the site and interact with surface water in the dredge or temporary settlement ponds. In the absence of site-derived nutrients, algal blooms are considered unlikely at the site. Notwithstanding, visual monitoring of the dredge pond is proposed, with field kit or laboratory analysis in the event visual indicators of algal blooms are recorded.

While PFAS sampling and laboratory analysis was included in the baseline monitoring conducted by Kleinfelder (2020–2024), the monitoring results show that PFAS compounds detected in groundwater beneath the site were limited to PFOS (one well only, located in the central site portion) and 6:2 FTS (all but one well monitored). The distribution of the PFAS detections indicates that it is not associated with a point source of contamination. Rather, it is considered likely to be a result of influences in the broader catchment, associated with ambient groundwater quality. On this basis, and the fact that PFAS compounds are not associated with extractive or processing activities relating to the project, PFAS have not been included as chemicals of interest for the monitoring program.

5.2 Baseline Groundwater Conditions

Section 2.6.5 provides information relating to recently measured groundwater quality in monitoring wells installed at the site.

Kleinfelder collected water quality data on a monthly basis from the site's monitoring well network available at that time, between September 2020 and October 2024. This data set is presented in Appendix B.

To establish baseline conditions, the monitoring well locations included in the Kleinfelder data set were reviewed to select suitable wells for deriving site-specific water quality criteria – those being wells which are likely to be unaffected by previous and existing site-based activities, as well as nearby land uses; noting the presence of current extractive activities to the east and west of the site. Nominally, these were considered to be wells located up- or cross-hydraulic gradient from site-based activities (in the site's southern and south-east portions). These are:

- BH2, BH3, BH4, BH5, BH7.
- MW1 (renamed to BH1S), MW3 (renamed to BH3S), MW5 (renamed to BH5S) and MW7 (renamed to BH7S).

BH6 was excluded from consideration because it is located directly down-hydraulic gradient (north-west) from existing extraction activities.

In reviewing the data set available for these monitoring wells, the following statistical parameters were calculated for each of the analytes considered for monitoring purposes:

- Minimum, maximum, median, mean, standard deviation and the 95% upper confidence limit (UCL) of mean concentrations.

The application ProUCL 5.2 (USEPA, 2022) was used for this purpose. The calculated statistics are tabulated in Appendix C. ProUCL outputs are also included in Appendix C.

5.3 Information Sources for Derivation of Project Water Quality Criteria

Section 4.1 provides a description of existing and potential beneficial uses of groundwater near the site, including down-hydraulic gradient areas to the north and north-west. These beneficial uses are consistent with the WQOs established for uncontrolled streams within the Hunter River water catchment, in which the site is located.

The WQOs have been used as a basis for establishing project water quality criteria which will be used to monitor the quality of surface water in the process pond, temporary settlement pond(s) and the groundwater monitoring well network.

There are various guidance documents published in Australia for protecting beneficial uses of surface water and groundwater. The documents used to derive project water quality criteria for monitoring purposes included:

- Australian and New Zealand Environment Conservation Council and Australian Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ, 2000). Guidelines for Fresh and Marine Water Quality.
- Water Quality Australia (WQA, 2018). Guidelines for Fresh and Marine Water Quality. This document is an update to the ANZECC & ARMCANZ (2000) document.
- National Health and Medical Research Council (NHMRC, 2008). Guidelines for Managing Risks in Recreational Water.
- NHMRC (2011, updated 2024). Australian Drinking Water Guidelines.

5.4 Derivation of Site-Specific Guideline Values for Aquatic Ecosystems

5.4.1 Guidance

The most recent update to the Australian water quality guidelines (Water Quality Australia (2018) Australian and New Zealand Guidelines for Fresh and Marine Water Quality ('ANZG')) provides a methodology for deriving site-specific guideline values for the protection of aquatic ecosystems. The approach is based on collection of data or information on an indicator for a water body (a WQO), then use of these data to determine concentrations that will protect the WQO(s).

The ANZG describes four approaches that can be used to derive site-specific guideline values:

- Reference site data
- Laboratory effects data
- Field effects data
- Multiple lines of evidence (a combination of more than one of the above approaches).

5.4.2 Adopted Approach

For this monitoring plan, site-specific data (from reference sites located within the subject site boundaries) were used to derive site-specific guideline values for the protection of aquatic ecosystems.

The ANZG recommends that site-specific guideline values for aquatic ecosystems are based on at least 2 years of monthly monitoring data from an appropriate site; for example, upstream of impacted areas, or from appropriate local reference systems that are representative of unimpacted water bodies. The ANZG also recommends using monitoring data that span seasonal changes in weather patterns and associated water levels and quality.

The Kleinfelder data was collected on a monthly basis from the site's existing monitoring well network, between September 2020 and October 2024, including wells that are up-hydraulic gradient from the proposed dredging pond and sand processing area, as wells as cross- and down-hydraulic gradient from it. The Kleinfelder data set is considered appropriate for the derivation of site-specific guideline values (aquatic ecosystems) for the project. This data set is presented in Appendix B.

The maximum concentrations reported for each of the analytes tested by Kleinfelder between 2020 and 2024, as representative of 'worst-case' baseline groundwater quality at wells which are unlikely to have been impacted by former extractive operations, have been adopted as site-specific guideline

values for freshwater aquatic ecosystems – for consideration in deriving project water quality criteria. These are summarised in Table 6.

5.5 Guideline Values for Drinking Water

The Australian Drinking Water Guidelines (National Health and Medical Research Council (NHMRC, last updated 2024) present drinking water criteria for a large range of potential contaminants and physical parameters.

The criteria derived for the analytes considered by this plan are presented for reference in Table 6.

5.6 Guideline Values for Recreational Use

The National Health and Medical Research Council (NHMRC, 2008) has published a document entitled Guidelines for Managing Risks in Recreational Water. This document presents guideline values for ensuring the protection of recreational users of surface water. Similar to the Drinking Water Guidelines, NHMRC (2008) presents guideline values for a large number of physical, microbiological and chemical contaminants.

The guideline values presented for the analytes considered by this plan are presented for reference in Table 6.

5.7 Guideline Values for Irrigation and Stock Watering

The ANZG presents guideline values for the protection of irrigated crops and livestock water. The values for livestock were updated from the previous version of the guidelines (ANZECC & ARMICANZ, 2000), however the irrigation guideline values were retained from this earlier document.

The guideline values presented in ANZG for irrigation and stock water are reproduced for reference in Table 6. The values presented for irrigation are for long-term groundwater use for this purpose. Long-term irrigation use is defined in the ANZECC & ARMICANZ (2000) document as up to 100 years.

Table 6: Summary of Baseline Groundwater Quality (Maximum Concentrations), Applicable Guideline Values for Beneficial Water Uses and Adopted Project Water Quality Criteria (mg/L)

Analyte	Maximum Reported ³ Concentration – Baseline Groundwater Quality and Site-Specific Guideline Value for Freshwater Aquatic Ecosystems	ANZG (2018) Freshwater Ecosystem Default Guideline Values (DGVs) (95% Protection Level)	Australian Drinking Water Guidelines (2024)	ANZG (2018) Irrigation Guideline Values (long-term)	ANZG (2018) Stock Water Guideline Values	NHMRC (2008) Recreational Guideline Values	Adopted Project Water Quality Criterion (Baseline Water Quality)
Sodium	53	-	180	-	-	180	53
Calcium	93	-	-	-	1000	-	93
Magnesium	13	-	-	-	500	0.5	13
Potassium	4	-	-	-	-	-	4
Sulphate	49	-	250	-	1000	500	49
Chloride	104	-	250	-	-	250	104
Fluoride	0.5	1.7	1.5	1	2	1.5	0.5
Nitrite as N	0.1	-	-	-	9	3	0.1
Nitrate as N	8.2	-	-	-	90	50	8.2
Nitrite + Nitrate as N	8.2	-	50	-	-	53	8.2

Analyte	Maximum Reported ³ Concentration – Baseline Groundwater Quality and Site- Specific Guideline Value for Freshwater Aquatic Ecosystems	ANZG (2018) Freshwater Ecosystem Default Guideline Values (DGVs) (95% Protection Level)	Australian Drinking Water Guidelines (2024)	ANZG (2018) Irrigation Guideline Values (long-term)	ANZG (2018) Stock Water Guideline Values	NHMRC (2008) Recreational Guideline Values	Adopted Project Water Quality Criterion (Baseline Water Quality)
Total Ammonia as Nitrogen	3.2	0.9	-	-	-	0.5	3.2
Total Kjeldahl Nitrogen as N	8.2	-	-	5	-	-	8.2
Electrical Conductivity @ 25°C	512	-	-	-	-	-	512
Total Dissolved Solids ²	2,780	-	-	-	500	-	2,780
pH	7.8	6.5-8.5 ¹	6.5-8.5	6.0-8.5	-	-	6.0 – 8.5
Aluminium	4.3	0.055	0.2	5	5	-	4.3
Arsenic	0.09	0.024	0.01	0.1	0.05	0.007	0.09
Boron	0.06	0.94	4	0.5	5	4	0.06

Analyte	Maximum Reported ³ Concentration – Baseline Groundwater Quality and Site- Specific Guideline Value for Freshwater Aquatic Ecosystems	ANZG (2018) Freshwater Ecosystem Default Guideline Values (DGVs) (95% Protection Level)	Australian Drinking Water Guidelines (2024)	ANZG (2018) Irrigation Guideline Values (long-term)	ANZG (2018) Stock Water Guideline Values	NHMRC (2008) Recreational Guideline Values	Adopted Project Water Quality Criterion (Baseline Water Quality)
Cadmium	0.0004	0.0002	0.002	0.01	0.01	-	0.0004
Chromium (total)	0.006	-	-	0.1	1	0.05	0.006
Copper	0.11	0.0014	2	0.2	0.4	2	0.11
Iron	6.9	-	0.3	0.2	-	0.03	6.9
Lead	0.02	0.0034	0.012	2	0.1	0.01	0.02
Manganese	0.27	1.9	0.5	0.2	10	0.5	0.27
Mercury	0.00005	0.006	0.001	0.002	0.002	0.001	0.00005
Nickel	0.06	0.011	0.02	0.2	1	0.02	0.06
Zinc	0.56	0.008	3	2	20	3	0.56

¹Guideline Value drawn from ANZECC & ARMCANZ (2000).

²TDS calculated by multiplying laboratory measured total hardness by 10 x.

³Maximum concentration reported in the up-hydraulic and cross-hydraulic gradient wells (excludes BH6).

5.8 Comparison of Baseline Water Quality with WQO Criteria

A comparison of the maximum concentrations reported for each of the chemicals and physical parameters of interest – in wells that are up-hydraulic or cross-hydraulic gradient from the current site-based activities – with the various guideline values and criteria representing the identified WQOs in Table 6 indicates the following:

- Baseline concentrations of the majority of chemicals and physical parameters of interest measured in the up-hydraulic and cross-hydraulic gradient wells are less than the lowest criteria presented for that analyte across each of the identified WQOs. This means that the current (project baseline) water quality meets all relevant WQO criteria and would be considered of suitable quality for each of these groundwater uses for the majority of the analytes of interest.
- The only exceptions included:
 - Magnesium - > recreational use criterion.
 - pH – outside of (below) range presented for freshwater ecosystems (ANZG, 2018), recreational use and drinking water.
 - Aluminium - > freshwater ecosystems (ANZG, 2018) and drinking water.
 - Arsenic - > freshwater ecosystems (ANZG, 2018), drinking water, stock water and recreational use.
 - Copper - > freshwater ecosystems (ANZG, 2018).
 - Iron - > drinking water, irrigation and recreational use.
 - Lead - > freshwater ecosystems (ANZG, 2018), drinking water and recreational use.
 - Zinc - > freshwater ecosystems (ANZG, 2018).

The default guideline values (DGVs) for freshwater ecosystems presented in ANZG (2018) are included for reference purposes only in Table 6, since these are superseded by the calculated site-specific guideline values (baseline concentrations) for freshwater ecosystems. The exceedences of the DGVs (ANZG, 2018) are not considered further for the purposes of this Plan.

With respect to magnesium, pH, aluminium, arsenic, lead and iron; each with baseline concentrations which exceed recreational use, drinking water and/or irrigation criteria; the concentrations of these chemicals and physical parameters measured in wells at the site are considered representative of ambient conditions within the hydro-stratigraphic units screened by the monitoring network (D1, D2 and D3). That is, in the absence of impacts associated with sand extraction, water quality indicated by these parameters already exceeds criteria relevant for protecting recreational, drinking water and irrigation uses of groundwater.

With respect to water quality reported in BH6, which is located down-hydraulic gradient from the existing site operations and was excluded from the summary statistics presented in Table 6, the maximum concentrations of several analytes of interest exceed the baseline water quality concentrations for other wells. These include: magnesium, potassium, sulfate, nitrite, nitrate, total ammonia, total alkalinity, electrical conductivity, pH, boron, iron and manganese. The conditions at BH6 must be considered when deriving and applying project water quality criteria, because they represent down-hydraulic gradient boundary conditions prior to commencement of the project.

Further discussion regarding application and interpretation of the project water quality criteria is provided in Section 7.5.

5.9 Selection of Project Water Quality Criteria for Monitoring Purposes

In the case of all chemicals and physical parameters considered by this Plan, the baseline water quality conditions, as represented by cross- and up-hydraulic gradient wells which are assumed to be unaffected by existing sand extraction processes, have been adopted as project water quality criteria. Although these conditions in some cases exceed criteria relevant for protecting selected beneficial uses of groundwater, they are considered representative of ambient conditions within the hydro-stratigraphic units screened by the monitoring well network installed at the site; and therefore appropriate to use as project criteria for the proposed sand extraction and processing activities.

The adoption of these concentrations as project water quality criteria will ensure that existing water quality at, and down-hydraulic gradient from the site is maintained for ongoing protection of the identified WQOs.

6 ENVIRONMENTAL CONTROL MEASURES

6.1 Overview

The GWMP proposes a range of environmental controls to be implemented to mitigate risk of environmental harm, including:

- Process optimisation, minimising disturbance during dredge cutting and limiting re-circulation of fines.
- Water treatment incorporated into the sand wash plant (pH correction and aeration).
- Temporary containment of fines in an aqueous environment pending environmental validation (lined settling ponds).
- Permanent interment of fines into the dredge pond, once a portion of the pond has reached terminal depth and does not require re-dredging.

The performance of these controls requires diligent monitoring and if deteriorating conditions are observed, several TARP options can be implemented to increase the level of protection or treat pond water / groundwater if required.

Management practices to prevent leaks and spills are not discussed within the GWMP (which focuses on control measures for preventing potential environmental harm associated with day-to-day operations) and may be incorporated into the site PIRMP. If groundwater impacts associated with a leak or spill are identified, a suitably qualified expert should be engaged to determine the most appropriate actions based on the nature of the incident and type of chemical released.

6.1.1 ASS Management Principles

The Queensland acid sulfate soil guidance: Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines, Version 5.1 is the most recently published ASS guideline at the time of this GWMP being authored and is widely accepted in NSW as the best practice guideline (i.e. superseding information presented in the NSW guidelines).

The QLD technical manual states:

“Once methods of minimising disturbance have been fully explored, the following risk-based management strategies are preferred for dealing with any unavoidable disturbances:

- *neutralisation of ASS (Section 7)*
- *hydraulic separation on its own or in conjunction with dredging (Section 8)*
- *strategic reburial of PASS at least one metre deeper than the seasonally lowest watertable elevation, or several metres below permanent standing water (Section 9). This method alone is not suitable for soils with significant Actual and/or Retained Acidity”.*

The proposed environmental controls combine minimising of disturbance, and all three of the preferred management strategies, to provide a best practice outcome and mitigate the risk of acid sulfate soil oxidation, and subsequent mobilisation of metals and metalloids either associated directly

with the oxidation of pyrites or mobilised as a result acidification associated with the oxidation of pyrite.

6.2 Process Optimisation

6.2.1 Minimising Disturbance During Dredging

6.2.1.1 Dredging / Cutting

The dredging process of ‘cutting’ material from its in-situ location can potentially disturb soil particles, dispersing them through the water column as an uncontrolled release of material (and any dissociable metals) into the environment.

Holcim has nominated to employ a Jaden Cutter Suction Dredge (CSD) for the primary dredging operation (Figure 3 illustrates an indicative CSD head). CSDs work by loosening soil with a toothed rotating cutting head mounted in front of a suction pipe, with the vacuumed slurry then piped to shore for processing in the wash plant.

The cutter head speed can be adjusted to achieve an optimal operating efficiency based on characteristics of the in-situ soils. Once adjusted, the suction aims to remove nearly all of the cut soils. As a result, the potential for disbursement of physical or chemical contaminants into the water column is sufficiently mitigated.

The dredge operator may continually review the appropriate cutter speed to ensure optimal efficiency, the protection of water quality and sustainable operation (i.e. power consumption).

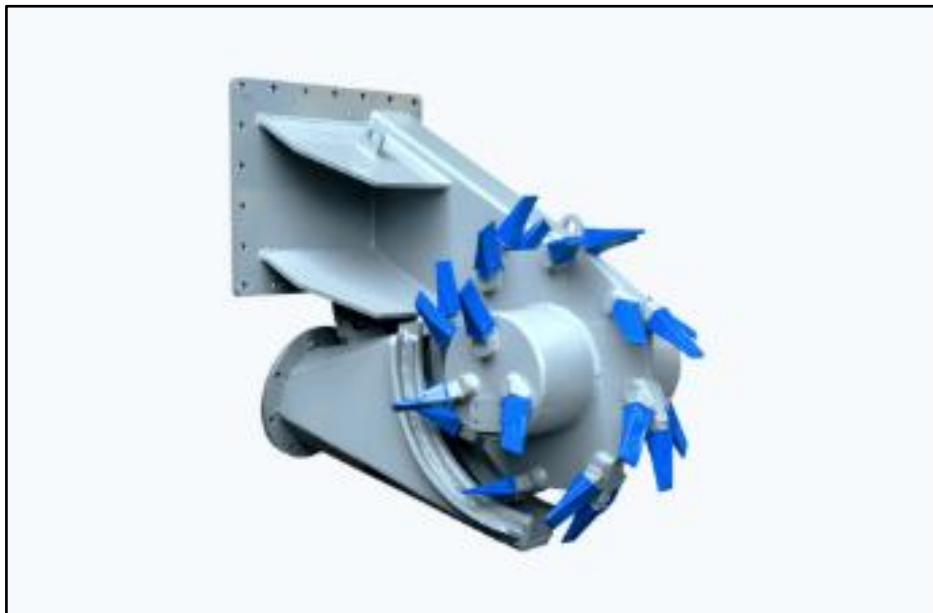


Figure 3: s60 Jaden Dredge Cutter (Neumann Equipment, 2021).

6.2.1.2 Minimising Re-circulation

Outflows from the sand wash plant will contain a small portion of fines (Holcim has advised the fines return is averaged to 2 tonnes per hour at peak operating capacity). During early stages of dredging, the wash plant outflow will be diverted through a temporary settling pond, to avoid deposition in the

dredging zone and re-circulation of fines. Once a portion of the dredge pond has reached terminal depth, the wash plant outflow (and associated fines) will be returned to the main dredge pond for deep interment. This proposed approach is subject to validation of the environmental suitability of fines return and is further discussed in following sub-sections.

If fines are not suitable for interment, they will be incorporated back into the wash plant for separation and subsequent treatment / management under the provision of the project's ASSMP.

6.2.2 Minimising Opportunity for Pyrite Oxidation

The strategy for minimising the opportunity for pyrite oxidation is consistent maintenance of anoxic or near-anoxic conditions throughout the dredging, processing, and deposition of fines into temporary settling ponds, and later; deep interment in the dredge pond.

Pyrite remains stable and largely unreactive when kept in a saturated, low-oxygen environment. The following operational procedures are designed to prevent such exposure:

Saturated Dredging Operations: The dredging process will be conducted below the water table. The extraction of sand will occur from within the saturated zone, ensuring that the pyritic material remains in its naturally anoxic state during removal.

Wash Plant Processing under Saturated Conditions: The dredged material will be transported to the wash plant as a slurry. Throughout the washing and classification process, the material will be kept saturated. This continuous saturation is critical in preventing the introduction of significant oxygen that could initiate pyrite oxidation.

Fines Management and Settling Ponds: Fine particulate matter, expected to contain a higher proportion of reactive pyrite, will be concentrated during the washing process. This fines-laden water will be directed to designated settling ponds.

Subaqueous Deposition: The outflow stream from the wash plant will discharge fines directly into the temporary settling pond, designed to ensure deposition occurs beneath a permanent water cover. A minimum water depth of greater than 1 metre (>1m) will be maintained over the settled fines at all times. This water cap acts as a barrier, significantly limiting oxygen diffusion from the atmosphere to the settled pyritic material.

Prevention of Re-suspension: The use of an appropriately sized and designed settling pond will facilitate effective settlement of fines and minimise the potential for their re-suspension into the water column. While DO levels in the pond water are expected to be low, preventing re-suspension further limits any potential interaction of fines with oxygenated water; which, although a lower risk than atmospheric exposure, is an additional precautionary measure.

Deep Interment of Fines in Dredge Pond: Following the temporary pond settling phase, the consolidated fines from the settling ponds will be carefully transferred and permanently interred within the dredge pond, and the wash plant outflow will be redirected to the dredge pond. This final deep deposition will also occur below the permanent water level of the dredge pond, ensuring long-term anoxic conditions and the continued stability of the pyritic material. This mimics the natural, undisturbed state of the acid sulfate soils.

By adhering to these measures, the operational plan actively prioritises the maintenance of water saturation across all stages of material handling. This strategy is fundamental to preventing the oxidation of pyrite and mitigating the potential for acid generation, thereby protecting the surrounding groundwater environment. Regular monitoring of water levels in the settling ponds and dredge pond will be required to ensure the effectiveness of this control measure.

6.3 Water Treatment (Lime Dosing)

6.3.1 Dredging Water Treatment

To mitigate potential acid generation from oxidation of pyrites and existing pH (with reference to low pH levels identified in groundwater monitoring (Kleinfelder, 2024)), a lime dosing system will be employed with multiple inlet points to the wash plant to allow for process control. An additional outlet should be included with capacity to dose to the main dredge pond if circulation of water through dredging process and the wash plant is not sufficient to maintain the pond pH at near neutral. This may occur at the wash plant outflow, or at a separate dosing point that could be positioned in the dredge pond to achieve optimal mixing based on the dosing requirements).

The optimal dosing point will require testing during the commissioning phase of the wash plant and may vary during operation, depending on the depth of extraction and slurry composition. The potential for the wash plant to act as a water treatment plant should also be considered, as dosing prior to cyclone separation will allow for aeration and potential precipitation of metals.

The system will be 'tuned' during operation to achieve the appropriate dose rate and dosing point.

Dosing points and their advantages and disadvantages are set out in Table 7. The project may adopt one or several dosing points at any given time, depending on system 'tuning' and water quality performance monitoring results.

Table 7: Lime Dosing Points and Their Advantages and Disadvantages

Dosing Point	Advantages	Disadvantages
Wash plant pre-Cyclone 1	- Most mixing potential - Most aeration potential after pH correction (metals removal) - Precipitated metals may be removed with sand - Practical dosing of sand stockpile (if required)	- Potential loss of lime into sand stockpile (overuse of lime incurring unnecessary costs if sand product does not require lime)
Wash plant post-Cyclone 1	- Reduce loss of lime into sand stockpile if stockpile does not require lime - Precipitated metals may be removed with saleable sand	- Reduced mixing and aeration
Wash plant Outflow	- No loss of lime into sand stockpiles	- Limited mixing - No aeration (reduced potential for precipitation of metals)
Dredge Pond (bypass wash plant)	- Ability to pH correct the pond in addition to dosing of the wash plant process water. - Ability to manage pH of dredge pond independent of dredging (e.g. continue dosing when outside of dredge operating hours)	

It is anticipated that real-time pH monitoring points will be present at the outflow of the wash plant to control and adjust the lime-dosing rate. Additional testing points may be included to achieve optimal performance. Alternative pH control monitoring points may be determined as more suitable by the dosing system designer; and should be adjusted as per their recommendation to achieve optimal dosing.

The treatment system should aim to achieve a near neutral pH outflow. If elevated metals are present, an outflow pH of between 7 and 8.5 pH units should be maintained for optimal metals precipitation and maintaining dredge pond pH to meet performance thresholds (refer to Section 5). If the main pond supports a pH lower than the performance monitoring criteria (Section 7.5.3), discharging at a higher pH may be required to assist in restoring the dredge pond to the target pH.

6.3.2 Drained Water from Sand Stockpiles

The area in which the sand stockpiles will be located will be designed in accordance with the specifications of the ASSMP. Sand stockpiling will occur on a bunded and lined stockpiling pad, with a sump to collect drained water (also commonly referred to as leachate in ASS technical guidance documents).

Preliminary wash plant designs indicate an approximate 15% moisture content (MC) in sands deposited into the stockpiling area. Holcim has advised an upper limit of 8% MC for export concrete, but ideally 5-6%.

At a sand production rate of 300 tph, up to 30 m³ of water will be drained and require management (indicative volume subject to final MC, rainfall and evaporation). Performance testing will be undertaken to confirm this drained water is of a suitable quality for discharge back to the dredge pond such that a discharge to the dredge pond will not lead to a cumulative impact and breach of the project water quality criteria. This testing is described in Section 7.4.3.

If drained water is not suitable for direct discharge to the dredge pond, it may be appropriate to divert drained water through the wash plant. This should only be undertaken if treatment is required to achieve the performance monitoring criteria (Section 7.5.3) and may be managed by utilising the wash plant as a standby treatment system until sufficient performance data is collected to determine if regular treatment is required.

Performance thresholds and management options for drained water are set out in Table 8.

These measures are applicable to dry weather conditions. When a significant rainfall event occurs, sump overflow may be directed back to the dredge pond.

Table 8: Stockpile Pad Water Management Options

Drained Water Quality	Threshold	Management Measure	Outcome
Consistent with dredge pond water quality objectives	>6.5 or <8.5 pH	Discharge direct to dredge pond	Most efficient discharge
High pH	>8.5 pH	Discharge direct to dredge pond. Review dosing process to ensure optimal lime dosing and verify high pH discharge will not be detrimental to dredge pond water quality.	May be beneficial to manage long-term pond pH levels. Possible excess use of lime.
Low pH only	<6.5 pH	Alkaline dosing either via dedicated dosing point, or divert through wash plant for pH correction.	pH correction
Low pH + elevated iron and aluminium.	<6.5 pH >6.3 mg/kg Iron and/or >4.3 mg/kg Aluminium	Divert through wash plant.	pH correction and metals precipitation (potentially extracted during cyclone separation)
Other elevated metals that may not be managed through the wash plant.	Refer to Table 6	Expert advice to be sought based on water chemistry results. Additional water treatment potentially required.	To be determined based on water quality

6.4 Fines Management

6.4.1 Overview

Fines that cannot be captured / separated during the wash plant process will be returned in the wash plant outflow. While the process of keeping acid sulfate soils in an aqueous environment follows best practice and complies with ASS guidance, it is understood that the regional regulators have concerns regarding the environmental suitability of this process due to legacy issues associated with previous sand dredging operators in the region (i.e. RZM's mining operations).

The proposed fines management for the Salt Ash Quarry centres around return of fines to the dredge pond, with preliminary safety measures (capture in a lined settling pond) to allow for proof of performance testing to verify that lime dosing at the wash plant and sub-aqueous management are

sufficient environmental controls to allow for the return of fines into the dredge pond (where interaction with groundwater can occur).

6.4.2 Temporary Containment of Fines

Fines will initially be captured by diverting wash plant outflow to a lined temporary settling pond for capture of fines. Water from the temporary settling pond will outflow into the main dredge pond for recirculation in the dredging process.

The key aspects considered for design are:

- Retention time
- Storage capacity
- Segregation from groundwater (lined basin)
- Limiting potential for fines oxidation
- Storage sizing for potential capture period
- Discharge mechanism (minimise disturbance and turbidity).

Sediment basin design and indicative calculations and drawings are provided as Appendix D.

The calculations have allowed an approximate 3-hour residence time with a residence capacity of 1,800 m³ and additional sediment storage capacity for 0.67 m³/h of fines. A 6-month settlement pond capacity is recommended with a volume of 7,236 m³, which is expected to provide sufficient storage capacity to ensure time for assessment of accumulated fines and generation of a sufficient void to allow for a dedicated long-term interment location within the dredge pond.

It is noted that the basis of design relies on flow rates and an indicated 2t per hour solids return (as advised by Holcim). The actual fines content may vary, particularly in earlier stages of dredging through the D1/D2 layer, where elevated clay and silt content are present. Real world monitoring of the fines accumulation should be undertaken to verify the volume of settled solids and allow for review of storage capacity requirements.

6.4.3 Permanent Deep Interment of Fines

6.4.3.1 Validation Of Environmental Suitability

Prior to directing wash plant outflows to the dredge pond, the accumulated fines in the settling pond must be environmentally validated as suitable for placement into the dredge pond.

An assessment of the accumulated fines should be undertaken within three months from the commencement of dredging. The validation should be undertaken adopting a weight of evidence-based approach.

Key questions to confirm suitability are:

- Have pyrites in the accumulated fines undergone significant oxidation?
- Are soluble metals being released from accumulated fines?
- Has water quality in the settling pond shown evidence of degradation (e.g. low pH, elevated metals, reduced sodium chloride ratio)?

- Has water quality in the dredge pond shown evidence of cumulative degradation (e.g. low pH, elevated metals, reduced sodium chloride ratio)?
- What is the quality of pore water within the fines?
- Are metals readily leachable from captured fines?
- Are IRB or SRB populations present at high levels that would likely impact water quality on a broad scale?

To answer these questions, the following analysis of the accumulated fines is proposed:

- Chromium Reducible Sulfur
- Heavy metals
- ASLP (metals)
- Elutriate (metals)
- Total Organic Carbon
- Bacteria (IRB and SRB).

The results of this analysis should be considered in conjunction with water quality monitoring data up to the point of the validation.

The validation questions are presented with rationale and performance indicators in Table 9.

Table 9: Performance Indicators for Fines Interment

Question	Analytical Parameter	Performance Indicators	Rationale
Have pyrites in the accumulated fines undergone significant oxidation?	Chromium Reducible Sulfur (SCR) and Net Acidity	Low Risk: SCR content is consistent with baseline unprocessed sand and Net Acidity is negative (i.e. has net acid-neutralising capacity). Moderate Risk: Minor decrease in SCR with low or zero Net Acidity. Requires further investigation into buffering capacity of the dredge pond. High Risk: Significant decrease in SCR compared to baseline and positive Net Acidity. Fines are unsuitable for return without pre-treatment.	To confirm that saturation during the dredging process and sub-aqueous storage in settling ponds prevents significant oxidation of pyrite. The primary concern is the generation of sulfuric acid which can lower pH and mobilise metals. Lime dosing at the wash plant is expected to contribute to a reduction in Net Acidity.

Are soluble metals being released from accumulated fines?	Pore Water Analysis (dissolved metals)	Low Risk: Pore water metal concentrations are below the 95% protection levels for freshwater ecosystems (ANZG, 2018). Moderate Risk: Some metal concentrations exceed the 95% protection levels but are below the 80% protection levels (ANZG, 2018). Requires assessment of dilution and mixing in the dredge pond. High Risk: Multiple metal concentrations significantly exceed the 95% protection levels (ANZG, 2018). Fines are unsuitable for return.	To directly measure the concentration of soluble metals within the fines that could be released into the dredge pond and subsequently interact with groundwater. This provides a direct measure of the immediate risk to water quality.
Are metals readily leachable from captured fines?	Australian Standard Leaching Procedure (ASLP) and Elutriate Testing (metals)	Low Risk: Leachate concentrations are below the 95% species protection level in freshwater (ANZG, 2018), considering a conservative dilution factor within the dredge pond. Moderate Risk: Leachate concentrations for some metals exceed the 95% protection level (ANZG, 2018) but can be demonstrated to meet objectives after accounting for realistic mixing and dilution in the dredge pond. High Risk: Leachate concentrations are likely to cause exceedance of water quality objectives in the dredge pond even with dilution. Fines are unsuitable for return.	To simulate the potential for metal release from the fines under environmental conditions representative of the dredge pond. This assesses the long-term leaching potential and helps predict cumulative impacts on the receiving groundwater system.

What is the overall potential for the fines to degrade water quality?	Total Organic Carbon (TOC)	Low Risk: TOC levels are consistent with natural background levels in the local environment. Moderate/High Risk: Elevated TOC levels which can contribute to the complexation and mobilisation of metals and provide a substrate for microbial activity. The risk level depends on the magnitude of the elevation and should be considered in conjunction with other parameters.	To assess the potential for organic matter in the fines to influence metal mobility and serve as a food source for bacteria that can impact water chemistry.
Are problematic bacterial populations present at high levels?	Bacteria: IRB and SRB	Low Risk: Low populations, consistent with background levels in the surrounding environment. Moderate Risk: Elevated populations of either IRB or SRB. This may indicate conditions conducive to problematic biogeochemical cycling (e.g., formation of metal precipitates, generation of hydrogen sulfide). High Risk: High populations of IRB and/or SRB, indicating significant potential to alter redox conditions and impact water quality on a broad scale.	To determine if the fines are a significant source of bacteria that could negatively impact water quality through processes altering the solubility of metals.

Has the fines management process shown evidence of degrading water quality in the settling and dredge ponds?	Water Quality Monitoring Data (pH, electrical conductivity, metals, sodium: chloride ratio)	Low Risk: Water quality in both the settling pond and the dredge pond remains within the established background range and meets ANZG (2018) guidelines (DGVs) for the protection of aquatic ecosystems. The sodium: chloride ratio remains stable, indicating no significant changes in the groundwater/surface water interaction. Moderate Risk: Minor, transient exceedances of some parameters that are quickly attenuated. The sodium: chloride ratio shows minor fluctuations. Requires increased monitoring frequency. High Risk: Sustained or increasing trends of key contaminants (low pH, elevated metals) in either water body. A decreasing sodium: chloride ratio may indicate changes in groundwater interaction. This would trigger a halt to fines return and a review of the management process.	To provide a continuous, real-world assessment of the overall performance of the fines management system. This acts as a crucial feedback loop to validate the effectiveness of the preventative measures and detect any unforeseen cumulative impacts.
What is the overall heavy metal load of the fines?	Total Heavy Metals in Fines	Low Risk: Total metal concentrations are below the ANZECC (2000) Interim Sediment Quality Guideline (ISQG) - Low values. Moderate Risk: Some metal concentrations are between the ISQG-Low and ISQG-High values. This triggers further investigation into the bioavailability of these metals. High Risk: One or more metal concentrations exceed the ISQG-High values. Fines are likely unsuitable for return.	To quantify the total contaminant load being returned to the dredge pond. This is essential for understanding the long-term potential for sediment contamination and future liabilities.

6.4.3.2 Fines Interment Protocol (Interment After Validation of Fines Suitability)

Where practicable, discharge of fines to the dredge pond is to occur at a nominated point in the dredge pond (ideally a point where terminal depth has been achieved to avoid re-disturbing and re-circulating settled fines).

The following protocol should be implemented to manage the Discharge Point:

Subsurface Discharge – the discharge pipe should be at a depth of at least 4m below the water surface and ideally positioned at least 5m above the pond floor (if practicable) to avoid potential for flow to re-disturb settled fines.

Energy Dissipation – Due to the high flow rates being returned to the pond, suspended particulates will be prone to circulation in the water column. To minimise settling times, a diffuser should be attached to the outlet pipe to reduce discharge velocity to the extent practicable.

Avoidance Zones – The fines deposition area should be clearly demarcated as an exclusion zone for the dredge head to be avoided to the extent practical up until the point at which dredging will require further passes to reach terminal depth (after which point the area should again be excluded). This can be implemented visually with reference to the proposed silt curtain, and through use of GPS and dredge management software.

Silt Curtains - To prevent dispersion of suspended fines through the dredge pond, a silt or turbidity curtain should be deployed and anchored around the discharge area. Silt curtains should be positioned such that they do not interfere with dredging operations and can be inspected in line with manufacturer's and/or installation guidance.

Target Placement Depth - The primary requirement is that the uppermost surface of all deposited fines must remain a minimum of 4.0 m below the established low water level of the pond. The low water level will be established using data from project-specific pond level monitoring, supplemented with groundwater data. Based on initial data presented in Kleinfelder (2024), the lowest recorded water level is 0.2 m AHD (from BH15 on 15 July 2024). This sets the required maximum fines placement elevation at -3.8 m AHD. An indicative cross-section of this placement method is shown in Figure 4.

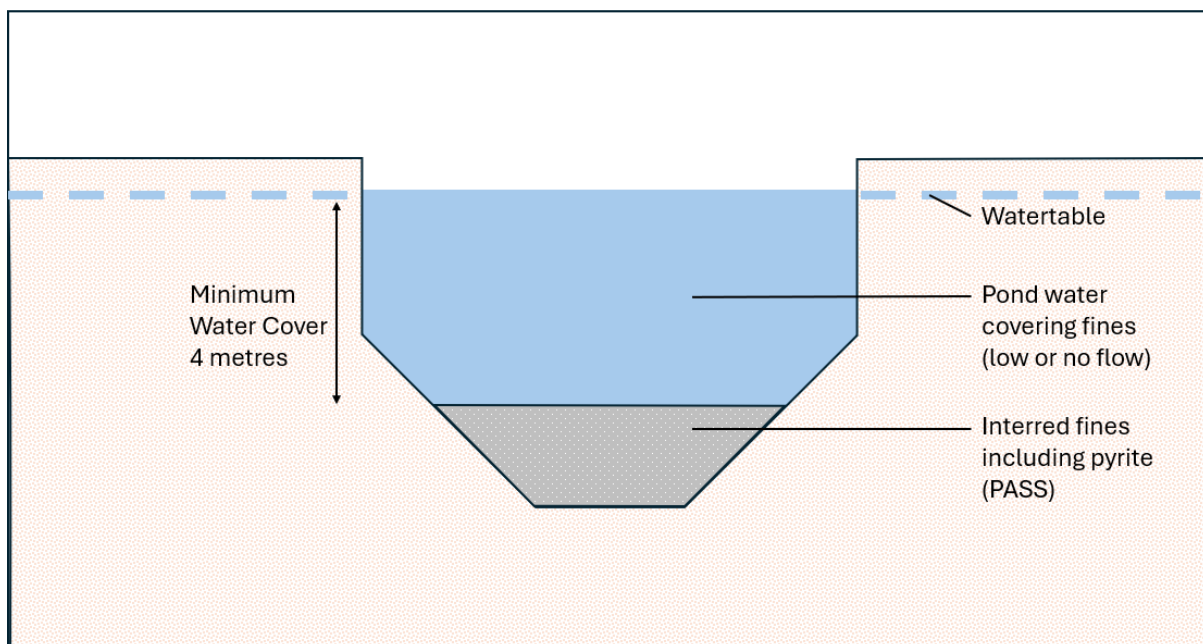


Figure 4: Indicative Underwater Reburial Design (Based on Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines V5.1)

Ongoing Monitoring and Verification - The pond's water level must be monitored continuously; and a hydrographic survey undertaken at least annually to confirm the location and level (elevation) of accumulated fines. This data will be reviewed periodically to verify that the placement of fines remains compliant with the target depth. Should monitoring indicate that the groundwater wells do not accurately represent the pond's hydraulic level, a suitably qualified expert must be retained to review the situation and redefine the target depth.

Corrective Actions for Non-Compliance - If fines are placed above the target depth, the response will depend on the extent of the non-compliance.

For minor deviations, mitigation will focus on adjusting discharge points to ensure future placement is correct. Re-handling of existing material is likely not required.

For significant deviation, corrective actions may be necessary. This may include capping the material (e.g. with geofabric) or re-dredging the fines for placement at the appropriate depth. The final method will be determined based on the specific circumstances.

6.5 Long-Term Riparian Stabilisation and Restoration

A site Rehabilitation Strategy has been authored for the proposal; Minesoils Pty Ltd (2025) Salt Ash Sand Quarry Rehabilitation Strategy. Rehabilitation measures specific to long-term water quality include landform stability, achieved by establishing a 20-degree batter for the site perimeter, which will be revegetated to facilitate drainage and control erosion. The pond's terrestrial embankments will be planted with native shrubs and grasses for stability, while aquatic species such as the common Spike Rush (*Eleocharis acuta*) will be cultivated in the aquatic zone to absorb wave energy and prevent bank erosion.

6.6 Contingency Options

The environmental controls set out in this section are expected to be sufficient to protect groundwater quality and meet the environmental objectives of the project. Notwithstanding, a range of contingency management options have been considered, presented within an options report prepared by ENV (ENV (2025) 250154_Salt Ash GW Options_20250515).

The objective of this report was to review options for managing a worst-case scenario of deteriorating water quality in the dredge pond. The options report demonstrates that the contingency options are technically feasible if they were required to be implemented for the project, however, a detailed review would need to be undertaken at the time of any issues to further understand the most suitable options based on water chemistry and where the project is through its lifecycle. The contingency measures include:

Broadscale Lime Dosing of the Dredge Pond – Can be implemented to treat low pH and as a preventative measure to the mobilisation of metals or further acidity-induced reactions. The proposed controls include a lime dosing system that can readily be directed to raise the pond pH in the event of acidic conditions.

Reactive Fill Barriers - This passive, in-situ approach involves constructing a barrier with reactive materials to treat groundwater as it flows through the barrier. Two primary installation concepts are explored for example purposes (noting that further testing and design considerations would be required before selecting a remedial option):

- **In-Pond Reactive Layer:** Placing a layer of reactive material on the downgradient underwater batter of the dredge pond. This has the advantage of intercepting water before it leaves the pond but presents significant challenges related to underwater installation, stability, and quality control.
- **In-Soil Permeable Reactive Barriers (PRBs):** Installing a treatment wall directly into the soil downgradient of the pond using methods like trenching, deep soil mixing (DSM), or jet grouting. The report analyses various reactive media for these barriers, including alkaline materials to neutralize acidity, organic carbon and Zero-Valent Iron (ZVI) to remove dissolved oxygen, and other media including zeolites and biochar for metal adsorption. If a PRB was to be implemented, the design and reactive media must be developed and/or selected based on the water chemistry which is identified as the cause of the issue (i.e. testing would be required to determine appropriate material and suitability).

Hydraulic Containment (Pump and Treat - P&T) - A conventional remediation strategy, P&T involves extracting contaminated groundwater through a network of wells to create a hydraulic barrier, followed by above-ground treatment. While a proven and reliable technology for plume containment, the options report notes its significant disadvantages, including high long-term operational costs and the fact that it does not treat the source of the contamination. Furthermore, prolonged drawdown could worsen the problem by exposing additional soils to air. If a pump and treat remedial methodology was to be employed, a detailed design would be required to achieve capture of lateral groundwater flow while minimising potential for drawdown.

6.7 Justification of Environmental Controls

The primary environmental risk identified at the Salt Ash quarry is the potential oxidation of ASS. The proposed dredging operation could expose pyritic material to oxygen, leading to the generation of sulfuric acid and the mobilization of dissolved iron and other trace elements.

To address this, a hierarchy of management measures has been proposed to target three key risk areas:

- 1) **Sand Extraction and Processing:** Managing sulfidic fines to prevent oxidation during the washing process.
- 2) **In-Pond Water Quality:** Treating the dredge pond water if low pH or other contaminants are detected.
- 3) **Downgradient Aquifer Protection:** Intercepting and treating any residual contaminants that may migrate from the pond into the surrounding groundwater (if required).

6.7.1 Compliance with Best-Practice ASS Guidelines

The proposed controls adhere to the principles outlined in national and state guidelines, including the ASSMAC and the Queensland Acid Sulfate Soil Technical Manual, which is referenced as a key guideline. The key ASS management principles and how the proposed environmental control measures adhere to these principles, is outlined below:

- **Minimising Oxidation:** A core principle of ASS management is to prevent the oxidation of pyrite by limiting its exposure to oxygen. The proposed dredging process achieves this by ensuring the exposure time of fines in the wash plant is extremely short, typically only minutes. The fines are then promptly returned to a submerged, anoxic environment in the dredge pond, which prevents drying and significantly limits the potential for oxidation. This practice is supported by the National Dredging Guidelines (2018), which note the slow reaction kinetics of pyrite make significant oxidation unlikely during short entrainment times.
- **Neutralisation:** Should any acidification occur, the report details options for neutralisation, a key tenet of ASS management. This includes the potential for in-line dosing of the fines slurry with alkaline reagents (such as hydrated lime) or direct dosing of the pond to manage pH.
- **Strategic Disposal:** Best practice dictates that pyritic material should be disposed of in a sub-aquatic environment to prevent oxidation. The proposed plan to return fines directly to the dredge pond aligns with this principle. This method is highlighted in the report as a key remediation measure that was recommended for the historic RZM site, where it was estimated that returning tailings to the pond bottom would "eliminate 90% of pyrite oxidation".

7 WATER QUALITY MONITORING

7.1 Overview

Water quality monitoring will be required over the life of the project to ensure that future extraction activities do not lead to adverse effects on groundwater, and that the WQOs established for the project are met (refer to Section 4.1 and Section 5).

Water quality monitoring will be used for two purposes: 1) as a means of protecting groundwater by identifying early changes in water quality ('performance monitoring') and 2) ensuring that the quality of water leaving the site in a down-hydraulic gradient direction meets the project water quality criteria.

A range of management measures will be implemented during dredging and sand processing to reduce acid generation and minimise acid inputs to groundwater at the site. Performance monitoring will provide an opportunity to identify changes in groundwater quality, evaluate existing acid mitigation measures and make changes to these measures where required.

The water quality monitoring plan focuses on groundwater, because previous investigations have established a direct hydraulic connection between surface water and groundwater beneath the site. For the purposes of this plan, surface water created during dredging of the extraction pond is considered to be exposed groundwater. Any changes in groundwater quality occurring during dredging of the pond are also likely to occur, in time, in groundwater immediately adjacent to the down-hydraulic gradient side of the pond. Since surface water infiltrates into the uppermost aquifer (D1 unit), acid generation occurring from ground level activities associated with sand processing and fines management (where the implemented management measures are not successful in mitigating such generation), may also lead to changes in the uppermost aquifer.

Notwithstanding, monitoring of the process pond and settlement pond(s) will also occur during the proposed operations, to provide 'real time' information on changes in water quality within the process streams.

7.2 Data Gap Analysis

A review was undertaken of the existing monitoring well network to identify whether it is appropriate for the required monitoring program; and has the capacity to identify changes in groundwater quality within a suitable timeframe to make changes to process activities and/or acid mitigation measures.

Existing wells are located generally, around the perimeter of the final dredge pond (Stage 7), as well as at selected locations within the footprint of the final pond. The extents of each of the 7 development stages are illustrated on Figure 4, Appendix A. During the earlier dredging stages (Stages 1 and 2), some existing monitoring wells will be destroyed (BH7S and BH7D). The closest remaining monitoring wells to the down-gradient dredging boundary will be BH106 and BH111, located approximately 10 m and 100 m, respectively, from the Stage 1 and 2 dredging boundaries in this direction. Advice from the groundwater numerical modellers for this project (Element Environment Pty Ltd) is that particle tracking indicates that the likely groundwater velocity across the site is approximately 23 m/year.

This seepage velocity means that groundwater associated with the final extent of Stages 1 and 2 will reach BH106 in less than one year; and take up to 5 years to migrate to BH111. This time period is unlikely to provide sufficient resolution for identifying and resolving changes in groundwater quality identified by the well. During earlier development of these stages, groundwater will take even longer to reach the wells, as they will be further from the dredging face in a down-hydraulic gradient direction. On this basis, additional well(s) will be required to the north and north-west of Stages 1 and 2 to provide sufficient coverage in these areas.

With respect to middle stages of development (Stages 3 and 4), additional monitoring wells will be destroyed by the dredging operations (BH101 and BH106), with the nearest remaining wells BH129I and BH129D; BH121 and BH111 located approximately 115 m, 12 m and 115 m, respectively, from the down-gradient dredging boundaries.

With respect to later stages of development (Stages 5, 6 and 7), existing wells BH111, BH121 and BH122 will be destroyed, with the closest remaining wells being BH129I and BH129D; BH6S and BH6D; BH125S/I/D; BH126S/I/D; BH1S and BH1D, located between approximately 12 m and 90 m from the final dredging extent of these stages.

From the above observations, the following additional wells will be required to provide adequate early information regarding changes in groundwater quality from the dredging operations. In some locations, wells will be required at multiple depth intervals (shallow (S), intermediate (I) and deep (D)), consistent with the nomenclature used for previous investigations.

Stages 1 and 2:

- BH130 (S/I)
- BH131 (S/I/D)
- BH132 (S/I/D)
- BH133 (S/I/D)
- BH134 (S/I/D)
- BH135 (S/I/D)

Stages 3, 4 and 5:

- BH136 (S/I)
- BH137 (S/I)
- BH138 (S/I).

Stages 6 and 7:

- No additional wells required.

The location of the additional wells is presented on Figure 5, Appendix A.

The wells may be installed progressively, as the stages are developed. Further details regarding the monitoring network and sampling required for each of the development stages is provided in Section 7.4.1

As the project progresses through the various stages, some of the additional wells will be destroyed, or require decommissioning prior to continuing the dredging operations.

7.3 Data Quality Objectives (DQOs)

A data quality objectives (DQO) process consistent with the National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended 2013 – the ‘NEPM’) and other applicable Guidelines has been adopted to formulate the sampling and analysis quality plan (SAQP). Although the DQO process presented in the NEPM has been developed for site contamination assessment, it can be used to develop any sampling or monitoring program because it provides an iterative planning approach that is used to define the type, quantity and quality of data needed to support decisions relating to the environmental condition of a site.

7.3.1 Objective

The primary objective of water quality monitoring during the project is to identify changes to groundwater quality in a timely manner such that changes, if required, can be made to the project activities; specifically, management measures that have been implemented to mitigate acid generation.

7.3.2 Identify the Decisions

The principal decision questions for the water quality monitoring program are as follows:

- Are the extractive or processing activities leading to water quality changes at the site?
- If so, are these changes leading to material water quality changes in off-site groundwater or surface water, or are they likely to lead to future changes in off-site groundwater or surface water quality?
- If so, do any on-site activities require changes to reduce acid generation and improve water quality beneath the site and in adjacent, down-hydraulic gradient areas?

7.3.3 Information Inputs for Decision Making

inputs needed to support the investigation decision (Section 6.2) include the following:

- Periodic groundwater quality monitoring of on-site wells.
- Regular monitoring of water inside the dredge pond.
- Regular monitoring of water inside the settlement pond.
- Quality assurance (QA) data which allows evaluation of the precision, accuracy and representativeness of the water quality data set.
- Collated water quality data, with a comparison to the project water quality criteria.
- Details of all extractive and processing activities occurring during the project, with specific information on management measures used to prevent or reduce acid generation.

7.3.4 Study Boundaries

The study boundaries for water quality monitoring include both spatial and temporal boundaries.

Laterally, the spatial boundaries incorporate the portion of the entire property, described as Lot 4, DP774726, with a total area of approximately 47 ha.

Vertically, the spatial boundaries are dictated by the physical dimensions of the hydro-stratigraphic units and depth of extractive processes. The project involves dredging to a maximum depth of approximately 30 m, while the deepest hydro-stratigraphic unit (D3) extends to a depth of at least 33 m (deepest wells installed – BH1D and BH3D (Geosyntec, 2025)). Water quality monitoring will occur in wells which are screened across all four units (D1, D2, D1/D2 and D3), meaning that the quality of groundwater beneath the site will be monitored to a depth of 33 m.

With respect to temporal boundaries, the project has an expected lifespan of up to 30 years. Water quality monitoring will be required for the life of the project.

7.3.5 Decision Rules

Field-measured and laboratory analysed concentrations of the chemicals and physical parameters of interest for the project will be compared with the project water quality criteria. These criteria are derived and summarised in Section 5.

The following decision rules will be applied (in the order listed below) to evaluate the data and address the principal decision questions:

1. Is the data quality acceptable for comparison of the dataset(s) with the project water quality criteria?
2. Are any concentrations of the chemicals or physical parameters of interest greater than the project water quality criteria?
3. Is there any outlying data that may be explained by human error or issues with data quality?
4. What is the 95% UCL of arithmetic mean concentration for detectable chemicals and physical parameters of interest in the same system being monitored; and is the 95% UCL concentration below the relevant project water quality criteria?
5. Where were the chemical and/or physical parameter concentrations greater than the project water quality criteria reported; and can the concentration(s) be delineated by a concentration further down-hydraulic gradient which meets the project water quality criteria (groundwater wells only)?
6. Does the criteria exceedence represent a potentially changed condition in the water system(s) being monitored, or is the value within historical data ranges?
7. If not, does the exceedence require changes to extractive or processing activities, to improve water quality at this, or any other locations?
8. Are changes to this Plan required as a result of the exceedence? For example, is an increased frequency of monitoring required at the exceedence location or any others; and/or is analysis for different chemicals or physical parameters required at the exceedence location or any others?

7.3.6 Decision Errors and Performance/Acceptance Criteria

Decision errors are generally categorised as either Type I or Type II errors, broadly defined as:

- Type I: Rejection of a true null hypothesis, which leads to a 'false positive' finding.
- Type II: Failure to reject a false null hypothesis, which leads to a 'false negative' finding.

The potential decision errors for the proposed water quality monitoring program are considered to include both Type I and Type II errors, as follows:

Type I:

- Assessment that water at the site DOES require management or changes to extractive/processing activities, when NO management or changes are required; and/or
- Assessment that water quality changes ARE a result of the project activities, when in fact the changes ARE NOT derived from these activities (NOTE: this is unlikely, given the volume of baseline data collected from the site); or

Type II:

- Assessment that water quality changes DO NOT require management or changes to extractive/processing activities, when management or changes ARE required; and/or
- Assessment that water quality changes ARE NOT a result of the project activities, when in fact the water quality changes ARE caused by project activities.

Type I and Type II errors typically stem from two sources – sampling error, which is influenced by population variability, sample collection design and the number of samples taken; and measurement error, influenced primarily by measurement problems in the sample collection and (laboratory) analytical processes. To limit the potential for decision errors to occur, the following techniques will be employed:

- Designing the sampling program to capture inherent variability in the environmental media being sampled.
- Designing the sampling program to collect data which provides an appropriate basis for making the decisions. In other words, the samples will be as representative as possible of the environmental media which is the subject of the monitoring. This will be achieved by adopting recommended sampling approaches and densities from appropriate sampling guidelines, as a minimum, where applicable. It will also be achieved by collecting and storing the samples in an appropriate manner, to ensure sample integrity.
- Selecting project water quality criteria which are representative of, and sufficiently conservative for, identified potential receptors associated with beneficial uses of groundwater down-hydraulic gradient from the site.
- Using laboratories which are accredited by the National Association of Testing Authorities (NATA) for the proposed analytical program.
- Using field equipment which has been appropriately calibrated and is otherwise reliable for water quality monitoring purposes.

The principal objective of this step of the DQO process is to specify limits associated with the probabilities of each of these two types of error occurring. The proposed limits for the water quality monitoring program are discussed in Section 7.5.

7.3.7 Optimisation

The sampling and analysis quality plan (SAQP) is presented in Section 7.4. It has been designed to collect water quality data from the site that is representative of conditions within the hydro-stratigraphic units and dredge and settlement ponds, which can be used for decision-making purposes.

The SAQP and project water quality objectives are based on data collected from the site over the previous 5 years, which are considered suitable to establish a baseline of water quality at the site, prior to the project commencing.

The SAQP design, as well as the broader Plan, incorporates guidance and requirements presented in NEPC (2013) and NSW EPA (2022). To optimise the design, the sampling and analysis program was devised to collect information required to answer the principal decision questions of the Plan.

During implementation of the SAQP, the design of the program may need to change to take account of site conditions, as they are encountered. Changes to the methodology and/or design are discussed in this Plan where applicable.

As further data becomes available during the monitoring program, the sampling design may need to be revised to include additional sampling locations or analytes. There may also be an opportunity to reduce the scale of the monitoring, depending on the program results. Any changes to the program would be discussed and agreed with regulatory authorities prior to implementation.

7.4 Sampling and Analysis Quality Plan

7.4.1 Installation of Additional Monitoring Wells

As discussed in Section 7.2, additional monitoring wells are required to provide information sufficiently close to extraction areas to monitor groundwater quality and implement changes to extractive and/or processing activities in a timely manner, if they are required. The additional well locations are illustrated in Figure 5, Appendix A.

It is likely that the wells will be installed in stages, as extractive works progress and extraction areas increase in size. Alternatively, all wells may be installed prior to commencing extraction.

The wells will be installed in accordance with the National Uniform Drillers Licensing Committee (NUDLC) *Minimum Construction Requirements for Water Bores in Australia* (4th Edition, dated 2020), using a methodology which is appropriate for the hydro-stratigraphic unit being penetrated.

7.4.2 Groundwater Monitoring

Monitoring of the groundwater well network will include field-measured parameters and collection of samples for laboratory analysis. Purging and sampling of the wells will occur in accordance with relevant National and NSW-based guidance for water quality sampling.

At each location, a calibrated water level meter will first be used to measure depth to standing water level (SWL) and total well depth, relative to the top of the well casing.

Low purge methods such as use of a peristaltic pump, or micropurge methods, will then be used to evacuate 'stale' water from inside the well and draw water which is representative of the surrounding aquifer into the well. During purging, the SWL will be monitored for drawdown and a calibrated multi-parameter water quality meter will be used to measure the following indicators of water quality:

- pH
- Dissolved oxygen (DO)
- Temperature
- Electrical conductivity (EC)
- Oxidation reduction potential (ORP).

Once measurements of these indicators have stabilised such that water representative of the aquifer is available in the well for sampling, a sample of the water will be collected into appropriate containers provided by a NATA accredited laboratory and preserved on ice in an insulated container. The samples will be shipped to the NATA accredited laboratory with chain of custody (COC) documentation for the required analysis.

The locations (groundwater wells) and frequency for each groundwater monitoring event required under this Plan are summarised in Table 11.

7.4.3 Surface Water Monitoring

7.4.3.1 Dredging Pond (dredging)

While dredging is occurring within the dredging pond, stratified water quality monitoring will initially be conducted at three locations within the dredging pond. These are:

- Near the dredging location – 3 x depth intervals (surface, intermediate and deep – near the dredging depth). Sampling would occur from the dredging barge, using a Van Dorn sampler or similar apparatus.
- Two additional locations, situated up-hydraulic gradient (south to south-east) and down-hydraulic gradient (north to north-west) from the dredging location – 3 x depth intervals per location (surface, intermediate and deep – near the pond floor). Sampling would occur by boat or other watercraft suitable for this purpose, also using a Van Dorn or similar sampling apparatus.

As the project progresses and the dredge pond increases in size, additional monitoring locations will need to be added to the monitoring program to effectively monitor water quality within the dredge pond. As a minimum, surface water monitoring should always occur near the dredging location, and both up- and down-hydraulic gradient from it. Additional locations would be placed to provide coverage across the pond area.

Nominal dredge pond monitoring locations (early project, Stages 1 and 2) are illustrated on Figure 6, Appendix A. The locations and frequency for each monitoring event required under this Plan are summarised in Table 11.

A visual inspection of the pond will also be undertaken weekly during the dredging operations, to identify indicators of algal blooms within the pond. Performance monitoring criteria, including common indicators of algal blooms, are included in Table 11.

7.4.3.2 Outflow of Wash Plant

The outflow of the wash plant (discharge to settlement pond) requires monitoring to ensure that the corrected pH (lime dosing during processing) is effective in neutralising the process water and minimising the solubilisation (through acidity) of metals in the process water.

Samples will be collected by hand from this location.

7.4.3.3 Settlement Pond

Water quality monitoring will be conducted at the discharge point of the settlement pond, such that any changes in water chemistry and quality occurring during the transit of water through the pond can be evaluated. Outflow water quality from the wash plant would be used as a proxy for inflow water quality into the settlement pond.

Sampling will occur by hand, from an intermediate depth within the water column behind the spillway of the pond. If discharge is via pipe from the pond, a sample would be collected directly from the pipe (via a fitted tap or valve).

Sediment level monitoring will also be required within the pond, to ensure a minimum water column cover above the sediment. Standing water level (depth of water column) would be measured at a minimum of 5 x locations within the pond.

The frequency and details of water quality and sediment level monitoring required in the settlement pond is summarised in Table 11.

7.4.3.4 Dredging Pond (fines interment)

Once fines are returned to the dredging pond, water quality monitoring will be conducted to evaluate whether deposition is leading to adverse water quality changes within the pond. Monitoring will occur near the upper surface of the fines at the site of deposition, and in a down-hydraulic gradient direction (north to north-west) from it, near the dredging face in this direction. Monitoring at the deposition location will aim to minimise disturbance of the fines. At each of these locations, sampling will occur via a boat or similar watercraft, using a Van Dorn sampler or equivalent apparatus; with samples collected at three discrete depth intervals.

Where the site of deposition is close enough to the dredging location, monitoring locations associated with the dredging activity may also be used to evaluate changes associated with fines interment.

Sampling at these locations would occur by boat or other watercraft suitable for this purpose.

Details of the monitoring are summarised in Table 11.

7.4.3.5 Stockpiling Pad (leachate)

Leachate deriving from the stockpiling pad will require monitoring to ensure it is suitable for discharge to the dredge pond. Monitoring will be conducted at the leachate collection point (sump), with a sample collected directly by hand.

The frequency and details of water quality monitoring required at the sump is summarised in Table 11.

7.4.4 Quality Assurance and Quality Control (QA/QC)

All field sampling and monitoring will be conducted in accordance with relevant Australian and NSW guidance documents, including those endorsed by NSW EPA.

Field QA/QC samples will be collected during the monitoring program to evaluate the precision, accuracy and representativeness of the data sets produced from the monitoring. These field QA/QC sample requirements are presented in Table 10. Requirements for internal laboratory QA/QC are also presented in Table 10.

Table 10: Quality Assurance/Quality Control (QA/QC) Sampling and Laboratory Analysis Requirements

QA Sample Type	Media	Frequency	Acceptable Range of Results
Field Samples			
Intra-laboratory duplicate	Water	1 per 20 primary samples or 1 per sampling round	Acceptable RPDs for each Limit of Reporting (LOR) multiplier range are: 81 (1 - 10 x LOR); 50 (10 - 30 x LOR); 30 (> 30 x LOR).
Inter-laboratory duplicate	Water	1 per 20 primary samples or 1 per sampling round	Acceptable RPDs for each Limit of Reporting (LOR) multiplier range are: 81 (1 - 10 x LOR); 50 (10 - 30 x LOR); 30 (> 30 x LOR).
Equipment rinsate	Water	1 per piece of reusable equipment, per sampling round	Results <LOR.
Trip blank and trip spike	Water	1 each per sampling round	Trip blank: Results <LOR. Trip spike: BTEX results within a laboratory-specified range (typically 70-130% recovery).
Laboratory Samples			
Internal duplicate	Water	1 per 10 primary samples	Laboratory-specified
Matrix spike	Water	1 per sampling batch (20 samples)	Laboratory-specified
Surrogate spike	Water	1 per sampling batch (20 samples)	Laboratory-specified
Control sample	Water	1 per sampling batch (20 samples)	Laboratory-specified
Laboratory blank	Water	1 per sampling batch (20 samples)	Results <LOR

Table 11: Water Quality Monitoring Program Summary

Water Quality Monitoring Type	Location(s)	Frequency of Monitoring	Sampling Methodology	Field-Measured Parameters	Laboratory-Measured Parameters
Groundwater – Stages 1 and 2					
	Shallow wells: BH3S, BH7S (until destroyed), BH106, BH111, BH121, BH130S, BH131S, BH132S, BH133S, BH134S, BH135S Intermediate wells: BH130I, BH131I, BH132I, BH133I, BH134I, BH135I Deep wells: BH2D, BH3D, BH7D (until destroyed), BH132D, BH133D, BH134D, BH135D	Quarterly	Peristaltic pump or micropurge	pH, temperature, dissolved oxygen (DO), oxidation/reduction potential (ORP), electrical conductivity (EC), turbidity	Major anions and cations ¹ / Physical parameters ² / metals ³

¹Major anion and cations: sodium, calcium, magnesium, potassium, sulfate, chloride, fluoride, nitrate and nitrite, ammonia total; Kjeldahl nitrogen (TKN).

²Physical parameters and inorganics: Total dissolved solids (TDS), total alkalinity and acidity.

³Metals: aluminium, arsenic, boron, cadmium, chromium (total), copper, iron, lead, manganese, mercury, nickel and zinc.

Water Quality Monitoring Type	Location(s)	Frequency of Monitoring	Sampling Methodology	Field-Measured Parameters	Laboratory-Measured Parameters
Groundwater – Stages 3, 4 and 5					
	Shallow wells: BH3S, BH6S, BH101 (until destroyed), BH106 (until destroyed), BH111, BH121, BH122, BH130S, BH131S, BH132S, BH133S (until destroyed), BH134S (until destroyed), BH135S, BH136S (until destroyed), BH137S (until destroyed), BH138S Intermediate wells: BH129I, BH130I, BH131I, BH132I, BH133I (until destroyed), BH134I (until destroyed), BH135I, BH136I (until destroyed), BH137I (until destroyed), BH138I Deep wells: BH2D, BH3D, BH6D, BH129D, BH132D, BH133D (until destroyed), BH134D (until destroyed), BH135D	Quarterly	Peristaltic pump or micropurge	pH, temperature, DO, ORP, EC, turbidity	Major anions and cations ¹ / Physical parameters ² / metals ³

¹Major anion and cations: sodium, calcium, magnesium, potassium, sulfate, chloride, fluoride, nitrate and nitrite, ammonia total; Kjeldahl nitrogen (TKN).

²Physical parameters and inorganics: Total dissolved solids (TDS), total alkalinity and acidity.

³Metals: aluminium, arsenic, boron, cadmium, chromium (total), copper, iron, lead, manganese, mercury, nickel and zinc.

Water Quality Monitoring Type	Location(s)	Frequency of Monitoring	Sampling Methodology	Field-Measured Parameters	Laboratory-Measured Parameters
Groundwater – Stages 6 and 7					
	Shallow wells: BH1S, BH3S, BH6S, BH111 (until destroyed), BH121 (until destroyed), BH122, BH125S, BH126S, BH130S (until destroyed), BH131S (until destroyed), BH132S (until destroyed), BH135S (until destroyed), BH138S (until destroyed), Intermediate wells: BH125I, BH126I, BH129I, BH130I (until destroyed), BH131I (until destroyed), BH132I (until destroyed), BH135I (until destroyed), BH138I (until destroyed) Deep wells: BH01D, BH2D, BH3D, BH6D, BH125D, BH126D, BH129D, BH132D (until destroyed), BH135D (until destroyed)	Quarterly	Peristaltic pump or micropurge	pH, temperature, DO, ORP, EC, turbidity	Major anions and cations ¹ / Physical parameters ² / metals ³

¹Major anion and cations: sodium, calcium, magnesium, potassium, sulfate, chloride, fluoride, nitrate and nitrite, ammonia total; Kjeldahl nitrogen (TKN).

²Physical parameters and inorganics: Total dissolved solids (TDS), total alkalinity and acidity.

³Metals: aluminium, arsenic, boron, cadmium, chromium (total), copper, iron, lead, manganese, mercury, nickel and zinc.

Water Quality Monitoring Type	Location(s)	Frequency of Monitoring	Sampling Methodology	Field-Measured Parameters	Laboratory-Measured Parameters
Surface Water – Dredging Pond (dredging)					
	Dredge (1 x) – surface, intermediate and deep Up-gradient of dredge (1 x) – surface, intermediate and deep Down-gradient of dredge (1 x) – surface, intermediate and deep	- <u>Weekly</u> (All field parameters) - <u>Monthly</u> (All field parameters and laboratory analysis)	Van Dorn sampler or similar, from a barge (dredge location) and boat or similar (up- and down-gradient locations)	pH, temperature, DO, ORP, EC, turbidity	Major anions and cations ¹ / Physical parameters ² / metals ³
	Entire dredge pond	Weekly	Visual inspection of pond surface for indicators of algal blooms. Common indicators include discoloured water, an unnatural odour, a coloured scum on the surface (commonly blue or green) and floating 'mats'.	-	If algal blooms are visually identified: - Total cyanophyta - Hepatoxins (including microcystins and nodularins) and Neurotoxins (including Aconotoxin-a and saxitoxins) ⁴

¹Major anion and cations: sodium, calcium, magnesium, potassium, sulfate, chloride, fluoride, nitrate and nitrite, ammonia total; Kjeldahl nitrogen (TKN).

²Physical parameters and inorganics: Total dissolved solids (TDS), total alkalinity and acidity.

³Metals: aluminium, arsenic, boron, cadmium, chromium (total), copper, iron, lead, manganese, mercury, nickel and zinc.

⁴Field kits are commercially available which are able to identify the presence of blue green algae and some of their toxins. These may be used initially as a surrogate for laboratory analysis to determine whether blue green algae are present.

Water Quality Monitoring Type	Location(s)	Frequency of Monitoring	Sampling Methodology	Field-Measured Parameters	Laboratory-Measured Parameters
Surface Water – Wash Plant Outflow					
	Wash plant outflow (1 x)	- <u>Daily</u> (All field parameters) - <u>Monthly</u> (All field parameters and laboratory analysis)	Hand sampling	pH, temperature, DO, ORP, EC, turbidity	Major anions and cations ¹ / Physical parameters ² / metals ³
Surface Water – Settlement Pond Discharge					
Water Quality	Settlement pond discharge (1 x)	- <u>Daily</u> (All field parameters) - <u>Monthly</u> (All field parameters and laboratory analysis)	Hand sampling	pH, temperature, DO, ORP, EC, turbidity	Major anions and cations ¹ / Physical parameters ² / metals ³
Sediment Level	Entire settlement pond	Monthly	Measure water depth at a minimum of 5 x locations within pond using calibrated depth meter	Water depth above sediment (SWL)	-

¹Major anion and cations: sodium, calcium, magnesium, potassium, sulfate, chloride, fluoride, nitrate and nitrite, ammonia total; Kjeldahl nitrogen (TKN).

²Physical parameters and inorganics: Total dissolved solids (TDS), total alkalinity and acidity.

³Metals: aluminium, arsenic, boron, cadmium, chromium (total), copper, iron, lead, manganese, mercury, nickel and zinc.

Water Quality Monitoring Type	Location(s)	Frequency of Monitoring	Sampling Methodology	Field-Measured Parameters	Laboratory-Measured Parameters
Surface Water – Dredge Pond (fines interment)					
	Interment location (1 x) – surface, intermediate and deep (near interment face) Up-gradient of dredge (1 x) – surface, intermediate and deep (near interment face) Down-gradient of dredge (1 x) – surface, intermediate and deep (near interment face)	- <u>Weekly</u> (All field parameters) - <u>Monthly</u> (All field parameters and laboratory analysis)	Van Dorn sampler or similar, from a boat or similar watercraft	pH, temperature, DO, ORP, EC, turbidity	Major anions and cations ¹ / Physical parameters ² / metals ³
Surface Water – Stockpiling Pad (leachate)					
	Leachate collection point (sump) (1 x)	- <u>Daily</u> (All field parameters) - Weekly (All field parameters and laboratory analysis)	Hand sampling	pH, temperature, DO, ORP, EC, turbidity	Major anions and cations ¹ / Physical parameters ² / metals ³

¹Major anion and cations: sodium, calcium, magnesium, potassium, sulfate, chloride, fluoride, nitrate and nitrite, ammonia total; Kjeldahl nitrogen (TKN).

²Physical parameters and inorganics: Total dissolved solids (TDS), total alkalinity and acidity.

³Metals: aluminium, arsenic, boron, cadmium, chromium (total), copper, iron, lead, manganese, mercury, nickel and zinc.

7.5 Interpretation of Monitoring Results

7.5.1 Timing of Data Review

Daily monitoring data will be reviewed by the close of each day that daily monitoring occurs, with a consolidated review of weekly data (7 days of daily data) at the end of each week to identify changes that meet the trigger levels established for performance management (Table 13).

Similarly, weekly monitoring data will be reviewed by the end of each week, with monthly review of weekly data collated across a given month to compare individual concentrations and trends with the trigger levels.

Monthly data will be reviewed by the end of each month, with a review at 4 monthly intervals to compare individual concentrations and trends with the trigger levels.

An annual review of consolidated quarterly groundwater well monitoring data will be sufficient to identify trends and whether trigger levels presented in Table 13 have been met.

7.5.2 Data Quality Indicators (DQIs)

Data quality indicators (DQIs) will be used to evaluate the integrity of the field-measured data and laboratory analytical results. An example of DQIs that may be adopted for the project is included in Table 12.

Table 12: Example of Data Quality Indicators (DQIs)

Indicator	Compliance	Details
Details of Sampling Team	Yes	Field sampling was undertaken by an appropriately qualified Environmental Scientist.
SAQP Adhered To	Yes	All planned samples were collected and hence a complete dataset obtained.
Decontamination of Equipment	Yes	All reusable equipment was cleaned between sampling locations using a detergent and potable water, with a final rinse in deionised water.
Sample Collection	Yes	- Laboratory supplied jars used (no headspace). - Collected samples placed in cooler box with ice. - Each sample labelled with a unique sample ID. - Samples collected in accordance with the methodology detailed in the SAQP.
Chain of Custody	Yes	Chain of custody (COC) was completed with full and demonstrable delivery of samples. A copy of the COC is appended to the report.
Holding Times	Yes	Samples analysed within the laboratory specified holding times.
Sufficient Duplicates Analysed	Yes	Field duplicates (inter- and intra-laboratory) collected in accordance with NEPC (2013), with a ratio exceeding 2 duplicates per 20 primary samples.
Field Duplicate Results – Relative Percentage Difference (RPD)	Yes	- RPD calculated between the primary sample and each of the corresponding duplicates. The calculated RPDs are tabulated and appended to the report. - All calculated RPDs were below the acceptable threshold of ≤ 50%; or individual thresholds depending on concentration magnitude relative to the limit of reporting (LOR).
Indicator	Compliance	Details
Analyses NATA accredited	Yes	All samples were analysed by a NATA accredited laboratory for the analyses required. The laboratory certificates are appended to the report.
Internal Laboratory QA/QC	Yes	Satisfactory internal quality control data reported, including method blanks, matrix spikes, internal duplicates, laboratory recovery samples and surrogate spikes.

7.5.3 Performance Monitoring Results

Water quality monitoring results obtained from groundwater wells situated within the site area, close to extraction boundaries; and from surface water sources will be used to monitor performance of the dredging and processing activities, such that improvements may be made to these activities, if required, when the monitoring results show a decline in water quality. This monitoring includes all locations except for groundwater wells located near the site boundaries; and surface water monitoring conducted inside the dredge pond, where the excavation face is close to the site boundary. The performance monitoring is summarised as follows:

- Groundwater wells situated close to dredge pond extents, away from site boundaries, and in areas up-hydraulic gradient from the dredge pond extents.
- Surface water monitoring inside the dredge pond (during dredging and fines interment), except where a pond wall is close to a site boundary.
- Wash plant outflow.
- Settlement pond discharge to dredge pond.

The results of the performance monitoring will not be compared directly to the project water quality criteria presented in Table 6. Rather, a set of trigger levels will be implemented to provide a basis for decision-making relating to these results and implementing changes to the project activities. Both short-term and long-term trigger levels are presented in

Table 13 for individual types of performance monitoring.

The intention of the short-term trigger levels is to provide an opportunity to evaluate daily and weekly results in the context of rapid changes in water quality, such as in the event of a process failure. The long-term trigger levels are provided to assess trends in water quality occurring over weeks and months, as a result of process activities or management measures that may not be effective in mitigating acid generation.

Table 13: Trigger Levels for Performance Monitoring

Monitoring Type	Trigger Level – SHORT TERM	Trigger Level – LONG TERM
Groundwater Monitoring (internal, close to dredge pond faces)	N/A (monitoring occurs quarterly)	<u>Quarterly monitoring:</u> pH: reduction > 1.0 pH unit, across 4 x consecutive monitoring rounds (i.e. annual trend). <u>Total acidity:</u> 4 x consecutive increases (annual trend). <u>Aluminium and iron (dissolved):</u> 4 x consecutive increases (annual trend). <u>All metals (total):</u> 4 x consecutive increases (annual trend).

Monitoring Type	Trigger Level – SHORT TERM	Trigger Level – LONG TERM
Surface Water – dredge pond (during <u>dredging</u>)	<u>Weekly monitoring:</u> pH: reduction of > 1.0 pH unit from previous measurement. DO: 4 x consecutive increases (i.e. in month). Turbidity: 4 x consecutive increases (i.e. in month). Total acidity: 4 x consecutive increases (in month). Aluminium and iron (dissolved): 4 x consecutive increases (in month). All metals (total): 4 x consecutive increases (in month). Cyanobacteria: Visual identification of algal bloom indicators	<u>Monthly monitoring:</u> pH: reduction > 1.0 pH unit, across 4 x consecutive monitoring rounds. Turbidity: 4 x consecutive increases. Total acidity: 4 x consecutive increases. Aluminium and iron (dissolved): 4 x consecutive increases. All metals (total): 4 x consecutive increases. Cyanobacteria: N/A
Surface Water – dredge pond (during <u>interment of fines</u>)	<u>Weekly monitoring:</u> pH: reduction of > 1.0 pH unit from previous measurement. DO: 4 x consecutive increases (i.e. in month). Turbidity: 4 x consecutive increases (i.e. in month). Total acidity: 4 x consecutive increases (in month). Aluminium and iron (dissolved): 4 x consecutive increases (in month). All metals (total): 4 x consecutive increases (in month).	<u>Monthly monitoring:</u> pH: reduction > 1.0 pH unit, across 4 x consecutive monitoring rounds. Turbidity: 4 x consecutive increases. Total acidity: 4 x consecutive increases. Aluminium and iron (dissolved): 4 x consecutive increases. All metals (total): 4 x consecutive increases.
Wash Plant outflow	<u>Daily monitoring:</u> pH: reduction of > 1.0 pH unit from previous measurement. Total acidity: 4 x consecutive increases. Aluminium and iron (dissolved): 4 x consecutive increases.	<u>Weekly monitoring:</u> pH – reduction > 1.0 pH unit, across 4 x consecutive measurements (i.e. in month). Total acidity – 4 x consecutive increases (in month).

	All metals (total): 4 x consecutive increases.	Aluminium and iron (dissolved) – 4 x consecutive increases (in month). All metals (total) – 4 x consecutive increases (in month).
Monitoring Type	Trigger Level – SHORT TERM	Trigger Level – LONG TERM
Settlement Pond discharge	Daily monitoring: pH: reduction of > 1.0 pH unit from previous measurement. Total acidity: 4 x consecutive increases. Aluminium and iron (dissolved): 4 x consecutive increases. All metals (total): 4 x consecutive increases.	Weekly monitoring: pH – reduction > 1.0 pH unit, across 4 x consecutive measurements (i.e. in month). Total acidity – 4 x consecutive increases (in month). Aluminium and iron (dissolved) – 4 x consecutive increases (in month). All metals (total) – 4 x consecutive increases (in month).

Where the trigger levels are exceeded, project activities which may influence water quality represented by the trigger level exceedence(s) will be reviewed and changes implemented where appropriate. Actions which may be taken in these circumstances are described in the following section ('Trigger Action Response Plans') and Appendix E.

7.5.4 Project Water Quality Criteria

The water quality criteria derived for the project will be used to evaluate water quality discharging from the site (i.e. crossing the down-hydraulic gradient site boundary). Concentrations of the chemical and physical parameters adopted for monitoring purposes reported from the following monitoring types will be compared directly with the project water quality criteria:

- Groundwater wells situated close to the down-hydraulic gradient site boundaries.
- Surface water monitoring inside the dredge pond (during dredging and fines interment), where a pond wall is close to the site boundary.

All exceedences of the project water quality criteria will be investigated as soon as practicable. Review will include consideration of the following factors:

- Location of exceedence(s).
- History of exceedences at the same location and historical range of measured concentrations.
- Magnitude of the exceedence, relative to the project water quality criterion.
- Whether there is delineation of the exceedence in a down-hydraulic gradient direction (in the case of groundwater monitoring).

- Identification of possible causes of the exceedence.

The review will conclude with proposed changes to one or more of the extraction activities, process activities or management measures currently in place to mitigate acid generation. It is possible that some exceedences will not be considered significant, and that no plausible changes to extraction or processing available to prevent recurrence of the exceedence will be identified or proposed.

In the case of BH6 (and potentially other wells which may be installed down-hydraulic gradient of the extraction and process areas prior to dredging – refer to Section 7.2), concentrations of some analytes to be monitored already exceed the project water quality criteria. At these locations, the review process described above for reported exceedences will extend to identifying whether or not the exceedence can be directly associated with a project activity (dredging or processing). Where it cannot, it will be assumed that the exceedence continues to reflect ambient conditions within the hydro-stratigraphic unit(s) being monitored. In the event that the exceedence can be attributed to a project activity, the review process will continue and identify potential mitigation measures to prevent recurrence of the exceedence.

The Annual Return lodged with NSW EPA at the end of each reporting period (year) will identify all project water quality criteria exceedences; potential causes of the exceedence(s); any changes made during the reporting year to prevent recurrence; and any additional changes proposed in the future.

7.6 Changes to Monitoring Frequency and Locations

It is possible that changes to the frequency of one or more types of monitoring described in Table 11 will be recommended following review of the results (refer to Section 7.5). Changes in frequency may include either an increase or decrease in monitoring frequency, and also changes in monitoring locations.

Increases in monitoring may be recommended where a data review confirms that exceedences of the performance monitoring trigger levels and/or project water quality criteria have occurred, or continue to occur; or where changes have been made to acid mitigation measures or dredge or processing activities.

Conversely, decreases in monitoring frequency may be recommended after a particular activity has occurred or a management measure has been in place for a time period which allows confirmation that the activity or management measure has continued to be effective in mitigating acid generation and preserving water quality at the site (allowing the WQOs to be met).

Where a reduction in monitoring frequency is recommended, or changes to the monitoring network are proposed, appropriate justification will be provided in writing to NSW EPA, if it is likely to require a variation to the site's EPL.

7.7 Reporting Requirements

Table 14 presents a summary of proposed reporting requirements for the groundwater monitoring activities. Ultimately, it is expected that the site's EPL will dictate the type and frequency of reporting associated with groundwater monitoring during the project.

Table 14: Groundwater Monitoring Reporting Requirements

Type of Report	Report Contents	Author	Recipient
Weekly Summary	- Tabulated summary of daily and weekly monitoring data - Laboratory certificates (if relevant) - Identification of project water quality criteria exceedences (if relevant) - Identification of potential changes to dredging or processing activities (if relevant).	Suitably Qualified Environmental Consultant engaged by Holcim	Holcim
Monthly Summary	- Tabulated summary of weekly and monthly monitoring data - Laboratory certificates - Identification of project water quality criteria exceedences (if relevant) - Identification of potential changes to dredging or processing activities (if relevant).	Suitably Qualified Environmental Consultant engaged by Holcim	Holcim
Annual Return (aspects related to water quality monitoring only)	- Statement of compliance - Monitoring and complaints summary - Tabulated monitoring data, including historical results for previous reporting periods, with laboratory certificates. - Graphs showing key indicators of acid generation and other water quality parameters, as required - Summary of all project water quality criteria exceedences and their potential causes (if known) - Description of changes made to extraction or process activities during the reporting year to prevent recurrence of exceedences (if relevant) - Description of any additional changes to extraction or processing activities proposed in the future.	Suitably Qualified Environmental Consultant engaged by Holcim (report authored on behalf of Holcim)	Regulator (NSW EPA)

8 TRIGGER ACTION RESPONSE PLANS

A comprehensive suite of Trigger Action Response Plans (TARPs), have been prepared and presented as Appendix E.

The TARP framework presents an adaptive management strategy. It is an established, best-practice tool designed to provide a clear, hierarchical, and auditable system for managing environmental performance. The core purpose of the TARP is to move beyond passive monitoring and enable decisive, pre-planned intervention in response to observed changes in groundwater conditions. By linking specific monitoring data thresholds—or 'triggers'—to a pre-agreed set of response actions, the TARP ensures that operational and management responses are both timely and commensurate with the potential risk.

Each TARP is structured around a tiered series of trigger levels, derived from baseline data, predictive modelling, and established hydrogeological principles. These tiers escalate from early warning indicators to more significant performance thresholds. This graduated structure ensures that initial responses are investigatory, allowing for verification and analysis, while reserving more substantial mitigation and control measures for confirmed, higher-level exceedances.

TARPS should be reviewed and updated on receipt of Environmental Protection Licence Conditions to ensure that the triggers and thresholds suitably reflect licence conditions for the project.

9 REVIEW OF THIS PLAN

This Plan may be reviewed and amended from time to time, in response to one or more of the following:

- Changes in monitoring locations and/or methods.
- Changes in monitoring frequency.
- Changes to acid mitigation management measures.
- Changes to sand dredging or processing activities.
- Changes to the Trigger Action Response Plans (TARPs).
- Requests from NSW EPA.
- Incidents occurring on site that are directly relevant to the contents of this Plan.

Where changes are proposed to this Plan, NSW EPA will be notified in writing prior to making any changes, and a copy of the revised Plan provided to NSW EPA for its reference and record keeping.

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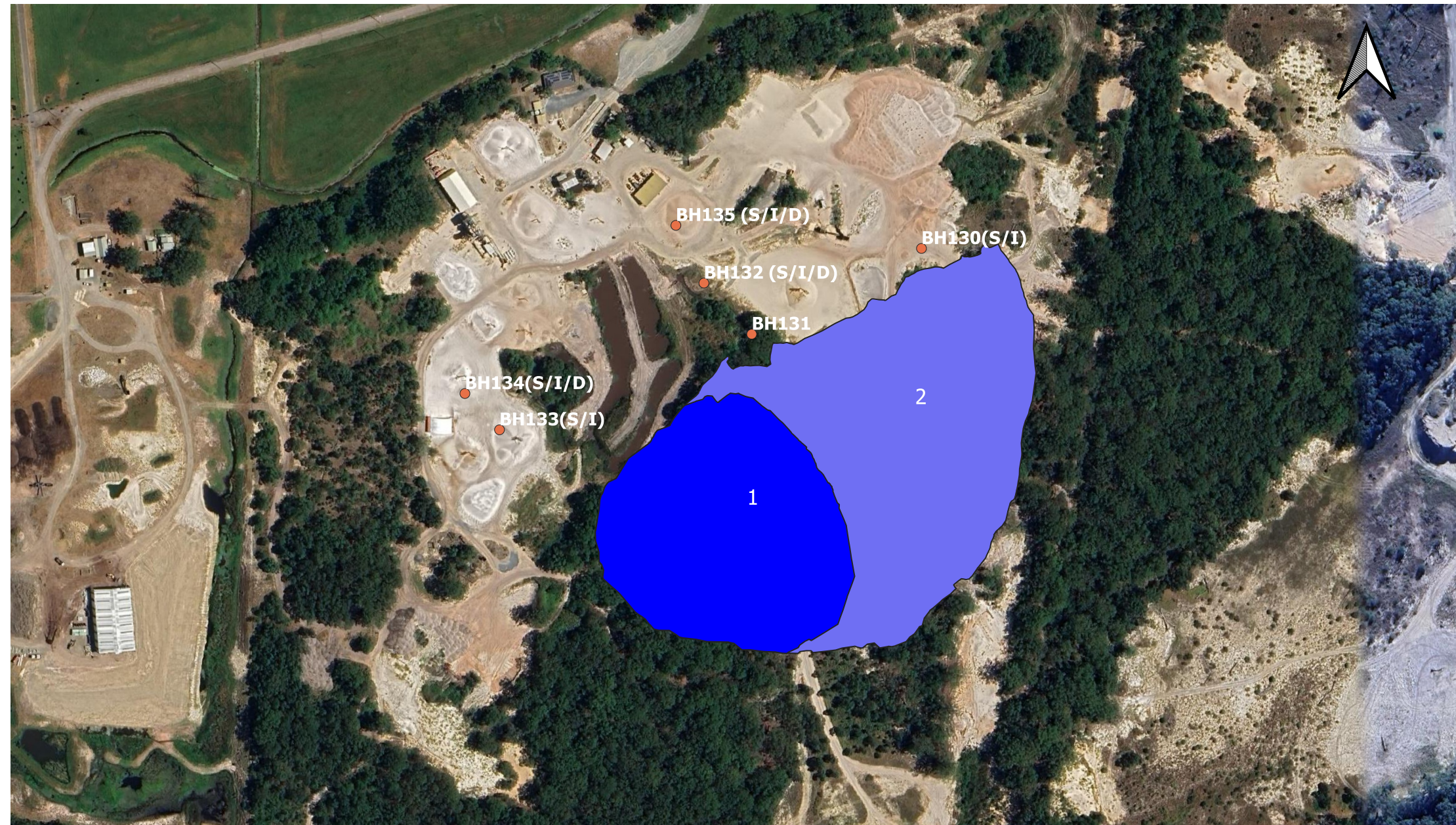
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APPENDIX A

Figures



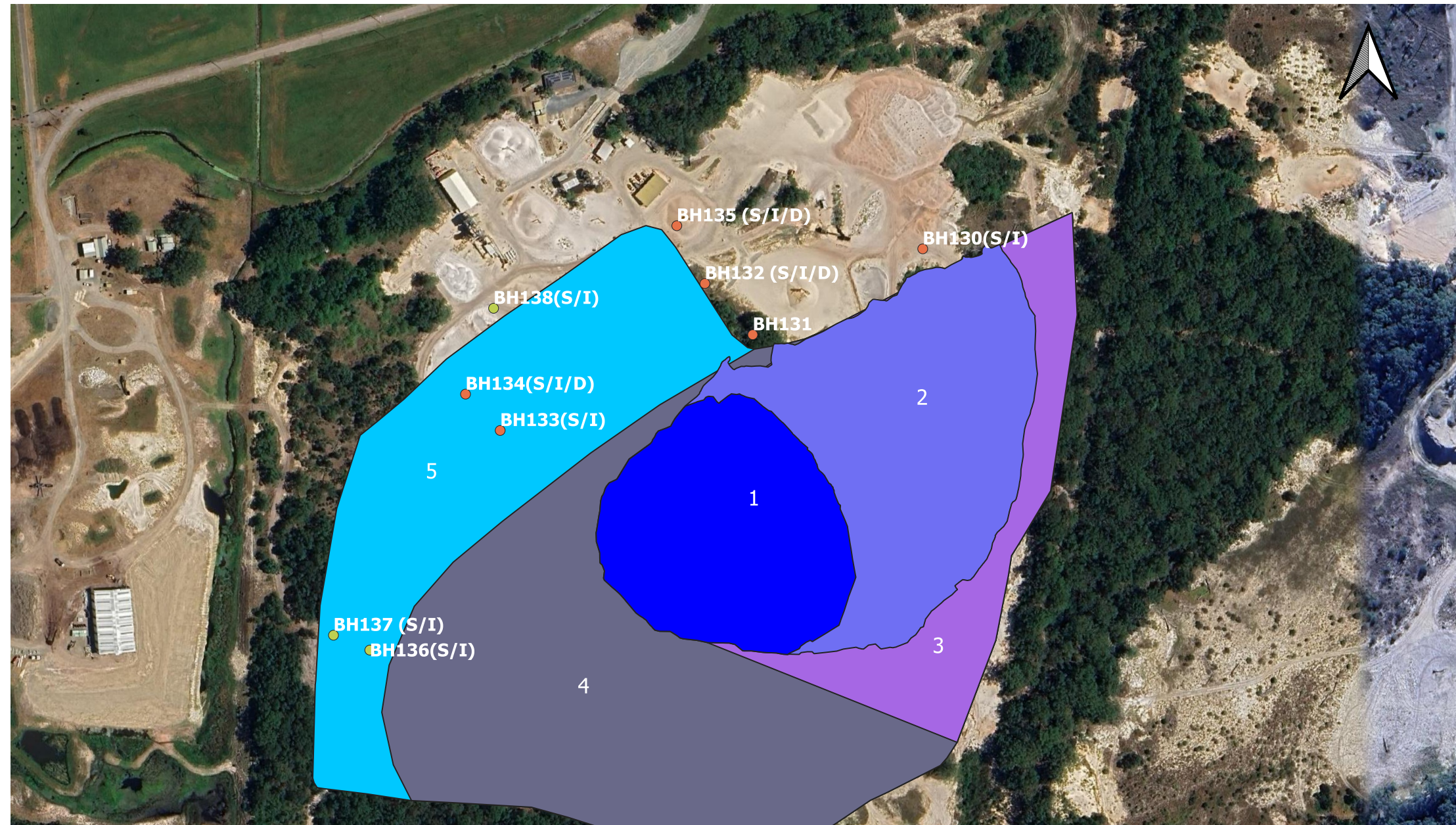
 Stage_1
 Stage_2

Google Satellite

0 100 200 m


ENV 
Solutions

Figure 1 (a): Stages 1 & 2

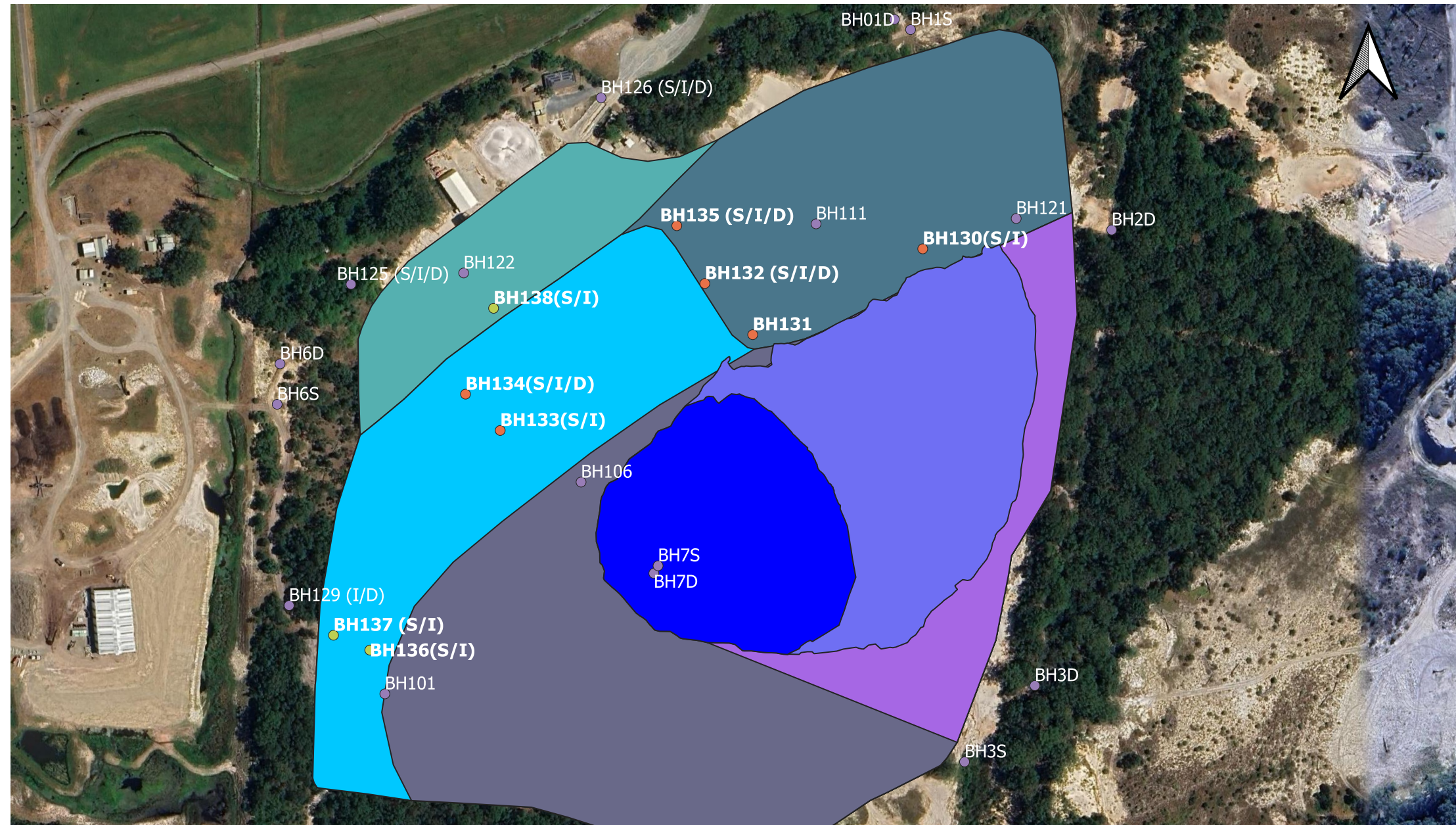


- | | |
|-----------------------|---------|
| Wells - Stage 1 & 2 | Stage_3 |
| Wells - Stage 3 4 & 5 | Stage_4 |
| Stage_1 | Stage_5 |
| Stage_2 | |

0 100 200 m



Figure 1 (b): Stages 1, 2, 3, 4 & 5



- | | |
|-------------------------|-----------|
| ● Wells | ■ Stage_3 |
| ● Wells - Stage 1 & 2 | ■ Stage_4 |
| ● Wells - Stage 3 4 & 5 | ■ Stage_5 |
| ■ Stage_1 | ■ Stage_6 |
| ■ Stage_2 | ■ Stage_7 |

0 100 200 m

ENV
Solutions

Figure 1 (c): Stages 1, 2, 3, 4, 5, 6 & 7

APPENDIX B

Baseline GW Quality Data



ATTACHMENT 3: RESULTS TABLES



Analyte	Units	Anions and Cations												Anions and Cations												Alkalinity					Inorganics		pH
		Sodium	Calcium	Magnesium	Potassium	Sulphate	Chloride	Fluoride	Reactive phosphorus as P	Total Phosphorus	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Ammonia Nitrogen	Total Kjeldahl Nitrogen as N	Nitrogen	Total Cations	Total Anions	Ionic Balance	%	Sodium Adsorption Ratio	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Hydroxide Alkalinity as CaCO3	Total Alkalinity as CaCO3	Total Hardness as CaCO3	Electrical Conductivity @ 25°C	Total Dissolved Solids					
Sample Name	Sample Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	%	-	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µS/cm	mg/L	pH units				
BH1	08-Sep-20	25	11	4.0	2.0	< 1.0	40	< 0.1	< 0.01	0.03	< 0.01	0.27	0.27	0.18	0.3	0.6	2.02	2.05	-	-	46	< 1.0	< 1.0	46	-	237	148	6.59					
	12-Oct-20	29	19	5.0	2.0	< 1.0	43	< 0.1	< 0.01	0.04	< 0.01	< 0.01	< 0.01	0.32	0.7	0.7	2.67	2.49	-	1.53	64	< 1.0	< 1.0	64	68	262	170	6.25					
	10-Nov-20	29	14	4.0	2.0	< 1.0	46	< 0.1	< 0.01	0.04	< 0.01	< 0.01	< 0.01	0.22	0.5	0.5	2.34	2.38	-	1.76	54	< 1.0	< 1.0	54	51	259	168	6.21					
	10-Dec-20	30	8.0	4.0	2.0	< 1.0	44	< 0.1	< 0.01	0.03	< 0.01	0.03	0.03	0.18	0.4	-	2.08	2.06	-	-	41	< 1.0	< 1.0	41	-	251	163	6.42					
	12-Jan-21	32	6.0	3.0	2.0	< 1.0	52	< 0.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.16	0.4	0.4	1.99	2.17	-	2.66	35	< 1.0	< 1.0	35	27	235	153	5.88					
	10-Feb-21	32	6.0	4.0	2.0	< 1.0	48	< 0.1	< 0.01	0.02	< 0.01	< 0.01	< 0.01	0.16	0.4	0.4	2.07	2.03	-	2.48	34	< 1.0	< 1.0	34	31	244	159	6.08					
	10-Mar-21	30	8.0	4.0	2.0	1.0	48	< 0.1	< 0.01	0.04	< 0.01	< 0.01	< 0.01	0.18	0.5	0.5	2.08	1.97	-	2.16	30	< 1.0	< 1.0	30	36	233	-	6.06					
	21-Apr-21	33	4.0	4.0	2.0	< 1.0	56	< 0.1	< 0.01	0.02	< 0.01	0.03	0.03	0.13	0.2	0.2	2.02	2.14	-	2.79	28	< 1.0	< 1.0	28	26	244	-	5.81					
	19-May-21	26	8.0	4.0	2.0	< 1.0	37	< 0.1	< 0.01	0.07	< 0.01	< 0.01	< 0.01	0.16	0.6	0.6	1.91	1.92	-	1.87	44	< 1.0	< 1.0	44	36	198	129	6.07					
	16-Jun-21	30	8.0	5.0	2.0	8.0	50	< 0.1	< 0.01	0.04	< 0.01	0.02	0.02	0.21	0.5	0.5	2.17	2.38	-	2.05	40	< 1.0	< 1.0	40	40	233	151	6.42					
	14-Jul-21	26	15	5.0	2.0	9.0	45	< 0.1	< 0.01	0.03	< 0.01	0.01	0.01	0.23	0.5	0.5	2.34	2.38	-	1.48	46	< 1.0	< 1.0	46	58	229	149	6.65					
	18-Aug-21	22	15	4.0	2.0	3.0	34	< 0.1	< 0.01	0.03	< 0.01	< 0.01	< 0.01	0.17	0.5	0.5	2.08	2.16	-	1.3	57	< 1.0	< 1.0	57	54	209	136	6.31					
	05-May-22	23	18	6.0	2.0	8.0	37	< 0.1	0.02	0.06	< 0.01	0.1	0.1	0.22	0.6	0.7	2.44	2.47	-	1.2	63	< 1.0	< 1.0	63	70	259	168	6.78					
	16-Jun-22	26	11	5.0	2.0	1.0	45	< 0.1	< 0.01	0.04	< 0.01	< 0.01	< 0.01	0.2	0.4	0.4	2.14	2.38	-	1.63	45	< 1.0	< 1.0	45	48	246	160	6.24					
	28-Jul-22	17	15	4.0	2.0	6.0	26	< 0.1	< 0.01	0.09	< 0.01	0.13	0.13	0.11	0.8	0.9	1.87	2.0	-	1.01	57	< 1.0	< 1.0	57	54	216	140	6.55					
	11-Aug-22	33	9.0	5.0	2.0	14	51	< 0.1	< 0.01	0.02	< 0.01	< 0.01	< 0.01	0.15	0.4	0.4	2.35	2.35	-	2.19	31	< 1.0	< 1.0	31	43	259	168	6.54					
	15-Sep-22	28	9.0	5.0	2.0	14	45	< 0.1	< 0.01	0.02	< 0.01	< 0.01	< 0.01	0.13	0.4	0.4	2.13	2.14	-	1.86	29	< 1.0	< 1.0	29	43	249	162	6.73					
	25-Oct-22	30	9.0	5.0	2.0	13	46	< 0.1	< 0.01	0.03	0.02	< 0.01	< 0.01	0.16	0.4	0.4	2.22	2.27	-	1.99	35	< 1.0	< 1.0	35	43	247	160	6.14					
	17-Nov-22	31	12	6.0	2.0	15	41	< 0.1	< 0.01	0.05	< 0.01	< 0.01	< 0.01	0.17	0.4	0.4	2.49	2.33	-	1.82	43	< 1.0	< 1.0	43	55	245	159	6.11					
	15-Dec-22	28	9.0	5.0	2.0	20	42	0.1	0.01	0.03	0.01	2.58	2.59	0.18	0.7	3.3	2.13	2.32	-	1.86	36	< 1.0	< 1.0	36	43	247	160	7.23					
	18-Jan-23	26	14	6.0	2.0	12	41	< 0.1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.21	0.4	0.4	2.37	2.32	-	1.46	46	< 1.0	< 1.0	46	60	246	160	6.22					
	14-Feb-23	23	15	6.0	2.0	12	39	< 0.1	0.01	0.03	< 0.01	< 0.01	< 0.01	0.23	0.4	0.4	2.29	2.45	-	1.27	55	< 1.0	< 1.0	55	62	245	159	6.38					
	13-Mar-23	22	12	5.0	2.0	12	34	< 0.1	0.01	0.02	< 0.01	0.01	0.01	0.26	0.6	0.6	2.02	2.35	-	1.35	57	< 1.0	< 1.0	57	50	255	166	6.33					
	17-Apr-23	26	14	5.0	2.0	13	35	< 0.1	0.01	0.03	< 0.01	< 0.01	< 0.01	0.3	0.6	0.6	2.29	2.44	-	1.52	59	< 1.0	< 1.0	59	56	257	167	6.17					
	15-May-23	28	10	4.0	2.0	12	37	< 0.1	0.01	0.02	< 0.01	< 0.01	< 0.01	0.22	0.4	0.4	2.1	2.25	-	1.89	48	< 1.0	< 1.0	48	41	228	148	6.21					
	15-Jun-23	23	13	4.0	2.0	15	36	< 0.1	< 0.01	0.06	< 0.01	< 0.01	< 0.01	0.22	0.6	0.6	2.03	2.29	-	1.43	48	< 1.0	< 1.0	48	49	243	158	6.24					
	25-Jul-23	22	14	4.0	2.0	17	30	< 0.1	0.01	0.02	< 0.01	< 0.01	< 0.01	0.15	0.6	0.6	2.04	2.14	-	1.33	47	< 1.0	< 1.0	47	51	229	149	5.92					
	16-Aug-23	23	18	5.0	2.0	13	30	< 0.1	0.02	0.04	< 0.01	< 0.01	< 0.01	0.21	0.5	0.5	2.36	2.34	-	1.24	61	< 1.0	< 1.0	61	66	240	166	6.18					
	12-Sep-23	27	12	5.0	2.0	9.0	32	< 0.1	0.02	0.04	< 0.01	< 0.01	< 0.01	0.21	0.5	0.5	2.24	1.99	-	1.65	45	< 1.0	< 1.0	45	50	215	140	6.15					
	24-Oct-23	25	10	4.0	2.0	11	36	< 0.1	< 0.01	0.03	< 0.01	< 0.01	< 0.01	0.21	0.5	0.5	1.97	2.14	-	1.69	45	< 1.0	< 1.0	45	41	230	150	6.02					
	15-Nov-23	25	11	4.0	2.0	10	35	< 0.1	< 0.01	0.07	< 0.01	< 0.01	< 0.01	0.19	0.5	0.5	2.02	2.05	-	1.64	43	< 1.0	< 1.0	43	44	222	144	6.03					
	20-Dec-23	25	15	5.0	2.0	12	36	< 0.1	0.01	0.02	< 0.01	< 0.01	< 0.01	0.22	0.7	0.7	2.3	2.3	-	1.43	52	< 1.0	< 1.0	52	58	250	162	6.6					
	19-Jan-24	27	14	5.0	2.0	13	34	< 0.1	0.01	0.03	< 0.01	< 0.01	< 0.01	0.21	0.6	0.6	2.34	2.35	-	1.58	56	< 1.0	< 1.0	56	56	233	-	6.32					
	14-Feb-24	26	11	4.0	2.0	14	32	< 0.1	< 0.01	0.03	< 0.01	< 0.01	< 0.01	0.21	0.5	0.5	2.06	2.23	-	1.71	52	< 1.0	< 1.0	52	44	120	78	6.5					
	13-Mar-24	22	20	5.0	2.0	16	30	< 0.1	0.01	0.02	< 0.01	0.02	0.02	0.3	0.8	0.8	2.42	2.44	-	1.14	63	< 1.0	< 1.0	63	70	258	168	6.18					
	17-Apr-24	26	19	5.0	2.0	11	30	< 0.1	0.01	0.04	< 0.01	0.3	0.3	0.32	1.1	1.4	2.54	2.43	-	1.37	68	< 1.0	< 1.0	68	68	241	157	6.2					
	20-May-24	25	23	6.0	2.0	14	32	< 0.																									

Sample Name		Sample Date		Anions and Cations																				Alkalinity		Inorganics		pH units																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
				Anions and Cations										Alkalinity		Inorganics																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
				Sodium	Calcium	Magnesium	Potassium	Sulphate	Chloride	Fluoride	Reactive phosphorus as P	Total Phosphorus	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Ammonia Nitrogen	Total Kjeldahl Nitrogen as N	Nitrogen	Total Cations	Total Anions	Ionic Balance	%	Sodium Adsorption Ratio	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Hydroxide Alkalinity as CaCO3	Total Alkalinity as CaCO3		Total Hardness as CaCO3	Electrical Conductivity @ 25°C	Total Dissolved Solids																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	

Analyte	Units	Anions and Cations												Anions and Cations												Alkalinity					Inorganics		pH
		Sodium	Calcium	Magnesium	Potassium	Sulphate	Chloride	Fluoride	Reactive phosphorus as P	Total Phosphorus	Nitrite as N	Nitrate as N	Nitrite + Nitrate as N	Total Ammonia as Nitrogen	Total Kjeldahl Nitrogen as N	Nitrogen	Total Cations	Total Anions	Ionic Balance	%	Sodium Adsorption Ratio	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Hydroxide Alkalinity as CaCO3	Total Alkalinity as CaCO3	Total Hardness as CaCO3	Electrical Conductivity @ 25°C	Total Dissolved Solids					
Sample Name	Sample Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L					
BH7	15-Nov-23	31	69	16	4.0	23	57	0.1	0.08	0.11	0.05	0.13	0.18	3.24	5.0	5.2	6.68	6.88	1.53	0.87	240	< 1.0	< 1.0	240	238	609	396	6.46					
	20-Dec-23	33	74	18	4.0	< 1.0	50	0.1	0.08	0.14	< 0.01	0.07	0.07	4.82	5.8	5.9	6.71	6.56	1.1	0.89	258	< 1.0	< 1.0	258	259	623	405	7.43					
	19-Jan-24	33	66	17	4.0	< 1.0	47	0.1	0.08	0.11	0.01	< 0.01	< 0.01	4.65	5.5	5.5	6.23	6.36	1.04	0.94	252	< 1.0	< 1.0	252	235	584	-	6.42					
	14-Feb-24	32	70	16	4.0	16	50	0.1	0.08	0.09	< 0.01	0.23	0.23	4.36	5.1	5.3	6.3	6.76	3.48	0.9	251	< 1.0	< 1.0	251	241	632	411	6.68					
	13-Mar-24	33	67	16	3.0	< 1.0	48	0.3	0.09	0.13	< 0.01	0.04	0.04	4.5	5.9	5.9	6.17	6.55	2.96	0.94	260	< 1.0	< 1.0	260	233	616	400	7.16					
	17-Apr-24	38	67	15	3.0	< 1.0	50	0.2	0.09	0.11	< 0.01	0.05	0.05	4.27	6.0	6.0	6.31	6.26	0.33	1.09	243	< 1.0	< 1.0	243	229	566	368	6.49					
	20-May-24	22	29	7.0	2.0	21	36	0.4	< 0.01	0.1	0.02	0.42	0.44	4.61	1.3	1.7	3.03	2.68	-	0.95	60	< 1.0	< 1.0	60	101	286	186	6.49					
	18-Jun-24	27	56	16	3.0	< 1.0	34	0.1	0.06	0.12	< 0.01	0.45	0.45	3.0	3.9	4.4	5.36	5.04	3.15	0.82	204	< 1.0	< 1.0	204	206	503	327	6.67					
	15-Jul-24	27	57	14	3.0	< 1.0	41	0.1	0.08	0.18	< 0.01	0.02	0.02	4.09	5.5	5.5	5.25	5.47	2.09	0.83	216	< 1.0	< 1.0	216	200	571	371	7.43					
	20-Aug-24	31	64	16	4.0	< 1.0	42	0.1	0.02	0.6	< 0.01	0.07	0.07	4.82	5.2	5.3	5.96	5.58	3.3	0.9	220	< 1.0	< 1.0	220	226	540	351	6.67					
	23-Sep-24	29	65	16	3.0	18	46	0.1	0.09	0.14	< 0.01	0.04	0.04	4.29	5.1	5.1	5.9	5.77	1.12	0.84	205	< 1.0	< 1.0	205	228	546	355	6.63					
	23-Oct-24	31	61	14	3.0	< 1.0	52	0.2	0.1	0.18	< 0.01	0.04	0.04	4.6	4.8	4.8	5.62	6.16	4.59	0.93	235	< 1.0	< 1.0	235	210	526	342	6.66					
	08-Sep-20	27	5.0	4.0	2.0	10	47	< 0.1	< 0.01	0.04	< 0.01	0.05	0.05	0.05	0.2	0.2	1.8	1.81	-	-	14	< 1.0	< 1.0	14	-	236	167	6.34					
	12-Oct-20	30	5.0	5.0	3.0	11	55	< 0.1	< 0.01	0.05	< 0.01	< 0.01	< 0.01	0.06	0.2	0.2	2.04	2.08	-	2.27	15	< 1.0	< 1.0	15	33	240	156	6.05					
	10-Nov-20	29	4.0	4.0	2.0	12	57	< 0.1	< 0.01	0.05	< 0.01	< 0.01	< 0.01	0.06	0.2	0.2	1.84	2.04	-	2.45	9.0	< 1.0	< 1.0	9.0	26	243	158	5.64					
	10-Dec-20	31	4.0	5.0	2.0	13	55	< 0.1	< 0.01	0.05	< 0.01	0.02	0.02	0.05	0.3	-	2.01	2.08	-	-	13	< 1.0	< 1.0	13	-	252	164	6.08					
	12-Jan-21	32	2.0	4.0	2.0	12	56	< 0.1	< 0.01	0.02	< 0.01	< 0.01	< 0.01	0.06	0.1	0.1	1.87	2.09	-	3.0	13	< 1.0	< 1.0	13	21	246	160	5.9					
	10-Feb-21	31	2.0	5.0	2.0	11	50	< 0.1	0.02	0.02	< 0.01	< 0.01	< 0.01	0.04	< 0.1	< 0.1	1.91	1.92	-	2.67	14	< 1.0	< 1.0	14	26	242	157	6.07					
	10-Mar-21	31	2.0	5.0	2.0	10	51	< 0.1	0.03	0.05	< 0.01	< 0.01	< 0.01	0.07	0.2	0.2	1.91	1.89	-	2.67	12	< 1.0	< 1.0	12	26	232	-	5.91					
	21-Apr-21	32	2.0	5.0	2.0	11	52	< 0.1	< 0.01	0.06	< 0.01	0.03	0.03	0.06	0.2	0.2	1.95	2.02	-	2.75	16	< 1.0	< 1.0	16	26	242	-	5.97					
	19-May-21	31	3.0	5.0	2.0	12	47	< 0.1	< 0.01	0.08	< 0.01	0.17	0.17	0.02	0.2	0.4	1.96	2.0	-	2.54	21	< 1.0	< 1.0	21	28	224	146	6.0					
	16-Jun-21	31	2.0	5.0	2.0	12	57	< 0.1	< 0.01	0.04	< 0.01	0.16	0.16	< 0.01	0.2	0.4	1.91	2.04	-	2.67	9.0	< 1.0	< 1.0	9.0	26	218	142	5.86					
	14-Jul-21	31	2.0	4.0	2.0	10	54	< 0.1	< 0.01	0.06	< 0.01	0.02	0.02	0.08	0.3	0.3	1.83	1.85	-	2.91	6.0	< 1.0	< 1.0	6.0	21	207	134	5.79					
	18-Aug-21	30	2.0	4.0	2.0	9.0	48	< 0.1	< 0.01	0.04	< 0.01	< 0.01	< 0.01	0.08	0.2	0.2	1.78	1.68	-	2.82	7.0	< 1.0	< 1.0	7.0	21	202	131	5.6					
	05-May-22	30	1.0	4.0	2.0	8.0	60	< 0.1	< 0.01	0.01	< 0.01	< 0.01	< 0.01	0.27	0.4	0.4	1.74	2.04	-	3.0	9.0	< 1.0	< 1.0	9.0	19	230	150	5.88					
	16-Jun-22	29	1.0	4.0	2.0	9.0	54	< 0.1	< 0.01	0.05	< 0.01	0.43	0.43	0.07	0.2	0.6	1.69	1.89	-	2.9	9.0	< 1.0	< 1.0	9.0	19	206	134	6.47					
	28-Jul-22	30	< 1.0	4.0	1.0	8.0	47	< 0.1	< 0.01	0.11	< 0.01	< 0.01	< 0.01	0.07	0.3	0.3	1.66	1.69	-	3.1	10	< 1.0	< 1.0	10	16	211	137	5.66					
	11-Aug-22	31	2.0	5.0	2.0	11	59	< 0.1	< 0.01	0.07	< 0.01	< 0.01	< 0.01	0.06	0.3	0.3	1.91	2.05	-	2.67	14	< 1.0	< 1.0	14	26	246	160	6.11					
	15-Sep-22	30	1.0	4.0	2.0	11	49	< 0.1	0.02	0.03	< 0.01	< 0.01	< 0.01	0.06	0.2	0.2	1.74	1.77	-	3.0	8.0	< 1.0	< 1.0	8.0	19	221	144	5.9					
	25-Oct-22	34	2.0	6.0	2.0	17	56	< 0.1	0.02	0.05	0.02	< 0.01	< 0.01	0.15	0.3	0.3	2.12	2.15	-	2.71	11	< 1.0	< 1.0	11	30	257	167	5.32					
	17-Nov-22	30	2.0	5.0	2.0	14	55	< 0.1	0.03	0.09	< 0.01	< 0.01	< 0.01	0.11	5.2	5.2	1.87	2.06	-	2.58	11	< 1.0	< 1.0	11	26	243	158	5.41					
	15-Dec-22	31	1.0	7.0	2.0	18	53	< 0.1	0.02	0.04	< 0.01	< 0.01	< 0.01	0.14	0.4	0.4	2.02	2.01	-	2.41	7.0	< 1.0	< 1.0	7.0	31	260	169	6.27					
	18-Jan-23	31	1.0	7.0	2.0	15	56	< 0.1	0.02	0.02	< 0.01	< 0.01	< 0.01	0.03	0.3	0.3	2.02	2.01	-	2.41	6.0	< 1.0	< 1.0	6.0	31	231	150	5.6					
	14-Feb-23	31	2.0	6.0	2.0	14	60	< 0.1	0.02	0.05	< 0.01	0.02	0.02	0.2	0.5	0.5	1.99	2.18	-	2.47	10	< 1.0	< 1.0	10	30	236	153	5.68					
	13-Mar-23	30	3.0	6.0	2.0	13	57	< 0.1	0.03	0.02	< 0.01	0.02	0.02	0.1	0.3	0.3	2.0	2.02	-	2.3	7.0	< 1.0	< 1.0	7.0	32	244	159	5.52					
	17-Apr-23	32	2.0	6.0	2.0	15	58	< 0.1	0.04	0.05	< 0.01	< 0.01	< 0.01	0.12	0.3	0.3	2.04	2.07	-	2.55	6.0	< 1.0	< 1.0	6.0	30	247	160	5.36					
	15-May-23	31	2.0	5.0	2.0	11	59	< 0.1	< 0.01	0.06	< 0.01	0.09																					

Analyte	Units	Anions and Cations										Anions and Cations										Alkalinity										Electrical Conductivity @ 25°C µS/cm	Total Dissolved Solids mg/L	pH
		Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L	Sulphate mg/L	Chloride mg/L	Fluoride mg/L	Reactive phosphorus as P mg/L	Total Phosphorus mg/L	Nitrite as N mg/L	Nitrate as N mg/L	Nitrite + Nitrate as N mg/L	Total Ammonia as Nitrogen mg/L	Total Kjeldahl Nitrogen as N mg/L	Nitrogen mg/L	Total Cations meq/L	Total Anions meq/L	Ionic Balance %	-	Sodium Adsorption Ratio	Bicarbonate Alkalinity as CaCO3 mg/L	Carbonate Alkalinity as CaCO3 mg/L	Hydroxide Alkalinity as CaCO3 mg/L	Total Alkalinity as CaCO3 mg/L	Total Hardness as CaCO3 mg/L								
Sample Name	Sample Date	26	4.0	3.0	2.0	<1.0	45	<0.1	<0.01	0.04	<0.01	<0.01	<0.01	0.18	1.1	1.1	1.63	1.49	-	2.39	11	<1.0	<1.0	11	22	182	118	5.43						
MW5	13-Mar-23	23	3.0	2.0	1.0	<1.0	36	<0.1	<0.01	0.01	<0.01	<0.01	<0.01	0.2	1.1	1.1	1.34	1.24	-	2.52	11	<1.0	<1.0	11	16	170	110	5.34						
	17-Apr-23	22	2.0	2.0	1.0	<1.0	34	<0.1	<0.01	0.04	<0.01	<0.01	<0.01	0.15	1.0	1.0	1.25	1.18	-	2.63	11	<1.0	<1.0	11	13	164	107	5.36						
	15-May-23	22	3.0	2.0	1.0	<1.0	39	<0.1	<0.01	0.01	<0.01	0.02	0.02	0.14	1.5	1.5	1.3	1.22	-	2.41	6.0	<1.0	<1.0	6.0	16	167	108	5.26						
	15-Jun-23	19	3.0	2.0	1.0	<1.0	34	<0.1	<0.01	0.05	<0.01	<0.01	<0.01	0.34	1.6	1.6	1.17	1.2	-	2.08	12	<1.0	<1.0	12	16	157	102	5.25						
	25-Jul-23	22	3.0	2.0	2.0	<1.0	37	<0.1	<0.01	0.03	<0.01	0.01	0.01	0.23	1.3	1.3	1.32	1.22	-	2.41	9.0	<1.0	<1.0	9.0	16	166	108	5.29						
	16-Aug-23	22	3.0	4.0	2.0	<1.0	50	<0.1	<0.01	0.06	0.01	0.06	0.07	0.28	1.2	1.3	1.49	1.59	-	1.96	9.0	<1.0	<1.0	9.0	24	128	83	5.29						
	12-Sep-23	23	3.0	3.0	2.0	<1.0	55	<0.1	0.01	0.07	<0.01	<0.01	<0.01	0.27	1.8	1.8	1.45	1.63	-	2.25	4.0	<1.0	<1.0	4.0	20	181	118	5.36						
	24-Oct-23	21	2.0	2.0	2.0	<1.0	33	<0.1	<0.01	0.19	<0.01	<0.01	<0.01	0.3	2.3	2.3	1.23	1.11	-	2.51	9.0	<1.0	<1.0	9.0	13	153	99	5.34						
	15-Nov-23	17	3.0	3.0	1.0	<1.0	34	<0.1	<0.01	0.08	<0.01	0.05	0.05	0.14	1.7	1.8	1.16	1.02	-	1.66	3.0	<1.0	<1.0	3.0	20	148	96	5.08						
	20-Dec-23	23	3.0	4.0	2.0	<1.0	35	<0.1	0.01	0.04	<0.01	<0.01	<0.01	0.27	1.8	1.8	1.53	1.17	-	2.04	9.0	<1.0	<1.0	9.0	24	172	112	5.78						
	19-Jan-24	26	3.0	3.0	2.0	<1.0	41	<0.1	<0.01	0.24	<0.01	<0.01	<0.01	0.42	3.4	3.4	1.58	1.36	-	2.54	10	<1.0	<1.0	10	20	175	-	5.16						
	14-Feb-24	26	4.0	4.0	2.0	<1.0	42	<0.1	<0.01	0.09	<0.01	<0.01	<0.01	0.4	2.1	2.1	1.71	1.3	-	2.2	6.0	<1.0	<1.0	6.0	26	197	128	5.3						
	13-Mar-24	25	2.0	2.0	2.0	<1.0	41	0.1	0.01	0.13	<0.01	<0.01	<0.01	0.71	4.4	4.4	1.4	1.26	-	2.99	5.0	<1.0	<1.0	5.0	13	194	126	5.4						
	17-Apr-24	21	3.0	3.0	2.0	9.0	29	<0.1	0.02	0.72	<0.01	1.2	1.2	0.48	4.4	5.6	1.36	1.12	-	2.05	6.0	<1.0	<1.0	6.0	20	145	94	5.16						
	20-May-24	10	3.0	4.0	1.0	<1.0	<1.0	<0.1	<0.01	0.11	<0.01	1.63	1.63	0.12	1.7	3.3	0.94	0.04	-	0.89	2.0	<1.0	<1.0	2.0	24	109	71	4.75						
	18-Jun-24	9.0	2.0	3.0	<1.0	4.0	15	<0.1	<0.01	0.05	<0.01	0.24	0.24	0.05	0.8	1.0	0.74	0.51	-	0.94	<1.0	<1.0	<1.0	<1.0	17	87	56	4.47						
	15-Jul-24	20	2.0	4.0	1.0	14	41	<0.1	<0.01	0.07	<0.01	0.02	0.02	0.21	1.3	1.3	1.32	1.59	-	1.88	7.0	<1.0	<1.0	7.0	21	205	133	5.39						
	20-Aug-24	26	3.0	4.0	1.0	5.0	37	<0.1	<0.01	0.04	<0.01	<0.01	<0.01	0.28	1.4	1.4	1.64	1.29	-	2.31	7.0	<1.0	<1.0	7.0	24	175	114	5.13						
	23-Sep-24	24	3.0	4.0	1.0	<1.0	46	<0.1	0.01	0.04	<0.01	0.08	0.08	0.15	1.2	1.3	1.55	1.32	-	2.13	1.0	<1.0	<1.0	1.0	24	175	114	4.95						
	23-Oct-24	30	3.0	4.0	2.0	<1.0	47	<0.1	<0.01	0.06	<0.01	<0.01	<0.01	0.25	0.9	0.9	1.83	1.4	-	2.67	4.0	<1.0	<1.0	4.0	24	197	128	5.06						
	MW7	05-May-22	21	18	4.0	2.0	<1.0	29	0.5	0.01	0.18	<0.01	0.01	0.01	0.8	1.4	1.4	2.19	2.1	-	1.16	64	<1.0	<1.0	64	61	237	154	6.71					
16-Jun-22		25	30	6.0	2.0	<1.0	40	0.4	0.03	0.18	<0.01	0.01	0.01	1.02	1.5	1.5	3.13	2.85	4.73	1.09	86	<1.0	<1.0	86	100	333	216	5.32						
28-Jul-22		25	27	5.0	2.0	34	37	0.4	<0.01	0.11	<0.01	0.01	0.01	0.6	0.9	0.9	3.11	3.17	0.99	1.16	71	<1.0	<1.0	71	88	341	222	6.49						
11-Aug-22		23	33	6.0	2.0	36	38	0.5	<0.01	0.09	<0.01	<0.01	<0.01	0.62	1.1	1.1	3.19	3.18	0.19	0.97	68	<1.0	<1.0	68	107	338	220	6.58						
15-Sep-22		28	42	9.0	2.0	22	47	0.3	0.03	0.04	<0.01	0.01	0.01	0.78	1.5	1.5	4.1	4.18	0.92	1.02	120	<1.0	<1.0	120	142	430	280	7.18						
25-Oct-22		31	42	10	2.0	34	47	0.3	0.03	0.06	<0.01	<0.01	<0.01	0.82	1.3	1.3	4.32	4.15	1.97	1.12	106	<1.0	<1.0	106	146	448	291	6.35						
17-Nov-22		24	34	9.0	2.0	19	44	0.4	0.03	0.09	<0.01	0.03	0.03	0.84	1.4	1.4	3.45	3.79	4.75	0.96	108	<1.0	<1.0	108	118	439	285	6.39						
15-Dec-22		28	44	10	2.0	31	46	0.4	0.04	0.09	<0.01	<0.01	<0.01	1.03	1.6	1.6	4.29	4.16	1.5	0.99	111	<1.0	<1.0	111	151	435	283	7.59						
18-Jan-23		30	45	11	3.0	17	52	0.4	0.03	0.09	0.01	<0.01	0.01	0.85	0.9	0.9	4.53	4.5	0.38	1.04	134	<1.0	<1.0	134	158	434	282	6.64						
14-Feb-23		29	44	10	4.0	14	52	0.4	0.01	0.12	<0.01	<0.01	<0.01	1.2	2.2	2.2	4.38	4.36	0.3	1.03	130	<1.0	<1.0	130	151	441	287	6.46						
13-Mar-23		26	35	9.0	3.0	-	-	-	-	0.03	-	-	-	0.72	1.38	1.9	2.6	-	-	-	-	-	-	-	-	-	-	-	-					
16-Mar-23		27	40	8.0	3.0	30	52	0.4	0.01	0.17	-	-	-	-	-	-	3.9	4.05	1.81	1.02	98	<1.0	<1.0	98	133	400	260	6.44						
17-Apr-23		33	41	10	4.0	17	54	0.5	0.01	0.08	<0.01	<0.01	<0.01	1.64	2.8	2.8	4.41	4.57	1.87	1.2	135	<1.0	<1.0	135	144	468	304	6.44						
15-May-23		30	36	9.0	4.0	8.0	50	0.5	0.02	0.06	<0.01	<0.01	<0.01	1.43	2.5	2.5	3.94	4.29	4.25	1.16	136	<1.0	<1.0	136	127	445	289	6.61						
15-Jun-23		27	30	9.0	3.0	43	39	0.4	0.01	0.08	<0.01	0.05	0.05	0.81	1.7	1.8	3.49	3.43	0.79	1.11	72	<1.0	<1.0	72	112	362	235	6.25						
25-Jul-23		35	77	19	5.0	27	49	0.4	0.01	0.06	<0.01	0.02	0.02	1.23	2.3	2.3	7.06	7.22	1.14	0.92	278	<1.0	<1.0	278	278	641	417	6.45						
16-Aug-23		31	44	12	4.0	6.0	61	0.5	0.01	0.09	0.01	3.09	3.1	1.42	2.5	5.6	4.63	4.66	0.31	1.07	141	<1.0	<1.0	141	159	428	278	5.69						
12-Sep-23		30	46	13	4.0	2.0	62	<0.1	0.03	0.1	<0.01	<0.01	<0.01	1.54	2.5	2.5	4.77	4.91	1.39	1.0	156	<1.0	<1.0	156	168	426	277	6.62						
24-Oct-23		25	43	11	3.0	12	42	0.4	0.01	0.03	<0.01	<0.01	<0.01	1.41	2.0	2.0	4.22	4.47	2.95	0.88	152	<1.0	<1.0	152	153	446	290	6.24						
15-Nov-23		20	34	8.0	2.0	10	52	0.4	0.01	0.06	<0.01	0.02	0.02	0.79	1.7	1.7	3.7	3.83	1.76	0.8	108	<1.0	<1.0	108	118	370	240	6.36						
20-Dec-23		31	39	10	3.0	29	44	0.4	0.02	0.08	<0.01	0.04	0.04	0.91	1.9	1.9	4.19	4.42	2.65	1.14	129	<1.0	<1.0											

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
BH1	08-Sep-20	0.22	0.022	< 0.05	< 0.0001	0.003	0.017	1.87	< 0.001	0.065	< 0.0001	0.004	0.032
	12-Oct-20	0.18	0.016	< 0.05	< 0.0001	0.003	0.006	1.8	< 0.001	0.108	< 0.0001	0.012	0.013
	10-Nov-20	0.17	0.01	< 0.05	< 0.0001	0.003	0.01	1.44	< 0.001	0.067	< 0.0001	0.004	0.1
	10-Dec-20	0.18	0.007	< 0.05	< 0.0001	0.002	0.01	1.11	< 0.001	0.046	< 0.0001	0.006	0.048
	12-Jan-21	0.24	0.011	< 0.05	< 0.0001	0.003	0.028	1.36	< 0.001	0.047	< 0.0001	0.008	0.036
	10-Feb-21	0.19	0.014	< 0.05	< 0.0001	0.002	0.015	1.15	< 0.001	0.054	< 0.0001	0.015	0.087
	10-Mar-21	0.2	0.021	< 0.05	< 0.0001	0.004	0.005	2.05	< 0.001	0.094	< 0.0001	0.012	0.136
	21-Apr-21	0.23	0.006	< 0.05	< 0.0001	0.002	0.001	0.84	< 0.001	0.029	< 0.0001	0.011	0.144
	19-May-21	0.52	0.014	< 0.05	< 0.0001	0.003	< 0.001	2.56	< 0.001	0.076	< 0.0001	0.031	0.033
	16-Jun-21	0.23	0.01	< 0.05	< 0.0001	0.002	0.002	2.13	< 0.001	0.075	< 0.0001	0.013	0.029
	14-Jul-21	0.2	0.014	< 0.05	< 0.0001	0.002	0.002	2.49	< 0.001	0.11	< 0.0001	0.002	0.023
	18-Aug-21	0.22	0.015	< 0.05	< 0.0001	0.002	0.004	3.87	< 0.001	0.193	< 0.0001	0.004	0.024
	05-May-22	0.15	0.014	< 0.05	< 0.0001	0.001	< 0.001	4.07	< 0.001	0.213	< 0.0001	< 0.001	0.009
	16-Jun-22	0.14	0.009	< 0.05	< 0.0001	0.001	< 0.001	2.58	< 0.001	0.107	< 0.0001	0.006	0.015
	28-Jul-22	0.13	0.007	< 0.05	< 0.0001	0.002	0.004	1.74	< 0.001	0.118	< 0.0001	0.061	0.145
	11-Aug-22	0.16	0.004	< 0.05	< 0.0001	0.001	0.002	1.55	< 0.001	0.078	< 0.0001	0.005	0.007
	15-Sep-22	0.17	0.004	< 0.05	< 0.0001	0.001	0.004	1.78	< 0.001	0.081	< 0.0001	0.003	0.027
	25-Oct-22	0.16	0.004	< 0.05	< 0.0001	0.002	0.003	1.65	< 0.001	0.087	< 0.0001	0.005	0.022
	17-Nov-22	0.18	0.005	< 0.05	< 0.0001	0.001	0.001	2.4	< 0.001	0.11	< 0.0001	0.011	0.012
	15-Dec-22	0.16	0.005	< 0.05	< 0.0001	0.002	< 0.001	1.96	< 0.001	0.082	< 0.0001	0.003	0.037
	18-Jan-23	0.14	0.005	< 0.05	< 0.0001	0.002	< 0.001	3.92	< 0.001	0.174	< 0.0001	0.002	0.027
	14-Feb-23	0.05	0.007	< 0.05	< 0.0001	0.001	0.002	5.12	< 0.001	0.194	< 0.0001	0.006	0.014
	13-Mar-23	0.12	0.007	< 0.05	< 0.0001	0.001	< 0.001	3.84	< 0.001	0.16	< 0.0001	0.006	0.018
	17-Apr-23	0.16	0.008	< 0.05	< 0.0001	0.002	< 0.001	4.38	< 0.001	0.177	< 0.0001	0.008	0.024
	15-May-23	0.19	0.006	< 0.05	< 0.0001	0.002	< 0.001	2.74	< 0.001	0.128	< 0.0001	0.009	0.02
	15-Jun-23	0.17	0.008	< 0.05	< 0.0001	0.002	< 0.001	4.08	< 0.001	0.172	< 0.0001	0.009	< 0.005
	25-Jul-23	0.22	0.007	< 0.05	< 0.0001	0.002	< 0.001	4.44	< 0.001	0.153	< 0.0001	0.009	0.024
	16-Aug-23	0.22	0.008	< 0.05	< 0.0001	0.002	< 0.001	5.22	< 0.001	0.18	< 0.0001	0.011	0.042
	12-Sep-23	0.22	0.005	< 0.05	< 0.0001	0.002	< 0.001	2.65	< 0.001	0.088	< 0.0001	0.011	0.044
	24-Oct-23	0.19	0.005	< 0.05	< 0.0001	0.002	0.002	2.62	< 0.001	0.077	< 0.0001	0.006	0.055
	15-Nov-23	0.19	0.004	< 0.05	< 0.0001	0.002	< 0.001	2.45	< 0.001	0.087	< 0.0001	0.005	0.017
	20-Dec-23	0.18	0.007	< 0.05	< 0.0001	0.002	< 0.001	3.5	< 0.001	0.124	< 0.0001	0.007	0.022
	19-Jan-24	0.2	0.007	< 0.05	< 0.0001	0.002	0.002	3.24	< 0.001	0.121	< 0.0001	0.002	0.04
	14-Feb-24	0.21	0.005	< 0.05	< 0.0001	0.002	< 0.001	2.35	< 0.001	0.087	< 0.0001	0.007	0.024
	13-Mar-24	0.19	0.01	< 0.05	< 0.0001	0.002	< 0.001	3.93	< 0.001	0.154	< 0.0001	0.002	0.035
	17-Apr-24	0.19	0.006	-	< 0.0001	0.003	0.003	2.87	< 0.001	0.116	< 0.0001	0.008	0.082
	20-May-24	0.17	0.01	< 0.05	< 0.0001	0.002	0.001	3.96	< 0.001	0.183	< 0.0001	0.002	0.084
	18-Jun-24	0.16	0.005	< 0.05	< 0.0001	0.002	< 0.001	2.25	< 0.001	0.103	< 0.0001	0.001	0.021
	15-Jul-24	0.21	0.005	< 0.05	< 0.0001	0.002	< 0.001	2.55	< 0.001	0.124	< 0.0001	0.002	0.04
	20-Aug-24	0.25	0.003	< 0.05	< 0.0001	0.002	0.001	1.6	< 0.001	0.074	< 0.0001	0.002	0.042
	23-Sep-24	0.25	0.002	< 0.05	< 0.0001	0.002	0.001	1.01	< 0.001	0.039	< 0.0001	0.008	0.026
	23-Oct-24	0.13	< 0.001	< 0.05	< 0.0001	0.002	0.004	0.2	< 0.001	0.041	< 0.0001	0.003	0.059
	08-Sep-20	0.32	0.031	< 0.05	< 0.0001	0.002	0.003	2.77	< 0.001	0.007	< 0.0001	0.017	0.042
	12-Oct-20	0.27	0.012	< 0.05	< 0.0001	0.002	0.002	1.16	< 0.001	0.01	< 0.0001	0.015	0.033

Table 4
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Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
BH2	10-Nov-20	0.28	0.012	< 0.05	< 0.0001	0.002	0.006	1.37	< 0.001	0.007	< 0.0001	0.003	0.057
	10-Dec-20	0.24	0.007	< 0.05	< 0.0001	0.001	0.006	0.93	< 0.001	0.006	< 0.0001	0.004	0.058
	12-Jan-21	0.27	0.004	< 0.05	< 0.0001	0.002	0.002	0.9	< 0.001	0.003	< 0.0001	0.003	0.017
	10-Feb-21	0.24	0.004	< 0.05	< 0.0001	0.002	0.004	0.66	< 0.001	0.004	< 0.0001	0.011	0.075
	10-Mar-21	0.26	0.002	< 0.05	< 0.0001	0.001	< 0.001	0.79	< 0.001	0.002	< 0.0001	0.005	0.042
	21-Apr-21	0.29	0.004	< 0.05	< 0.0001	0.001	0.001	0.85	< 0.001	0.007	< 0.0001	0.009	0.116
	19-May-21	0.39	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.54	< 0.001	0.005	< 0.0001	0.016	0.035
	16-Jun-21	0.39	< 0.001	< 0.05	< 0.0001	0.002	0.002	0.29	< 0.001	0.006	< 0.0001	0.024	0.057
	14-Jul-21	0.32	< 0.001	< 0.05	< 0.0001	0.002	0.003	0.29	< 0.001	0.005	< 0.0001	0.011	0.032
	18-Aug-21	0.28	0.001	< 0.05	< 0.0001	0.003	0.007	0.39	< 0.001	0.02	< 0.0001	0.011	0.073
	05-May-22	0.31	< 0.001	< 0.05	< 0.0001	0.001	0.004	0.47	< 0.001	0.002	< 0.0001	< 0.001	0.005
	16-Jun-22	0.33	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.47	< 0.001	0.005	< 0.0001	0.005	0.015
	28-Jul-22	0.24	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.47	< 0.001	0.002	< 0.0001	< 0.001	< 0.005
	11-Aug-22	0.29	< 0.001	0.06	< 0.0001	0.001	0.002	0.5	< 0.001	0.003	< 0.0001	0.01	0.012
	15-Sep-22	0.25	< 0.001	< 0.05	< 0.0001	0.001	0.003	0.43	< 0.001	0.003	< 0.0001	0.008	0.028
	25-Oct-22	0.26	< 0.001	< 0.05	< 0.0001	0.001	0.004	0.45	< 0.001	0.009	< 0.0001	0.004	0.025
	17-Nov-22	0.3	< 0.001	< 0.05	< 0.0001	0.002	0.002	0.49	< 0.001	0.004	< 0.0001	0.01	0.016
	15-Dec-22	0.29	< 0.001	< 0.05	< 0.0001	0.001	0.004	0.29	< 0.001	0.005	< 0.0001	0.005	0.071
	18-Jan-23	0.27	< 0.001	< 0.05	< 0.0001	0.001	0.003	0.29	< 0.001	0.003	< 0.0001	0.004	0.07
	14-Feb-23	0.17	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	0.34	< 0.001	0.002	< 0.0001	0.008	0.024
	13-Mar-23	0.26	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.39	< 0.001	0.007	< 0.0001	0.007	0.016
	17-Apr-23	0.3	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.29	< 0.001	< 0.001	< 0.0001	0.01	0.032
	15-May-23	0.32	< 0.001	< 0.05	< 0.0001	0.002	0.002	0.29	< 0.001	0.002	< 0.0001	0.004	0.025
	15-Jun-23	0.27	< 0.001	< 0.05	< 0.0001	0.001	0.009	0.07	< 0.001	0.003	< 0.0001	0.007	0.048
	25-Jul-23	0.37	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.26	< 0.001	0.001	< 0.0001	0.006	0.021
	16-Aug-23	0.4	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.27	< 0.001	0.002	< 0.0001	0.006	0.02
	12-Sep-23	0.38	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.22	< 0.001	< 0.001	< 0.0001	0.008	0.023
	24-Oct-23	0.36	< 0.001	< 0.05	< 0.0001	0.002	0.002	0.19	< 0.001	0.001	< 0.0001	0.006	0.024
	15-Nov-23	0.34	< 0.001	< 0.05	< 0.0001	0.003	< 0.001	0.23	< 0.001	0.005	< 0.0001	0.006	0.014
	20-Dec-23	0.34	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.22	< 0.001	0.002	< 0.0001	0.006	0.031
	19-Jan-24	0.32	< 0.001	< 0.05	< 0.0001	0.001	0.004	< 0.05	< 0.001	< 0.001	< 0.0001	0.001	< 0.005
	14-Feb-24	0.34	< 0.001	< 0.05	< 0.0001	0.001	0.001	0.06	< 0.001	< 0.001	< 0.0001	0.003	0.022
	13-Mar-24	0.31	< 0.001	< 0.05	< 0.0001	0.001	0.002	0.17	< 0.001	0.004	< 0.0001	0.007	0.099
	17-Apr-24	0.34	< 0.001	-	< 0.0001	0.001	0.001	0.2	< 0.001	0.001	< 0.0001	0.001	0.034
	20-May-24	0.26	< 0.001	< 0.05	< 0.0001	0.001	0.01	0.16	< 0.001	0.003	< 0.0001	0.004	0.122
	18-Jun-24	0.23	< 0.001	< 0.05	< 0.0001	0.001	0.005	0.12	< 0.001	0.002	< 0.0001	0.003	0.078
	15-Jul-24	0.21	< 0.001	< 0.05	< 0.0001	0.001	0.016	0.06	< 0.001	0.002	< 0.0001	0.003	0.125
	20-Aug-24	0.19	< 0.001	< 0.05	< 0.0001	0.001	0.019	< 0.05	< 0.001	0.003	< 0.0001	0.004	0.124
	23-Sep-24	0.22	< 0.001	< 0.05	< 0.0001	0.002*	0.007*	0.2	< 0.001	0.003	< 0.0001	0.004	0.072
	23-Oct-24	0.22	< 0.001	< 0.05	< 0.0001	0.001	0.008	0.13	< 0.001	0.007	< 0.0001	0.002	0.022
	08-Sep-20	0.27	0.004	< 0.05	< 0.0001	< 0.001	0.005	0.32	< 0.001	0.004	< 0.0001	0.033	0.049
	12-Oct-20	0.21	0.019	< 0.05	< 0.0001	< 0.001	0.004	0.66	< 0.001	0.004	< 0.0001	0.019	0.045
	10-Nov-20	0.25	0.006	< 0.05	< 0.0001	< 0.001	0.006	0.38	< 0.001	0.005	< 0.0001	0.004	0.065
	10-Dec-20	0.22	0.006	< 0.05	< 0.0001	< 0.001	0.008	0.28	< 0.001	0.004	< 0.0001	0.005	0.059

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
BH3	12-Jan-21	0.36	0.015	< 0.05	< 0.0001	0.001	0.021	0.57	< 0.001	0.004	< 0.0001	0.008	0.041
	10-Feb-21	0.45	0.01	< 0.05	< 0.0001	0.001	0.018	0.45	< 0.001	0.002	< 0.0001	0.008	0.036
	10-Mar-21	0.53	0.013	< 0.05	< 0.0001	0.001	0.031	0.62	< 0.001	0.002	< 0.0001	0.004	0.034
	21-Apr-21	0.47	0.008	< 0.05	< 0.0001	0.001	0.002	0.69	< 0.001	0.003	< 0.0001	0.007	0.093
	19-May-21	0.51	0.007	< 0.05	< 0.0001	0.001	< 0.001	0.72	< 0.001	0.005	< 0.0001	0.013	0.033
	16-Jun-21	0.81	0.025	< 0.05	< 0.0001	0.002	0.002	1.04	< 0.001	0.006	< 0.0001	0.029	0.064
	14-Jul-21	0.72	0.027	< 0.05	< 0.0001	0.002	0.002	0.99	< 0.001	0.006	< 0.0001	0.015	0.038
	18-Aug-21	0.39	0.006	< 0.05	< 0.0001	0.001	0.009	0.44	< 0.001	0.005	< 0.0001	0.01	0.045
	05-May-22	0.37	< 0.001	< 0.05	< 0.0001	0.001	0.001	0.08	< 0.001	0.001	< 0.0001	< 0.001	0.023
	16-Jun-22	0.32	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	0.1	< 0.001	0.003	< 0.0001	0.002	0.016
	28-Jul-22	0.25	< 0.001	< 0.05	< 0.0001	0.001	0.004	< 0.05	< 0.001	0.012	< 0.0001	0.008	0.06
	11-Aug-22	0.33	< 0.001	< 0.05	< 0.0001	0.001	0.002	0.56	< 0.001	0.009	< 0.0001	0.032	0.036
	15-Sep-22	0.17	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	0.13	< 0.001	0.003	< 0.0001	0.017	0.033
	25-Oct-22	0.22	< 0.001	< 0.05	< 0.0001	< 0.001	0.002	0.11	< 0.001	0.002	< 0.0001	0.003	0.019
	17-Nov-22	0.19	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	< 0.05	< 0.001	0.002	< 0.0001	0.012	0.036
	15-Dec-22	0.16	< 0.001	< 0.05	< 0.0001	< 0.001	0.007	< 0.05	< 0.001	0.002	< 0.0001	0.006	0.042
	18-Jan-23	0.14	< 0.001	< 0.05	< 0.0001	< 0.001	0.004	< 0.05	< 0.001	< 0.001	< 0.0001	0.003	0.043
	14-Feb-23	0.02	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	< 0.05	< 0.001	< 0.001	< 0.0001	0.004	0.017
	13-Mar-23	0.11	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.08	< 0.001	< 0.001	< 0.0001	0.005	0.029
	17-Apr-23	0.1	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.0001	0.007	0.04
	15-May-23	0.12	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	0.06	< 0.001	0.001	< 0.0001	0.004	0.039
	15-Jun-23	0.11	< 0.001	< 0.05	< 0.0001	< 0.001	0.001	< 0.05	< 0.001	0.003	< 0.0001	0.004	0.037
	25-Jul-23	0.13	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.36	< 0.001	0.002	< 0.0001	0.008	0.028
	16-Aug-23	0.09	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	0.25	< 0.001	0.003	< 0.0001	0.006	0.03
	12-Sep-23	0.1	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.23	< 0.001	< 0.001	< 0.0001	0.005	0.014
	24-Oct-23	0.07	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	< 0.05	< 0.001	0.003	< 0.0001	0.004	0.035
	15-Nov-23	0.06	< 0.001	< 0.05	< 0.0001	< 0.001	0.004	< 0.05	< 0.001	0.005	< 0.0001	0.005	0.038
	20-Dec-23	0.07	< 0.001	< 0.05	< 0.0001	0.001	0.003	0.06	< 0.001	0.005	< 0.0001	0.005	0.056
	19-Jan-24	0.09	< 0.001	< 0.05	< 0.0001	< 0.001	0.002	0.08	< 0.001	0.003	< 0.0001	0.003	0.032
	14-Feb-24	0.07	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	< 0.05	< 0.001	0.002	< 0.0001	0.003	0.031
	13-Mar-24	0.06	< 0.001	< 0.05	< 0.0001	< 0.001	0.004	< 0.05	< 0.001	0.008	< 0.0001	0.002	0.073
	17-Apr-24	0.05	< 0.001	-	< 0.0001	< 0.001	0.006	< 0.05	< 0.001	0.009	< 0.0001	0.004	0.104
	20-May-24	0.08	< 0.001	< 0.05	< 0.0001	< 0.001	0.002	0.12	< 0.001	0.004	< 0.0001	0.002	0.049
	18-Jun-24	0.08	< 0.001	< 0.05	< 0.0001	< 0.001	0.002	0.06	< 0.001	0.002	< 0.0001	< 0.001	0.023
	15-Jul-24	0.06	< 0.001	< 0.05	< 0.0001	< 0.001	0.008	< 0.05	< 0.001	0.005	< 0.0001	0.001	0.044
	20-Aug-24	0.06	< 0.001	< 0.05	< 0.0001	< 0.001	0.004	< 0.05	< 0.001	0.003	< 0.0001	0.002	0.046
	23-Sep-24	0.08	< 0.001	< 0.05	< 0.0001	< 0.001	0.006	< 0.05	< 0.001	0.006	< 0.0001	0.003	0.059
	23-Oct-24	0.11	< 0.001	< 0.05	< 0.0001	< 0.001	0.01	< 0.05	< 0.001	0.007*	< 0.0001	0.004*	0.11*
	08-Sep-20	0.11	0.028	< 0.05	< 0.0001	< 0.001	0.002	1.19	< 0.001	0.044	< 0.0001	0.004	0.029
	12-Oct-20	0.08	0.088	< 0.05	< 0.0001	< 0.001	< 0.001	1.01	< 0.001	0.007	< 0.0001	0.008	0.009
	10-Nov-20	0.1	0.026	< 0.05	< 0.0001	< 0.001	0.008	1.66	< 0.001	0.012	< 0.0001	< 0.001	0.04
	10-Dec-20	0.13	0.026	< 0.05	< 0.0001	< 0.001	0.004	2.4	< 0.001	0.017	< 0.0001	0.006	0.049
	12-Jan-21	0.16	0.035	< 0.05	< 0.0001	< 0.001	0.016	2.64	< 0.001	0.021	< 0.0001	0.008	0.045
	10-Feb-21	0.19	0.019	< 0.05	< 0.0001	< 0.001	0.002	2.86	< 0.001	0.026	< 0.0001	0.012	0.068

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
BH4	10-Mar-21	0.29	0.017	< 0.05	< 0.0001	0.001	< 0.001	3.4	< 0.001	0.027	< 0.0001	0.019	0.055
	21-Apr-21	0.56	0.03	< 0.05	< 0.0001	0.001	< 0.001	4.35	< 0.001	0.027	< 0.0001	0.017	0.078
	19-May-21	1.08	0.014	< 0.05	0.0001	0.002	0.003	4.06	< 0.001	0.03	< 0.0001	0.054	0.117
	16-Jun-21	1.08	0.02	< 0.05	< 0.0001	0.002	0.002	3.12	< 0.001	0.017	< 0.0001	0.016	0.055
	14-Jul-21	0.9	0.008	< 0.05	< 0.0001	0.002	0.005	2.07	< 0.001	0.011	< 0.0001	0.015	0.041
	18-Aug-21	1.48	0.007	< 0.05	< 0.0001	0.002	0.006	2.3	< 0.001	0.011	< 0.0001	0.011	0.039
	05-May-22	0.2	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.45	< 0.001	0.004	< 0.0001	< 0.001	< 0.005
	16-Jun-22	0.36	0.001	< 0.05	< 0.0001	0.001	0.003	0.46	< 0.001	0.007	< 0.0001	0.01	0.022
	28-Jul-22	0.74	0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.62	< 0.001	0.004	< 0.0001	< 0.001	< 0.005
	11-Aug-22	0.37	0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.54	< 0.001	0.006	< 0.0001	< 0.001	0.008
	15-Sep-22	1.06	0.002	< 0.05	< 0.0001	0.002	0.009	0.84	< 0.001	0.008	< 0.0001	0.017	0.074
	25-Oct-22	0.62	< 0.001	< 0.05	< 0.0001	0.001	0.002	0.57	< 0.001	0.008	< 0.0001	0.011	0.024
	17-Nov-22	0.82	0.001	< 0.05	< 0.0001	< 0.001	0.002	0.68	< 0.001	0.006	< 0.0001	0.009	0.028
	15-Dec-22	0.92	0.001	< 0.05	< 0.0001	0.002	0.001	0.61	< 0.001	0.006	< 0.0001	0.009	0.032
	18-Jan-23	0.53	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.41	< 0.001	0.004	< 0.0001	0.01	0.027
	14-Feb-23	0.4	< 0.001	< 0.05	< 0.0001	0.001	0.002	0.47	< 0.001	0.006	< 0.0001	0.014	0.037
	13-Mar-23	0.48	< 0.001	< 0.05	0.0001	0.001	< 0.001	0.36	< 0.001	0.004	< 0.0001	0.019	0.03
	17-Apr-23	0.35	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.35	< 0.001	0.002	< 0.0001	0.022	0.042
	15-May-23	0.35	< 0.001	< 0.05	< 0.0001	< 0.001	0.001	0.33	< 0.001	0.004	< 0.0001	0.018	0.047
	15-Jun-23	0.31	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	0.22	< 0.001	0.002	< 0.0001	< 0.001	< 0.005
	25-Jul-23	0.23	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.34	< 0.001	0.004	< 0.0001	0.008	0.032
	16-Aug-23	0.31	< 0.001	< 0.05	< 0.0001	0.001	0.001	0.42	< 0.001	0.005	< 0.0001	0.028	0.056
	12-Sep-23	0.35	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.38	< 0.001	0.002	< 0.0001	0.006	0.034
	24-Oct-23	0.34	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.34	< 0.001	0.004	< 0.0001	0.004	0.032
	15-Nov-23	0.34	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.34	< 0.001	0.007	< 0.0001	0.021	0.031
	20-Dec-23	0.38	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.36	< 0.001	0.006	< 0.0001	0.01	0.038
	19-Jan-24	0.3	< 0.001	< 0.05	< 0.0001	0.001	0.006	0.15	< 0.001	0.002	< 0.0001	0.005	0.02
	14-Feb-24	0.35	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.34	< 0.001	0.003	< 0.0001	0.003	0.03
	13-Mar-24	0.33	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.37	< 0.001	0.007	< 0.0001	0.002	0.063
	17-Apr-24	0.17	< 0.001	-	0.0001	0.001	0.003	0.2	< 0.001	0.009	< 0.0001	0.006	0.09
	20-May-24	0.19	< 0.001	< 0.05	< 0.0001	0.001	0.001	0.25	< 0.001	0.004	< 0.0001	0.006	0.067
	18-Jun-24	0.27	< 0.001	< 0.05	< 0.0001	0.001	0.01	0.2	< 0.001	0.004	< 0.0001	0.008	0.065
	15-Jul-24	0.46	< 0.001	< 0.05	< 0.0001	0.001	0.003	0.41	< 0.001	0.004	< 0.0001	0.005	0.033
	20-Aug-24	0.34	< 0.001	< 0.05	< 0.0001	0.001	0.001	0.3	< 0.001	0.003	< 0.0001	0.004	0.061
	23-Sep-24	0.35	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	0.31	< 0.001	0.004	< 0.0001	0.005	0.032
	23-Oct-24	0.36	< 0.001	< 0.05	< 0.0001	0.001	0.001	0.5	< 0.001	0.006	< 0.0001	0.008	0.033
	08-Sep-20	0.08	0.004	< 0.05	< 0.0001	< 0.001	0.003	0.22	< 0.001	0.012	< 0.0001	0.021	0.2
	12-Oct-20	0.09	0.011	< 0.05	< 0.0001	< 0.001	0.002	1.23	< 0.001	0.009	< 0.0001	0.015	0.038
	10-Nov-20	0.2	0.011	< 0.05	< 0.0001	0.002	< 0.001	2.07	< 0.001	0.016	< 0.0001	0.006	0.03
	10-Dec-20	0.12	0.006	< 0.05	< 0.0001	0.001	< 0.001	2.04	< 0.001	0.009	< 0.0001	0.013	0.039
	12-Jan-21	0.13	0.005	< 0.05	< 0.0001	0.001	0.021	1.49	< 0.001	0.006	< 0.0001	0.008	0.026
	10-Feb-21	0.21	0.004	< 0.05	< 0.0001	0.001	0.018	1.15	< 0.001	0.009	< 0.0001	0.018	0.048
	10-Mar-21	0.21	0.007	< 0.05	< 0.0001	0.001	< 0.001	1.43	< 0.001	0.009	< 0.0001	0.018	0.03
	21-Apr-21	0.42	0.003	< 0.05	< 0.0001	0.001	< 0.001	0.92	< 0.001	0.018	< 0.0001	0.014	0.044

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
BH5	19-May-21	0.38	0.002	< 0.05	< 0.0001	0.002	< 0.001	0.74	< 0.001	0.018	< 0.0001	0.014	0.028
	16-Jun-21	0.38	< 0.001	< 0.05	< 0.0001	0.002	0.001	0.85	< 0.001	0.019	< 0.0001	0.01	0.034
	14-Jul-21	0.39	< 0.001	< 0.05	< 0.0001	0.002	0.002	0.88	< 0.001	0.018	< 0.0001	0.008	0.022
	18-Aug-21	0.38	< 0.001	< 0.05	< 0.0001	0.002	0.002	0.64	< 0.001	0.015	< 0.0001	0.013	0.028
	05-May-22	0.28	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.47	< 0.001	0.008	< 0.0001	< 0.001	0.006
	17-Jun-22	0.15	< 0.001	< 0.05	< 0.0001	0.002	0.004	0.2	< 0.001	0.006	< 0.0001	< 0.001	0.035
	28-Jul-22	0.18	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.44	< 0.001	0.005	< 0.0001	< 0.001	< 0.005
	11-Aug-22	0.19	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.53	< 0.001	0.006	< 0.0001	< 0.001	0.007
	15-Sep-22	0.32	< 0.001	< 0.05	< 0.0001	0.002	0.001	0.56	< 0.001	0.012	< 0.0001	0.01	0.031
	25-Oct-22	0.36	< 0.001	< 0.05	0.0002	0.003	0.005	0.64	< 0.001	0.015	< 0.0001	0.01	0.037
	17-Nov-22	0.2	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.63	< 0.001	0.006	< 0.0001	0.008	0.019
	15-Dec-22	0.32	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.6	< 0.001	0.009	< 0.0001	0.006	0.023
	18-Jan-23	0.39	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.67	< 0.001	0.012	< 0.0001	0.005	0.039
	14-Feb-23	0.3	< 0.001	< 0.05	< 0.0001	0.002	0.003	0.58	< 0.001	0.012	< 0.0001	0.01	0.051
	13-Mar-23	0.33	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.49	< 0.001	0.006	< 0.0001	0.008	0.023
	17-Apr-23	0.34	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.57	< 0.001	0.007	< 0.0001	0.009	0.013
	15-May-23	0.29	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.63	< 0.001	0.008	< 0.0001	0.019	0.032
	15-Jun-23	0.18	< 0.001	< 0.05	< 0.0001	0.001	0.006	0.16	< 0.001	0.002	< 0.0001	0.001	0.027
	25-Jul-23	0.14	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.22	< 0.001	0.004	< 0.0001	0.01	0.034
	16-Aug-23	0.18	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.41	< 0.001	0.005	< 0.0001	0.012	0.029
	12-Sep-23	0.12	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.17	< 0.001	0.002	< 0.0001	0.006	0.02
	24-Oct-23	0.11	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.46	< 0.001	0.005	< 0.0001	0.004	0.029
	15-Nov-23	0.11	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.43	< 0.001	0.013	< 0.0001	0.006	0.025
	20-Dec-23	0.14	< 0.001	< 0.05	< 0.0001	0.001	0.002	0.27	< 0.001	0.005	< 0.0001	0.007	0.045
	19-Jan-24	0.2	< 0.001	< 0.05	< 0.0001	0.001	0.004	0.18	< 0.001	0.002	< 0.0001	0.002	0.014
	14-Feb-24	0.2	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.37	< 0.001	0.008	< 0.0001	0.004	0.052
	13-Mar-24	0.18	< 0.001	< 0.05	< 0.0001	0.002	0.005	0.32	< 0.001	0.009	< 0.0001	0.01	0.161
	17-Apr-24	0.18	< 0.001	-	< 0.0001	0.002	0.001	0.32	< 0.001	0.008	< 0.0001	0.004	0.073
	20-May-24	0.17	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.52	< 0.001	0.008	< 0.0001	0.003	0.054
	18-Jun-24	0.36	< 0.001	< 0.05	< 0.0001	0.001	0.002	0.46	< 0.001	0.01	< 0.0001	0.006	0.069
	15-Jul-24	0.25	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.49	< 0.001	0.007	< 0.0001	0.008	0.055
	20-Aug-24	0.16	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.46	< 0.001	0.007	< 0.0001	0.003	0.052
	23-Sep-24	0.2	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.59	< 0.001	0.008	< 0.0001	0.009	0.039
	23-Oct-24	0.15	< 0.001	< 0.05	< 0.0001	0.002	0.003	0.4	< 0.001	0.005	< 0.0001	0.008	0.028
	08-Sep-20	0.05	0.007	< 0.05	< 0.0001	0.002	0.003	4.74	< 0.001	0.175	< 0.0001	0.01	0.022
	12-Oct-20	0.05	0.005	< 0.05	< 0.0001	0.002	0.003	4.1	< 0.001	0.15	< 0.0001	0.008	0.017
	11-Nov-20	0.05	0.004	0.1	< 0.0001	0.001	0.001	4.36	< 0.001	0.182	< 0.0001	0.002	0.03
	10-Dec-20	0.05	0.004	< 0.05	< 0.0001	0.001	< 0.001	5.14	< 0.001	0.186	< 0.0001	< 0.001	0.005
	12-Jan-21	0.05	0.003	< 0.05	< 0.0001	0.002	0.002	5.42	< 0.001	0.218	< 0.0001	0.007	0.013
	10-Feb-21	0.04	0.002	< 0.05	< 0.0001	0.001	0.02	4.96	< 0.001	0.203	< 0.0001	0.019	0.06
	10-Mar-21	0.04	0.002	< 0.05	< 0.0001	0.002	< 0.001	5.98	< 0.001	0.248	< 0.0001	0.03	0.064
	21-Apr-21	0.05	0.002	< 0.05	< 0.0001	0.002	< 0.001	5.78	< 0.001	0.216	< 0.0001	0.012	0.03
	19-May-21	0.04	0.002	< 0.05	< 0.0001	0.001	< 0.001	5.64	< 0.001	0.209	< 0.0001	0.01	0.049
	16-Jun-21	0.06	0.002	< 0.05	< 0.0001	0.002	< 0.001	6.26	< 0.001	0.233	< 0.0001	0.011	0.028

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
BH6	14-Jul-21	0.04	0.002	< 0.05	< 0.0001	0.002	< 0.001	6.53	< 0.001	0.219	< 0.0001	0.01	0.018
	18-Aug-21	0.04	< 0.001	< 0.05	< 0.0001	0.001	0.003	6.73	< 0.001	0.244	< 0.0001	0.002	0.024
	05-May-22	0.05	0.002	< 0.05	< 0.0001	0.001	0.002	6.72	< 0.001	0.246	< 0.0001	< 0.001	0.01
	16-Jun-22	0.06	0.002	< 0.05	< 0.0001	0.001	< 0.001	6.86	< 0.001	0.292	< 0.0001	0.008	0.019
	28-Jul-22	0.17	0.001	< 0.05	< 0.0001	0.001	< 0.001	3.0	< 0.001	0.095	< 0.0001	< 0.001	< 0.005
	11-Aug-22	0.05	0.003	0.05	< 0.0001	0.001	< 0.001	8.47	< 0.001	0.333	< 0.0001	< 0.001	< 0.005
	15-Sep-22	0.04	0.001	< 0.05	< 0.0001	0.002	< 0.001	8.18	< 0.001	0.326	< 0.0001	0.009	0.024
	25-Oct-22	0.04	0.003	< 0.05	< 0.0001	0.002	< 0.001	8.53	< 0.001	0.328	< 0.0001	0.01	0.018
	17-Nov-22	0.03	< 0.001	< 0.05	< 0.0001	0.001	0.001	9.7	< 0.001	0.33	< 0.0001	0.008	0.013
	15-Dec-22	0.04	0.001	< 0.05	< 0.0001	0.001	< 0.001	7.75	< 0.001	0.316	< 0.0001	0.013	0.026
	18-Jan-23	0.03	0.002	< 0.05	< 0.0001	0.001	< 0.001	7.19	< 0.001	0.331	< 0.0001	0.012	0.104
	14-Feb-23	< 0.01	0.002	< 0.05	< 0.0001	0.002	< 0.001	9.6	< 0.001	0.316	< 0.0001	0.007	0.017
	13-Mar-23	0.06	0.002	< 0.05	0.0001	0.002	0.002	8.12	< 0.001	0.287	< 0.0001	0.006	0.021
	17-Apr-23	0.03	0.002	< 0.05	< 0.0001	0.001	< 0.001	9.83	< 0.001	0.356	< 0.0001	0.013	0.016
	15-May-23	0.04	0.002	< 0.05	< 0.0001	0.002	< 0.001	7.79	< 0.001	0.331	< 0.0001	0.004	0.024
	15-Jun-23	0.02	0.001	< 0.05	< 0.0001	0.001	0.002	4.13	< 0.001	0.327	< 0.0001	0.005	0.109
	25-Jul-23	0.04	0.002	< 0.05	< 0.0001	0.001	< 0.001	9.38	< 0.001	0.349	< 0.0001	0.009	0.038
	16-Aug-23	0.04	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	9.79	< 0.001	0.353	< 0.0001	0.009	0.027
	12-Sep-23	0.04	0.001	< 0.05	< 0.0001	0.001	< 0.001	9.22	< 0.001	0.378	< 0.0001	0.01	0.027
	24-Oct-23	0.03	0.002	< 0.05	< 0.0001	0.001	< 0.001	8.77	< 0.001	0.354	< 0.0001	0.004	0.027
	15-Nov-23	0.04	0.001	< 0.05	< 0.0001	0.001	< 0.001	8.72	< 0.001	0.355	< 0.0001	0.009	0.023
	20-Dec-23	0.04	0.002	< 0.05	< 0.0001	0.002	< 0.001	9.17	< 0.001	0.379	< 0.0001	0.009	0.04
	19-Jan-24	0.05	0.002	< 0.05	< 0.0001	0.002	0.003	9.69	< 0.001	0.359	< 0.0001	0.005	0.02
	14-Feb-24	0.04	0.002	< 0.05	< 0.0001	0.002	< 0.001	11	< 0.001	0.412	< 0.0001	0.003	0.034
	13-Mar-24	0.04	0.002	< 0.05	< 0.0001	0.002	< 0.001	10	< 0.001	0.386	< 0.0001	< 0.001	0.036
	17-Apr-24	0.04	0.002	-	< 0.0001	0.002	< 0.001	9.0	< 0.001	0.359	< 0.0001	0.001	0.032
	20-May-24	0.05	0.002	< 0.05	< 0.0001	0.002	< 0.001	7.92	< 0.001	0.307	< 0.0001	0.003	0.058
	18-Jun-24	0.03	0.001	< 0.05	< 0.0001	0.001	< 0.001	5.81	< 0.001	0.249	< 0.0001	0.002	0.046
	15-Jul-24	0.02	0.002	< 0.05	< 0.0001	0.002	< 0.001	7.71	< 0.001	0.29	< 0.0001	0.004	0.027
	20-Aug-24	0.03	0.002	< 0.05	< 0.0001	0.001	< 0.001	7.25	< 0.001	0.307	< 0.0001	0.002	0.016
	23-Sep-24	0.05	0.002	< 0.05	< 0.0001	0.001	< 0.001	8.36	< 0.001	0.322	< 0.0001	0.008	0.019
	23-Oct-24	0.05	0.002	0.05	< 0.0001	0.001	0.002	8.21	< 0.001	0.315	< 0.0001	0.004	0.074
	08-Sep-20	0.1	0.036	< 0.05	< 0.0001	0.002	0.003	2.85	< 0.001	0.04	< 0.0001	0.009	0.018
	12-Oct-20	0.03	0.014	< 0.05	< 0.0001	0.001	< 0.001	1.71	< 0.001	0.027	< 0.0001	0.009	0.008
	10-Nov-20	0.05	0.012	< 0.05	< 0.0001	0.002	< 0.001	2.66	< 0.001	0.029	< 0.0001	0.002	0.023
	10-Dec-20	0.04	0.009	< 0.05	< 0.0001	0.001	< 0.001	2.03	< 0.001	0.019	< 0.0001	0.002	0.018
	12-Jan-21	0.06	0.011	< 0.05	< 0.0001	0.002	0.02	2.02	< 0.001	0.013	< 0.0001	0.005	0.035
	10-Feb-21	0.05	0.008	< 0.05	< 0.0001	0.001	0.002	1.72	< 0.001	0.014	< 0.0001	0.009	0.034
	10-Mar-21	0.06	0.007	< 0.05	< 0.0001	0.002	< 0.001	1.98	< 0.001	0.014	< 0.0001	0.011	0.042
	21-Apr-21	0.08	0.004	< 0.05	< 0.0001	0.002	< 0.001	1.77	< 0.001	0.011	< 0.0001	0.004	0.034
	19-May-21	0.05	< 0.001	< 0.05	< 0.0001	< 0.001	0.003	0.18	< 0.001	0.005	< 0.0001	0.006	0.085
	16-Jun-21	0.07	< 0.001	< 0.05	< 0.0001	0.002	0.004	0.3	< 0.001	0.012	< 0.0001	0.006	0.099
	14-Jul-21	0.18	0.002	< 0.05	< 0.0001	0.003	0.001	2.69	< 0.001	0.02	< 0.0001	0.01	0.039
	18-Aug-21	0.34	0.004	< 0.05	< 0.0001	0.006	0.006	2.96	< 0.001	0.022	< 0.0001	0.005	0.033

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
BH7	05-May-22	0.52	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.09	< 0.001	0.009	< 0.0001	< 0.001	0.008
	16-Jun-22	0.1	< 0.001	< 0.05	< 0.0001	0.001	0.006	0.31	< 0.001	0.007	< 0.0001	0.003	0.023
	28-Jul-22	0.14	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.13	< 0.001	0.006	< 0.0001	< 0.001	< 0.005
	11-Aug-22	0.16	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.38	< 0.001	0.01	< 0.0001	< 0.001	0.018
	15-Sep-22	0.21	< 0.001	< 0.05	< 0.0001	0.003	0.002	1.13	< 0.001	0.008	< 0.0001	0.008	0.026
	25-Oct-22	0.22	< 0.001	< 0.05	< 0.0001	0.003	0.003	1.24	< 0.001	0.011	< 0.0001	0.011	0.029
	17-Nov-22	0.18	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.35	< 0.001	0.009	< 0.0001	0.008	0.014
	15-Dec-22	0.26	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.24	< 0.001	0.009	< 0.0001	0.013	0.048
	18-Jan-23	0.16	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.94	< 0.001	0.008	< 0.0001	0.008	0.047
	14-Feb-23	0.09	< 0.001	< 0.05	< 0.0001	0.002	0.001	1.08	< 0.001	0.011	< 0.0001	0.016	0.053
	13-Mar-23	0.18	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.93	< 0.001	0.013	< 0.0001	0.018	0.055
	17-Apr-23	0.14	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.03	< 0.001	0.011	< 0.0001	0.032	0.026
	15-May-23	0.15	< 0.001	< 0.05	< 0.0001	0.002	0.001	0.92	< 0.001	0.013	< 0.0001	0.018	0.042
	15-Jun-23	0.12	< 0.001	< 0.05	< 0.0001	0.003	0.012	0.13	< 0.001	0.016	< 0.0001	0.026	0.078
	25-Jul-23	0.25	< 0.001	< 0.05	< 0.0001	0.003	0.002	0.67	< 0.001	0.015	< 0.0001	0.014	0.058
	16-Aug-23	0.41	< 0.001	< 0.05	< 0.0001	0.003	< 0.001	1.13	< 0.001	0.014	< 0.0001	0.008	0.042
	12-Sep-23	0.4	< 0.001	< 0.05	< 0.0001	0.003	< 0.001	1.08	< 0.001	0.011	< 0.0001	0.014	0.042
	24-Oct-23	0.46	< 0.001	< 0.05	< 0.0001	0.003	0.001	0.96	< 0.001	0.013	< 0.0001	0.002	0.032
	15-Nov-23	0.6	< 0.001	< 0.05	< 0.0001	0.004	< 0.001	0.98	< 0.001	0.014	< 0.0001	0.006	0.021
	20-Dec-23	0.58	< 0.001	< 0.05	< 0.0001	0.004	< 0.001	0.91	< 0.001	0.013	< 0.0001	0.018	0.056
	19-Jan-24	0.42	< 0.001	< 0.05	< 0.0001	0.004	0.005	0.63	< 0.001	0.008	< 0.0001	0.009	0.024
	14-Feb-24	0.33	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.2	< 0.001	0.015	< 0.0001	0.006	0.031
	13-Mar-24	0.24	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.2	< 0.001	0.02	< 0.0001	0.014	0.041
	17-Apr-24	0.22	< 0.001	-	< 0.0001	0.002	0.001	1.14	< 0.001	0.02	< 0.0001	0.021	0.049
	20-May-24	0.2	< 0.001	< 0.05	< 0.0001	0.002	0.004	0.4	< 0.001	0.018	< 0.0001	0.01	0.217
	18-Jun-24	0.89	< 0.001	< 0.05	< 0.0001	0.004	0.003	0.52	< 0.001	0.006	< 0.0001	0.007	0.101
	15-Jul-24	0.52	< 0.001	< 0.05	< 0.0001	0.006	0.022	0.39	< 0.001	0.01	< 0.0001	0.016	0.163
	20-Aug-24	0.93	< 0.001	< 0.05	< 0.0001	0.004	0.002	0.56	< 0.001	0.006	< 0.0001	0.005	0.108
	23-Sep-24	0.83	< 0.001	< 0.05	< 0.0001	0.004	0.001	0.54	< 0.001	0.007	< 0.0001	0.01	0.03
	23-Oct-24	0.56	< 0.001	< 0.05	< 0.0001	0.002	0.01	0.38	0.004	0.01	< 0.0001	0.004	0.103
	05-May-22	0.04	0.003	< 0.05	< 0.0001	< 0.001	< 0.001	1.72	< 0.001	0.084	< 0.0001	< 0.001	0.037
	16-Jun-22	0.05	0.003	< 0.05	< 0.0001	< 0.001	0.002	2.91	< 0.001	0.088	< 0.0001	0.007	0.036
	28-Jul-22	0.02	0.002	< 0.05	< 0.0001	< 0.001	< 0.001	0.36	< 0.001	0.043	< 0.0001	< 0.001	0.013
	11-Aug-22	0.05	0.003	< 0.05	< 0.0001	0.001	< 0.001	1.19	< 0.001	0.084	< 0.0001	0.004	0.021
	15-Sep-22	0.04	0.005	< 0.05	< 0.0001	< 0.001	0.001	2.83	< 0.001	0.068	< 0.0001	0.003	0.017
	25-Oct-22	0.07	0.006	< 0.05	< 0.0001	0.001	< 0.001	3.71	< 0.001	0.18	< 0.0001	0.001	0.015
	17-Nov-22	0.06	0.005	< 0.05	< 0.0001	0.002	< 0.001	4.3	< 0.001	0.139	< 0.0001	0.003	0.008
	15-Dec-22	0.08	0.006	< 0.05	< 0.0001	0.002	0.001	4.91	< 0.001	0.194	< 0.0001	0.002	0.023
	18-Jan-23	0.09	0.006	< 0.05	< 0.0001	0.002	< 0.001	4.26	< 0.001	0.225	< 0.0001	0.004	< 0.005
	14-Feb-23	0.02	0.005	< 0.05	< 0.0001	0.002	< 0.001	4.07	< 0.001	0.187	< 0.0001	0.005	< 0.005
	13-Mar-23	0.09	0.005	< 0.05	< 0.0001	0.002	< 0.001	3.56	< 0.001	0.169	< 0.0001	0.002	0.005
	17-Apr-23	0.05	0.008	< 0.05	< 0.0001	0.001	< 0.001	2.03	< 0.001	0.154	< 0.0001	0.003	0.023
	15-May-23	0.1	0.016	< 0.05	< 0.0001	0.002	0.002	3.62	< 0.001	0.206	< 0.0001	0.004	0.018
	15-Jun-23	0.12	0.019	< 0.05	< 0.0001	0.002	< 0.001	4.49	< 0.001	0.163	< 0.0001	< 0.001	< 0.005

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
MW1	25-Jul-23	0.11	0.007	< 0.05	< 0.0001	0.002	< 0.001	3.33	< 0.001	0.242	< 0.0001	0.013	0.009
	16-Aug-23	0.13	0.008	< 0.05	< 0.0001	0.003	< 0.001	3.32	< 0.001	0.273	< 0.0001	0.005	0.031
	12-Sep-23	0.15	0.014	< 0.05	< 0.0001	0.002	< 0.001	2.63	< 0.001	0.213	< 0.0001	0.006	0.008
	24-Oct-23	0.16	0.015	< 0.05	< 0.0001	0.002	< 0.001	3.02	< 0.001	0.159	< 0.0001	0.002	0.017
	15-Nov-23	0.13	0.013	< 0.05	< 0.0001	0.002	0.001	3.08	< 0.001	0.236	< 0.0001	0.004	0.007
	20-Dec-23	0.14	0.013	< 0.05	< 0.0001	0.003	< 0.001	3.04	< 0.001	0.197	< 0.0001	0.01	0.012
	19-Jan-24	0.17	0.016	< 0.05	< 0.0001	0.003	< 0.001	3.28	< 0.001	0.128	< 0.0001	0.002	0.026
	14-Feb-24	0.16	0.025	< 0.05	< 0.0001	0.002	< 0.001	3.8	< 0.001	0.174	< 0.0001	0.005	0.039
	13-Mar-24	0.2	0.026	< 0.05	< 0.0001	0.002	< 0.001	3.38	< 0.001	0.142	< 0.0001	< 0.001	0.025
	17-Apr-24	0.11	0.009	-	< 0.0001	0.002	< 0.001	1.38	< 0.001	0.127	< 0.0001	0.002	0.043
	20-May-24	0.12	0.012	< 0.05	< 0.0001	0.002	< 0.001	1.05	< 0.001	0.132	< 0.0001	0.002	0.05
	18-Jun-24	0.07	0.008	< 0.05	< 0.0001	< 0.001	0.001	0.71	< 0.001	0.072	< 0.0001	0.002	0.027
	15-Jul-24	0.08	0.01	< 0.05	< 0.0001	0.002	< 0.001	0.77	< 0.001	0.125	< 0.0001	0.002	0.036
	20-Aug-24	0.11	0.011	< 0.05	< 0.0001	0.002 *	0.003	1.52	< 0.001	0.09	< 0.0001	0.002	0.028
	23-Sep-24	0.1	0.013	< 0.05	< 0.0001	0.001	0.004	1.13	< 0.001	0.091	< 0.0001	0.002	0.032
	23-Oct-24	0.12	0.019	< 0.05	< 0.0001	0.002	0.004	3.43	< 0.001	0.213	< 0.0001	0.001	0.068
MW3	05-May-22	0.92	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.61	< 0.001	0.012	< 0.0001	< 0.001	0.014
	16-Jun-22	0.89	0.003	< 0.05	< 0.0001	0.002	< 0.001	2.05	< 0.001	0.019	< 0.0001	0.012	0.027
	25-Oct-22	2.34	0.001	< 0.05	< 0.0001	0.002	0.005	3.14	< 0.001	0.016	< 0.0001	0.015	0.035
	17-Nov-22	1.05	0.002	< 0.05	< 0.0001	0.002	0.002	1.42	< 0.001	0.008	< 0.0001	0.006	0.018
	15-Dec-22	1.29	0.002	< 0.05	< 0.0001	0.002	0.005	1.05	< 0.001	0.007	< 0.0001	0.008	0.03
	18-Jan-23	1.21	0.002	< 0.05	< 0.0001	0.002	< 0.001	1.18	< 0.001	0.007	< 0.0001	0.003	0.047
	14-Feb-23	0.78	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.8	< 0.001	0.009	< 0.0001	0.008	0.038
	13-Mar-23	1.31	0.003	< 0.05	< 0.0001	0.002	< 0.001	0.96	< 0.001	0.01	< 0.0001	0.01	0.02
	17-Apr-23	1.41	0.003	< 0.05	< 0.0001	0.002	< 0.001	0.95	< 0.001	0.006	< 0.0001	0.01	0.028
	15-May-23	1.68	0.004	< 0.05	< 0.0001	0.003	0.002	0.88	< 0.001	0.009	< 0.0001	0.012	0.036
	15-Jun-23	1.59	0.002	< 0.05	< 0.0001	0.002	0.007	0.69	< 0.001	0.004	< 0.0001	0.001	0.006
	25-Jul-23	1.6	0.002	< 0.05	< 0.0001	0.002	0.005	0.7	< 0.001	0.005	< 0.0001	0.003	0.03
	16-Aug-23	1.49	< 0.001	< 0.05	< 0.0001	0.004	< 0.001	1.09	< 0.001	0.008	< 0.0001	0.004	0.028
	12-Sep-23	1.45	0.001	< 0.05	< 0.0001	0.002	0.001	0.69	< 0.001	0.002	< 0.0001	0.002	0.01
	24-Oct-23	1.33	0.001	< 0.05	< 0.0001	0.002	0.001	1.06	< 0.001	0.01	< 0.0001	0.004	0.02
	15-Nov-23	1.45	< 0.001	< 0.05	< 0.0001	0.002	0.003	0.79	< 0.001	0.006	< 0.0001	0.003	0.006
	20-Dec-23	1.46	0.001	< 0.05	< 0.0001	0.002	< 0.001	1.15	< 0.001	0.01	< 0.0001	0.005	0.017
	19-Jan-24	0.79	< 0.001	< 0.05	< 0.0001	0.002	0.007	0.95	< 0.001	0.008	< 0.0001	0.005	0.032
	14-Feb-24	0.65	< 0.001	< 0.05	< 0.0001	0.001	0.002	0.86	< 0.001	0.011	< 0.0001	0.005	0.1
	13-Mar-24	0.91	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.32	< 0.001	0.012	< 0.0001	0.008	0.07
	17-Apr-24	1.27	< 0.001	-	< 0.0001	0.002	0.001	1.11	< 0.001	0.01	< 0.0001	0.007	0.056
	20-May-24	4.22	< 0.001	< 0.05	< 0.0001	0.003	< 0.001	1.13	< 0.001	0.008	< 0.0001	0.004	0.027
	18-Jun-24	2.65	< 0.001	< 0.05	< 0.0001	0.003	0.002	1.05	< 0.001	0.007	< 0.0001	0.006	0.026
	15-Jul-24	0.96	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.69	< 0.001	0.003	< 0.0001	0.011	0.016
	20-Aug-24	0.89	< 0.001	< 0.05	< 0.0001	0.002	0.003	0.79	< 0.001	0.007	< 0.0001	0.003	0.022
	23-Sep-24	0.91	0.001	< 0.05	< 0.0001	0.002	< 0.001	1.06	< 0.001	0.009	< 0.0001	0.006	0.024
	23-Oct-24	0.96	0.001	< 0.05	< 0.0001	0.002	0.004	0.81	< 0.001	0.006	< 0.0001	0.003	0.02
	05-May-22	1.78	0.001	< 0.05	< 0.0001	0.003	0.001	6.9	< 0.001	0.108	< 0.0001	< 0.001	0.02

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
MW5	17-Jun-22	2.78	0.001	< 0.05	< 0.0001	0.003	< 0.001	5.96	< 0.001	0.109	< 0.0001	0.001	0.028
	28-Jul-22	2.45	< 0.001	< 0.05	< 0.0001	0.003	< 0.001	6.28	< 0.001	0.092	< 0.0001	0.002	0.008
	11-Aug-22	4.28	0.001	< 0.05	< 0.0001	0.002	< 0.001	3.13	< 0.001	0.048	< 0.0001	0.001	0.037
	15-Sep-22	4.09	< 0.001	< 0.05	< 0.0001	0.003	0.006	3.6	< 0.001	0.086	< 0.0001	0.013	0.062
	25-Oct-22	2.33	0.012	< 0.05	< 0.0001	0.003	0.007	5.45	0.001	0.117	< 0.0001	0.011	0.061
	17-Nov-22	2.05	0.002	< 0.05	< 0.0001	0.002	0.001	4.56	< 0.001	0.091	< 0.0001	0.034	0.057
	15-Dec-22	1.76	0.001	< 0.05	< 0.0001	0.002	< 0.001	3.86	< 0.001	0.088	< 0.0001	0.006	0.056
	18-Jan-23	1.81	0.001	< 0.05	< 0.0001	0.002	< 0.001	3.82	< 0.001	0.09	< 0.0001	0.01	0.066
	14-Feb-23	1.51	0.002	< 0.05	0.0004	0.002	0.003	4.26	< 0.001	0.087	< 0.0001	0.013	0.05
	13-Mar-23	2.06	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	3.42	< 0.001	0.074	< 0.0001	0.012	0.043
	17-Apr-23	1.52	0.001	< 0.05	< 0.0001	0.002	< 0.001	3.22	< 0.001	0.077	< 0.0001	0.054	0.109
	15-May-23	1.77	0.002	< 0.05	< 0.0001	0.002	0.002	3.13	< 0.001	0.097	< 0.0001	0.019	0.073
	15-Jun-23	2.14	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	3.05	< 0.001	0.074	< 0.0001	< 0.001	0.009
	25-Jul-23	2.58	< 0.001	< 0.05	< 0.0001	0.002	0.006	2.32	< 0.001	0.059	< 0.0001	0.018	0.078
	16-Aug-23	2.7	0.001	< 0.05	< 0.0001	0.002	0.001	2.49	< 0.001	0.071	< 0.0001	0.032	0.075
	12-Sep-23	2.18	0.004	< 0.05	< 0.0001	0.002	0.001	2.46	< 0.001	0.07	< 0.0001	0.015	0.073
	24-Oct-23	2.62	0.002	< 0.05	< 0.0001	0.002	0.005	2.12	0.001	0.055	< 0.0001	0.006	0.078
	15-Nov-23	2.41	< 0.001	< 0.05	< 0.0001	0.002	0.004	1.55	< 0.001	0.06	< 0.0001	0.01	0.084
	20-Dec-23	2.35	0.008	< 0.05	< 0.0001	0.002	0.002	1.78	0.002	0.056	< 0.0001	0.015	0.084
	19-Jan-24	2.92	0.002	< 0.05	< 0.0001	0.003	0.008	1.55	< 0.001	0.043	< 0.0001	0.011	0.079
	14-Feb-24	3.4	0.002	< 0.05	< 0.0001	0.003	< 0.001	1.6	< 0.001	0.061	< 0.0001	0.008	0.108
	13-Mar-24	2.54	0.002	< 0.05	< 0.0001	0.002	0.008	1.27	< 0.001	0.033	< 0.0001	0.011	0.075
	17-Apr-24	2.05	0.004	-	< 0.0001	0.002	0.005	1.36	0.001	0.043	< 0.0001	0.004	0.11
	20-May-24	1.24	0.002	< 0.05	< 0.0001	0.001	0.023	1.01	0.004	0.062	< 0.0001	0.013	0.286
	18-Jun-24	1.34	< 0.001	< 0.05	< 0.0001	< 0.001	0.005	0.66	0.002	0.029	< 0.0001	0.014	0.101
	15-Jul-24	1.5	0.001	< 0.05	< 0.0001	0.001	< 0.001	0.83	< 0.001	0.029	< 0.0001	0.022	0.066
	20-Aug-24	2.12	0.002	< 0.05	< 0.0001	0.002	0.003	1.31	< 0.001	0.033	< 0.0001	0.012	0.103
	23-Sep-24	2.45	0.002	< 0.05	< 0.0001	0.002	0.001	1.61	0.001	0.034	< 0.0001	0.013	0.056
	23-Oct-24	2.08	0.002	< 0.05	< 0.0001	0.002	0.002	1.41	0.002	0.028	< 0.0001	0.027	0.063
MW6	05-May-22	0.36	0.008	< 0.05	< 0.0001	0.002	< 0.001	2.17	< 0.001	0.067	< 0.0001	< 0.001	< 0.005
	16-Jun-22	0.2	0.007	< 0.05	< 0.0001	0.002	< 0.001	3.23	< 0.001	0.14	< 0.0001	0.008	0.015
	28-Jul-22	0.22	0.007	< 0.05	< 0.0001	0.001	< 0.001	3.95	< 0.001	0.188	< 0.0001	< 0.001	< 0.005
	11-Aug-22	0.29	0.008	< 0.05	< 0.0001	0.002	< 0.001	4.45	< 0.001	0.17	< 0.0001	< 0.001	< 0.005
	15-Sep-22	0.19	0.006	< 0.05	< 0.0001	0.002	< 0.001	4.73	< 0.001	0.108	< 0.0001	0.006	0.015
	25-Oct-22	0.25	0.006	< 0.05	< 0.0001	0.002	0.001	4.83	< 0.001	0.113	< 0.0001	0.008	0.014
	17-Nov-22	0.26	0.005	< 0.05	< 0.0001	0.003	< 0.001	4.72	< 0.001	0.125	< 0.0001	0.014	0.006
	15-Dec-22	0.19	0.006	< 0.05	< 0.0001	0.002	< 0.001	4.57	< 0.001	0.187	< 0.0001	< 0.001	0.008
	18-Jan-23	0.21	0.005	< 0.05	< 0.0001	0.002	< 0.001	4.2	< 0.001	0.166	< 0.0001	0.013	0.019
	14-Feb-23	0.14	0.008	< 0.05	< 0.0001	0.002	0.003	5.17	< 0.001	0.171	< 0.0001	0.004	0.026
	13-Mar-23	0.24	0.008	< 0.05	< 0.0001	0.001	< 0.001	4.26	< 0.001	0.157	< 0.0001	0.006	0.005
	17-Apr-23	0.23	0.007	< 0.05	< 0.0001	0.002	< 0.001	5.0	< 0.001	0.157	< 0.0001	0.02	0.011
	15-May-23	0.38	0.009	< 0.05	< 0.0001	0.002	< 0.001	4.26	< 0.001	0.177	< 0.0001	0.01	0.01
	15-Jun-23	0.43	0.018	< 0.05	< 0.0001	0.002	< 0.001	4.67	< 0.001	0.165	< 0.0001	< 0.001	< 0.005
	25-Jul-23	0.29	0.01	< 0.05	< 0.0001	0.002	< 0.001	5.41	< 0.001	0.165	< 0.0001	< 0.001	0.018

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
MW6	16-Aug-23	0.3	0.008	< 0.05	< 0.0001	0.002	< 0.001	5.77	< 0.001	0.149	< 0.0001	0.013	0.02
	12-Sep-23	0.36	0.008	< 0.05	< 0.0001	0.002	< 0.001	5.63	< 0.001	0.164	< 0.0001	0.006	0.018
	24-Oct-23	0.26	0.008	< 0.05	< 0.0001	0.002	< 0.001	5.95	< 0.001	0.14	< 0.0001	0.004	0.022
	15-Nov-23	0.29	0.01	< 0.05	< 0.0001	0.002	0.003	5.07	< 0.001	0.115	< 0.0001	0.006	0.014
	20-Dec-23	0.24	0.013	< 0.05	< 0.0001	0.002	< 0.001	5.02	0.001	0.135	< 0.0001	0.027	0.086
	19-Jan-24	0.19	0.01	< 0.05	< 0.0001	0.002	0.003	5.4	< 0.001	0.137	< 0.0001	0.002	0.022
	14-Feb-24	0.19	0.009	< 0.05	< 0.0001	0.002	< 0.001	6.62	< 0.001	0.172	< 0.0001	0.002	0.019
	13-Mar-24	0.22	0.013	< 0.05	< 0.0001	0.002	< 0.001	4.35	< 0.001	0.144	< 0.0001	0.004	0.042
	17-Apr-24	0.24	0.011	-	< 0.0001	0.002	0.002	3.24	< 0.001	0.083	< 0.0001	0.004	0.066
	20-May-24	0.21	0.011	< 0.05	< 0.0001	0.002	< 0.001	2.5	< 0.001	0.064	< 0.0001	0.001	0.021
	18-Jun-24	0.19	0.01	< 0.05	< 0.0001	0.002	0.003	3.45	0.001	0.062	< 0.0001	0.006	0.055
	15-Jul-24	0.16	0.008	< 0.05	< 0.0001	0.001	< 0.001	3.89	< 0.001	0.091	< 0.0001	0.004	0.035
	20-Aug-24	0.11	0.008	< 0.05	< 0.0001	0.001	0.009	3.83	< 0.001	0.127	< 0.0001	0.009	0.14
	23-Sep-24	0.16	0.008	< 0.05	< 0.0001	0.002	< 0.001	4.17	< 0.001	0.151	< 0.0001	0.001	0.018
	23-Oct-24	0.18	0.008	0.05	< 0.0001	0.002	0.003	4.64	< 0.001	0.15	< 0.0001	0.011	0.027
MW7	05-May-22	1.45	0.002	< 0.05	< 0.0001	0.002	< 0.001	1.96	< 0.001	0.027	< 0.0001	< 0.001	0.023
	16-Jun-22	0.72	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.89	< 0.001	0.022	< 0.0001	0.008	0.019
	28-Jul-22	0.83	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.89	< 0.001	0.01	< 0.0001	0.002	0.018
	11-Aug-22	1.18	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.94	< 0.001	0.02	< 0.0001	< 0.001	0.015
	15-Sep-22	1.69	< 0.001	< 0.05	< 0.0001	0.002	0.033	1.07	0.003	0.02	< 0.0001	0.03	0.121
	25-Oct-22	1.14	< 0.001	< 0.05	< 0.0001	0.002	0.003	1.13	< 0.001	0.033	< 0.0001	0.003	0.017
	17-Nov-22	1.18	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.74	< 0.001	0.039	< 0.0001	0.018	0.009
	15-Dec-22	0.89	< 0.001	< 0.05	< 0.0001	0.002	0.003	0.7	< 0.001	0.038	< 0.0001	0.008	0.042
	18-Jan-23	0.67	< 0.001	< 0.05	< 0.0001	0.001	< 0.001	0.68	< 0.001	0.044	< 0.0001	0.019	0.026
	14-Feb-23	0.47	< 0.001	< 0.05	< 0.0001	0.001	0.001	0.71	< 0.001	0.04	< 0.0001	0.005	0.013
	13-Mar-23	0.72	< 0.001	< 0.05	0.0002	0.002	0.005	0.58	< 0.001	0.039	< 0.0001	0.021	0.026
	17-Apr-23	1.05	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.6	< 0.001	0.038	< 0.0001	0.011	0.013
	15-May-23	1.15	< 0.001	< 0.05	< 0.0001	0.002	0.002	0.64	< 0.001	0.04	< 0.0001	0.023	0.02
	15-Jun-23	1.06	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.6	< 0.001	0.037	< 0.0001	< 0.001	< 0.005
	25-Jul-23	1.2	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.62	< 0.001	0.039	< 0.0001	0.01	0.036
	16-Aug-23	1.12	< 0.001	< 0.05	< 0.0001	0.002	0.003	0.67	< 0.001	0.038	< 0.0001	0.01	0.048
	12-Sep-23	1.64	< 0.001	< 0.05	< 0.0001	0.002	0.001	0.64	< 0.001	0.037	< 0.0001	0.017	0.023
	24-Oct-23	1.21	< 0.001	< 0.05	< 0.0001	0.002	0.004	0.72	< 0.001	0.051	< 0.0001	0.006	0.04
	15-Nov-23	1.03	< 0.001	< 0.05	< 0.0001	0.003	0.016	0.71	< 0.001	0.055	< 0.0001	0.017	0.036
	20-Dec-23	0.8	< 0.001	< 0.05	< 0.0001	0.003	0.003	0.88	0.002	0.035	< 0.0001	0.016	0.065
	19-Jan-24	0.78	< 0.001	< 0.05	< 0.0001	0.002	0.008	0.66	< 0.001	0.033	< 0.0001	0.01	0.066
	14-Feb-24	0.71	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	1.0	< 0.001	0.04	< 0.0001	0.004	0.043
	13-Mar-24	0.68	< 0.001	< 0.05	< 0.0001	0.002	< 0.001	0.7	< 0.001	0.049	< 0.0001	0.01	0.03
	17-Apr-24	0.64	0.001	-	< 0.0001	0.003	0.005	0.79	< 0.001	0.04	< 0.0001	0.01	0.093
	20-May-24	1.19	< 0.001	< 0.05	< 0.0001	0.001	0.035	0.53	0.009	0.008	< 0.0001	0.015	0.287
	18-Jun-24	1.98	< 0.001	< 0.05	0.0001	0.003	0.108	0.85	0.013	0.025	< 0.0001	0.06	0.452
	15-Jul-24	1.59	< 0.001	< 0.05	< 0.0001	0.001	0.035	0.42	0.005	0.002	< 0.0001	0.014	0.16
	20-Aug-24	1.89	< 0.001	< 0.05	< 0.0001	0.003	0.087	0.92	0.015	0.007	< 0.0001	0.062	0.562
	23-Sep-24	0.86	< 0.001	< 0.05	< 0.0001	0.004	0.005	0.77	< 0.001	0.037	< 0.0001	0.008	0.034

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte		Metals											
		Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date												
	23-Oct-24	0.69	< 0.001	< 0.05	< 0.0001	0.002	0.005	0.86	0.003	0.05	< 0.0001	0.004	0.068

Notes:
- - Not analysed
< - Less than laboratory limit of reporting
mg/L - Milligrams per litre
Bold indicates a detection above the laboratory limit of reporting
"*" denotes duplicate/triplicate sample result adopted for analytical use due to RPD >50%
RPD - Relative Percentage Difference

[illegible]



Analyte	Perfluoroalkyl Sulfonamides																	Perfluoroalkyl Carboxylic Acids										Perfluoroalkyl Sulfonic Acids						(n:2) Fluorotelomer Sulfonic Acids				Sum of PFAS			
	Perfluorooctane sulfonamide (FOSA)		N-Methyl-perfluorooctane sulfonamide (MeFOSA)	N-Ethyl-perfluorooctane sulfonamide (EtFOSA)		N-Methyl-perfluorooctane sulfonamidoethanol (MeFOSAE)		N-Ethyl-perfluorooctane sulfonamidoethanol (EtFOSAE)		N-Ethyl-perfluorooctane sulfonamidoacetic acid (EtFOSAA)		N-Methyl-perfluorooctane sulfonamidoacetic acid (MeFOSAA)		Perfluorobutanoic acid (PFBA)	Perfluoro-n-pentanoic acid (PFtPA)	Perfluorohexanoic acid (PFtHA)	Perfluoroheptanoic acid (PFtHpA)	Perfluorooctanoic acid (PFtOA)	Perfluorononanoic acid (PFtNA)	Perfluorodecanoic acid (PFtDA)	Perfluorotridecanoic acid (PFtTDA)	Perfluoroundecanoic acid (PFtUDA)	Perfluorododecanoic acid (PFtDDA)	Perfluorotetradecanoic acid (PFtTDA)	Perfluorobutanesulfonic acid (PFBS)	Perfluoropropanesulfonic acid (PFPS)	Perfluoropentanesulfonic acid (PFtPS)	Perfluorohexanesulfonic acid (PFtHS)	Perfluoroheptanesulfonate (PFtHpS)	Perfluorooctanesulfonic acid (PFtOS)	Perfluorodecanesulfonic acid (PFtDS)	4:2 Fluorotelomer Sulfonate (4:2 FTS)	6:2 Fluorotelomer Sulfonate (6:2 FTS)	8:2 Fluorotelomer sulfonate (8:2 FTS)	10:2 Fluorotelomer sulfonic acid (10:2 FTS)	Sum of PFtAS and PFOS	Sum of PFAS (IA DER List)	Sum of PFAS	Perfluorononanesulfonic acid (PFtNS)		
	Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	
Sample Name	Location	Sample Date																																							
	MW7	20-Aug-24	< 0.02	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.02	< 0.02	< 0.1	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02

Notes:
-- Not analysed
< - Less than laboratory limit of reporting
µg/L - Micrograms per litre
Bold indicates a detection above the laboratory limit of reporting

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Analyte			Metals											
			Aluminum	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Zinc
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample Name	Sample Date	Sample Type												
TB01_23102024	23-Oct-24	Trip Blank	< 0.01	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.005
RB01_23102024	23-Oct-24	Rinsate	< 0.01	< 0.001	< 0.05	< 0.0001	< 0.001	< 0.001	< 0.05	< 0.001	< 0.001	< 0.0001	< 0.001	< 0.005
BH3_23102024	23-Oct-24	Primary	0.11	< 0.001	< 0.05	< 0.0001	< 0.001	0.01	< 0.05	< 0.001	0.002	< 0.0001	0.002	0.039
QC01_23102024	23-Oct-24	Duplicate	0.06	< 0.001	< 0.05	< 0.0001	< 0.001	0.004	< 0.05	< 0.001	0.006	< 0.0001	0.003	0.09
Relative Percentage Difference			59%	NC	NC	NC	NC	86%	NC	NC	100%	NC	40%	79%
BH3_23102024	23-Oct-24	Primary	0.11	< 0.001	< 0.05	< 0.0001	< 0.001	0.01	< 0.05	< 0.001	0.002	< 0.0001	0.002	0.039
QC01A_23102024	23-Oct-24	Triplicate	0.07	< 0.001	< 0.05	< 0.0002	< 0.001	0.01	0.07	0.001	0.007	< 0.0001	0.004	0.11
Relative Percentage Difference			44%	NC	NC	NC	NC	0%	33%	0%	111%	NC	67%	95%

Notes:
< - Less than laboratory limit of reporting
NC - Not calculated
mg/L - Milligrams per litre
RPD - Relative Percentage Difference

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
BH1	08-Sep-20	27	11.2	NM	10.392	N	Light brown, N/O, N/S	D. Kousbroek
	12-Oct-20	27	11.2	NM	10.513	N	Light brown, N/O, N/S	D. Kousbroek
	10-Nov-20	27	11.2	0.924000	10.276	N	Light brown, N/O, N/S	D. Kousbroek
	10-Dec-20	27	11.2	NM	10.531	N	Clear, N/O, N/S	D. Kousbroek
	12-Jan-21	27	11.2	NM	10.269	N	Clear, N/O, N/S	D. Kousbroek
	10-Feb-21	27.02	11.2	NM	10.351	N	Slight brown, N/O, N/S	D. Kousbroek
	10-Mar-21	27	11.2	NM	10.346	N	Cloudy brown, N/O, N/S	D. Kousbroek
	21-Apr-21	27	11.2	NM	9.902	N	Cloudy brown, slight sulfur odour, N/S	D. Kousbroek
	19-May-21	27	11.2	NM	9.965	N	Yellow, N/O, N/S	D. Kousbroek
	16-Jun-21	27	11.2	NM	9.982	N	Slight yellow/brown, low sulphur odour, N/S	D. Kousbroek
	14-Jul-21	27	11.2	NM	9.863	N	Slight yellow-brown, low sulphur odour, N/S	D. Kousbroek
	18-Aug-21	27	11.2	NM	10.068	N	Slight yellow, N/O, N/S	D. Kousbroek
	05-May-22	27	11.2	1.23400	9.966	N	Slight Yellow, No/NS	M. Ferguson
	16-Jun-22	27	11.2	1.19400	10.006	N	Light Yello, Low sulfure odour, NS	M. Ferguson
	28-Jul-22	27	11.2	1.41400	9.786	N	Light yellow	M Ferguson
	10-Aug-22	27	11.2	1.50500	9.695	N	Clear	M Ferguson
	15-Sep-22	27	11.2	1.29900	9.901	N	Clear	J Roby
	25-Oct-22	27.7	11.2	1.38200	9.818	N	Good Condition	JR, AK
	17-Nov-22	27.04	11.2	1.28500	9.915	N	Clear, NO/NS	J. Roby
	15-Dec-22	27.04	11.2	1.13500	10.065	N	Odor, Light yellow	M Ferguson
	18-Jan-23	27	11.2	0.974999	10.225	N	Weak Odor, Clear	A king
	14-Feb-23	27	11.2	0.940000	10.26	N	Clear, NO/NS	A.King
	13-Mar-23	27.7	11.2	0.946000	10.254	N	Sheen, Clear	A King
	17-Apr-23	27	11.2	1.03200	10.168	N	Odor, Clear	A King
	15-May-23	27	11.2	0.969000	10.231	N	Clear	A King
	15-Jun-23	27.7	11.2	0.835999	10.364	N	Light yellow, no odour/sheen	M. Ferguson
	25-Jul-23	26.79	11.2	1.00100	10.199	N	Clear	A King
	16-Aug-23	26.78	11.2	1.03700	10.163	N	Clear, no odor, no sheen	AK
	12-Sep-23	26.693	11.2	0.906000	10.294	N	Odor, Clear	A King
	25-Oct-23	26.57	11.2	0.734000	10.466	N	Clear, no odour, no sheen	TJ
	15-Nov-23	26.57	11.2	0.767000	10.433	N	clear to yellow colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	26.86	11.2	0.700000	10.5	N	Clear, no odour, no sheen	TJ
	19-Jan-24	27.5	11.2	0.641000	10.559	N	Odor, Clear	T Jeffery
	14-Feb-24	26.903	11.2	0.844000	10.356	N	Odor, Slight Yellow	T Jeffery
	13-Mar-24	27.88	11.2	0.250000	10.95	N	Odor, Yellow	T Jeffery
	17-Apr-24	26.49	11.2	0.760000	10.44	N	Slight yellow, moderate sulphur odour, no sheen, Odor, Slight yellow	T Jeffery
	20-May-24	26.505	11.2	1.16500	10.035	N	Slight yellow, strong sulphur odour, no sheen, Strong Odor, Slight yellow	T Jeffery
	19-Jun-24	27.505	11.2	1.19100	10.009	N	Clear	C Waddell
	15-Jul-24	26.818	11.2	0.20900	10.991	N	Very light yellow	C Waddell
	20-Aug-24	26.516	11.2	1.21500	9.985	N	Yellow, no sheen, moderate sulphur odour, Odor, Yellow	T Jeffery
	23-Sep-24	24.856	11.2	1.04700	10.153	N	Clear	C Waddell
	23-Oct-24	26.972	11.2	0.394000	10.806	N	Odor, Clear	C Waddell
	08-Sep-20	24.21	12.89	NM	11.804	N	Clear, slight sulphur odour, N/S	D. Kousbroek
	12-Oct-20	24.21	12.89	NM	11.915	N	Slight brown, N/O, N/S	D. Kousbroek
	10-Nov-20	24.21	12.89	1.20300	11.687	N	Slight brown, N/O, N/S	D. Kousbroek
	10-Dec-20	24.21	12.89	NM	11.945	N	Slight brown, N/O, N/S	D. Kousbroek
	12-Jan-21	24.21	12.89	NM	11.678	N	Clear, N/O, N/S	D. Kousbroek
	10-Feb-21	24.31	12.89	NM	11.784	N	Clear, N/O, N/S	D. Kousbroek
	10-Mar-21	24.21	12.89	NM	11.778	N	Clear, N/O, N/S	D. Kousbroek
	21-Apr-21	24.21	12.89	NM	11.093	N	Clear, slight sulfur odour, N/S	D. Kousbroek
	19-May-21	24.21	12.89	NM	11.185	N	Slight yellow, N/O, N/S	D. Kousbroek
	16-Jun-21	24.21	12.89	NM	11.23	N	Slight yellow, slight sulphur odour, N/S	D. Kousbroek

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
BH2	14-Jul-21	24.21	12.89	NM	11.096	N	Slight yellow, mod sulphur odour, N/S	D. Kousbroek
	18-Aug-21	24.21	12.89	NM	11.325	N	Clear, slight sulphur odour, N/S, N/O	D. Kousbroek
	05-May-22	24.21	12.89	1.64700	11.243	N	Slight Yellow, low sulfur odour, NS	M. Ferguson
	16-Jun-22	24.21	12.89	NM	11.278	N	Clear, Strong Sulfur Odour, NS	M. Ferguson
	28-Jul-22	24.21	12.89	1.98000	10.91	N	Odor, Clear	M Ferguson
	11-Aug-22	24.22	12.89	2.04800	10.842	N	Clear	M Ferguson
	15-Sep-22	24	12.89	1.89000	11	N	Clear	J Roby
	25-Oct-22	24.56	12.89	1.83000	11.06	N	Good Condition	JR, AK
	17-Nov-22	24.56	12.89	1.77500	11.115	N	Clear, NO/NS	J. Roby
	15-Dec-22	24.56	12.89	1.60700	11.283	N	Odor, Clear	M Ferguson
	18-Jan-23	24.035	12.89	1.42700	11.463	N	Odor, Clear	A king
	14-Feb-23	24.035	12.89	1.33000	11.56	N	Clear, NO/NS	A.King
	13-Mar-23	24.063	12.89	1.31500	11.575	N	Clear	A King
	17-Apr-23	24	12.89	1.39200	11.498	N	Clear	A King
	15-May-23	24	12.89	1.31400	11.576	N	Clear	A King
	15-Jun-23	24.11	12.89	1.20100	11.689	N	Clear, no odour/sheen	M. Ferguson
	25-Jul-23	24.06	12.89	1.29000	11.6	N	Clear	A King
	16-Aug-23	23.73	12.89	1.29400	11.596	N	Clear, no odor, no sheen	AK
	12-Sep-23	23.75	12.89	1.17300	11.717	N	Clear	A King
	25-Oct-23	23.74	12.89	0.990001	11.9	N	Slight yellow, low Sulphur odour, no sheen	TJ
	15-Nov-23	23.75	12.89	1.00000	11.89	N	clear colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	23.984	12.89	0.938001	11.952	N	Clear, low Sulphur odour, no sheen	TJ
	19-Jan-24	23.716	12.89	0.845000	12.045	N	Odor, Clear	T Jeffery
	14-Feb-24	23.725	12.89	0.832001	12.058	N	Odor, Slightly Yellow	T Jeffery
	13-Mar-24	24.975	12.89	0.650000	12.24	N	Weak Odor, Sliht yellow	T Jeffery
	18-Apr-24	23.916	12.89	0.978001	11.912	N	Slight yellow, high sulphur odour, no sheen, Strong Odor, Slight yellow	T Jeffery
	20-May-24	23.72	12.89	1.40600	11.484	N	Slight yellow, stong sulphur odour, no sheen, Strong Odor, Slight yellow	T Jeffery
	19-Jun-24	24.028	12.89	1.56500	11.325	N	Light Brown	C Waddell
	15-Jul-24	24.203	12.89	1.16100	11.729	N	Clear	C Waddell
	20-Aug-24	23.695	12.89	1.58600	11.304	N	Clear, no sheen, no odour, Clear	T Jeffery
	23-Sep-24	23.719	12.89	1.42400	11.466	N	Slight Brown	C Waddell
	23-Oct-24	24.401	12.89	1.46700	11.423	N	Clear	C Waddell
	08-Sep-20	27.39	13.69	NM	12.162	N	Clear, N/S, N/O	D. Kousbroek
	12-Oct-20	27.39	13.69	NM	12.281	N	Clear, N/S, N/O	D. Kousbroek
	10-Nov-20	27.39	13.69	1.58100	12.109	N	Clear, N/S, N/O	D. Kousbroek
	10-Dec-20	27.39	13.69	NM	12.302	N	Clear, N/S, N/O	D. Kousbroek
	12-Jan-21	27.39	13.69	NM	12.076	N	Clear, N/S, N/O	D. Kousbroek
	10-Feb-21	27.5	13.69	NM	12.183	N	Slight brown, N/S, N/O	D. Kousbroek
	10-Mar-21	27.39	13.69	NM	12.185	N	Slight brown, N/S, N/O	D. Kousbroek
	21-Apr-21	27.39	13.69	NM	11.066	N	Slight brown, N/S, N/O	D. Kousbroek
	19-May-21	27.39	13.69	NM	11.2	N	Slight yellow, N/O, N/S	D. Kousbroek
	16-Jun-21	27.39	13.69	NM	11.309	N	Slight brown, N/S, N/O	D. Kousbroek
	14-Jul-21	27.39	13.69	NM	11.143	N	Slight yellow-brown, mod sulphur odour, N/S	D. Kousbroek
	18-Aug-21	27.39	13.69	NM	11.388	N	Slight yellow-brown, N/S, N/O	D. Kousbroek
	05-May-22	27.39	13.69	2.35400	11.336	N	Slight yellow, No/NS	M. Ferguson
	16-Jun-22	27.39	13.69	2.32200	11.368	N	Yellow, Mod sulfur Odour, NS	M. Ferguson
	28-Jul-22	27.39	13.69	2.95800	10.732	N	Very light yellow	M Ferguson
	11-Aug-22	27.55	13.69	2.98900	10.701	N	Light brown	M Ferguson
	15-Sep-22	27	13.69	2.82100	10.869	N	Clear	J Roby
	25-Oct-22	27.265	13.69	2.71600	10.974	N	Good Condition	JR, AK
	17-Nov-22	27.265	13.69	2.58000	11.11	N	Clear, NO/NS	J. Roby
	15-Dec-22	27.265	13.69	2.39400	11.296	N	Clear	M Ferguson

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
BH3	18-Jan-23	27.375	13.69	2.15500	11.535	N	Clear	A king
	14-Feb-23	27.375	13.69	2.01500	11.675	N	Clear, NO/NS	A.King
	13-Mar-23	27.019	13.69	1.91800	11.772	N	Clear	A King
	17-Apr-23	27	13.69	1.94800	11.742	N	Clea	A King
	15-May-23	27	13.69	1.85200	11.838	N	Clear	A King
	15-Jun-23	27.1	13.69	1.74200	11.948	N	Very light yellow, no odour/sheen	M. Ferguson
	25-Jul-23	27.05	13.69	2.09200	11.598	N	Clear	A King
	16-Aug-23	27.33	13.69	1.70300	11.987	N	Clear, no odor, no sheen	AK
	12-Sep-23	27.08	13.69	1.61100	12.079	N	Clear	A King
	25-Oct-23	27.304	13.69	1.52600	12.164	N	Clear, no odour, no sheen	TJ
	15-Nov-23	27.32	13.69	1.39500	12.295	N	clear colouration, no odour, no sheen, fast recharge	TJ
	20-Dec-23	27.425	13.69	1.29300	12.397	N	Yellow, Sulphur odour, no sheen	TJ
	19-Jan-24	26.99	13.69	1.21800	12.472	N	Clear	T Jeffery
	14-Feb-24	27.332	13.69	1.17800	12.512	N	Clear	T Jeffery
	13-Mar-24	28.19	13.69	1.05000	12.64	N	Clear	T Jeffery
	17-Apr-24	26.974	13.69	1.28400	12.406	N	Clear, no sheen, no odour, Clear	T Jeffery
	20-May-24	26.972	13.69	1.79900	11.891	N	Clear, no odour, no sheen, Clear	T Jeffery
	19-Jun-24	27.545	13.69	2.09500	11.595	N	Clear	C Waddell
	15-Jul-24	27.371	13.69	2.23900	11.451	N	Clear	C Waddell
	20-Aug-24	26.975	13.69	2.09800	11.592	N	Clear, no sheen, no odour, Clear	T Jeffery
	23-Sep-24	27.485	13.69	2.33800	11.352	N	Clear	C Waddell
	23-Oct-24	27.336	13.69	2.02500	11.665	N	Clear	C Waddell
BH4	08-Sep-20	20.15	5.3	NM	3.863	N	Clear, slight sulphur odour, N/S	D. Kousbroek
	12-Oct-20	20.15	5.3	NM	3.759	N	Light brown-yellow, slight sulphur odour, N/S	D. Kousbroek
	10-Nov-20	20.15	5.3	1.66700	3.633	N	Light brown-yellow, slight sulphur odour, N/S	D. Kousbroek
	10-Dec-20	20.15	5.3	NM	3.806	N	Light brown, slight sulphur odour, N/S	D. Kousbroek
	12-Jan-21	20.15	5.3	NM	3.646	N	Clear, sulphur odour, N/S	D. Kousbroek
	10-Feb-21	20.15	5.3	NM	3.673	N	Clear, Mod sulphur odour, N/S	D. Kousbroek
	10-Mar-21	20.15	5.3	NM	3.694	N	Clear, mod sulphur odour, N/S	D. Kousbroek
	21-Apr-21	20.15	5.3	NM	2.469	N	Slight brown, strong sulphur odour, N/S	D. Kousbroek
	19-May-21	20.15	5.3	NM	2.563	N	Dark yellow/brown, strong sulfur odour, N/S	D. Kousbroek
	16-Jun-21	20.15	5.3	NM	2.668	N	Slight yellow-clear, mod sulphur odour, N/S	D. Kousbroek
	14-Jul-21	20.15	5.3	NM	2.483	N	Yellow, slight sulphur odour, N/S	D. Kousbroek
	18-Aug-21	20.15	5.3	NM	2.714	N	Deep yellow, mod sulphur odour, N/S, N/O	D. Kousbroek
	05-May-22	20.15	5.3	2.57800	2.722	N	Clear, No/NS	M. Ferguson
	16-Jun-22	20.15	5.3	2.58200	2.718	--	Light Yellow, Low sulfur odour, NS	M. Ferguson
	28-Jul-22	20.15	5.3	3.28600	2.014	N	Light yellow	M Ferguson
	11-Aug-22	20.16	5.3	3.33700	1.963	N	Clear	M Ferguson
	15-Sep-22	20	5.3	3.16000	2.14	N	Clear	J Roby
	25-Oct-22	19.805	5.3	3.05000	2.25	N	Good Condition	JR, AK
	17-Nov-22	19.805	5.3	2.93000	2.37	N	Clear, NO/NS	J. Roby
	15-Dec-22	19.805	5.3	2.72500	2.575	N	Odor, Light yellow	M Ferguson
	18-Jan-23	19.815	5.3	2.46600	2.834	N	Clear	A king
	14-Feb-23	19.815	5.3	2.30700	2.993	N	Clear, moderate Sulphur odour, NS	A.King
	13-Mar-23	19.909	5.3	2.18700	3.113	N	Clear	A King
	17-Apr-23	19	5.3	2.17400	3.126	N	Clear	A King
	15-May-23	19	5.3	2.09400	3.206	N	Clear	A King
	15-Jun-23	19.02	5.3	1.97400	3.326	N	Clear, no odour/sheen	M. Ferguson
	25-Jul-23	19.78	5.3	1.94600	3.354	N	Clear	A King
	16-Aug-23	19.75	5.3	1.90800	3.392	N	Clear, no odor, no sheen	AK
	12-Sep-23	19.776	5.3	1.81800	3.482	N	Clear	A King
	25-Oct-23	19.768	5.3	1.62400	3.676	N	Clear, low sulphur odour, no sheen	TJ

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
	15-Nov-23	19.79	5.3	1.76600	3.534	N	clear colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	19.76	5.3	1.48500	3.815	N	Clear, no odour, no sheen	TJ
	19-Jan-24	19	5.3	1.39000	3.91	N	Odor, Clear	T Jeffery
	14-Feb-24	19.746	5.3	1.33000	3.97	N	Odor, Clear	T Jeffery
	13-Mar-24	20.89	5.3	1.28500	4.015	N	Weak Odor, Clear	T Jeffery
	17-Apr-24	19.736	5.3	1.40400	3.896	N	Clear, no sheen, no odour, Weak Odor, Clear	T Jeffery
	20-May-24	19.738	5.3	1.89200	3.408	N	Clear, low sulphur odour, no sheen, Weak Odor, Clear	T Jeffery
	18-Jun-24	20.509	5.3	1.59900	3.701	N	Clear	C Waddell
	15-Jul-24	19.878	5.3	3.41400	2.886	N	Odor, Clear	C Waddell
	20-Aug-24	19.73	5.3	2.42000	2.88	N	Slight yellow, no odour, no sheen, Slight yellow	T Jeffery
	27-Sep-24	19.745	5.3	2.19600	3.104	N	Clear	C Waddell
	23-Oct-24	19.738	5.3	1.89600	3.404	N	Clear	C Waddell
BH5	08-Sep-20	20.74	5.89	NM	4.596	N	Deep yellow, mod sulphur odour, N/S, N/O	D. Kousbroek
	12-Oct-20	20.74	5.89	NM	4.632	N	Deep yellow, mod sulphur odour, N/S, N/O	D. Kousbroek
	10-Nov-20	20.74	5.89	1.36400	4.526	N	Deep yellow, mod sulphur odour, N/S, N/O	D. Kousbroek
	10-Dec-20	20.74	5.89	NM	4.714	N	Deep yellow, mod sulphur odour, N/S, N/O	D. Kousbroek
	12-Jan-21	20.74	5.89	NM	4.544	N	Deep yellow, mod sulphur odour, N/S, N/O	D. Kousbroek
	10-Feb-21	20.7	5.89	NM	4.572	N	Deep yellow, mod sulphur odour, N/S, N/O	D. Kousbroek
	10-Mar-21	20.74	5.89	NM	4.538	N	Clear, strong sulphur odour, N/S	D. Kousbroek
	21-Apr-21	20.74	5.89	NM	3.542	N	Light brown, strong sulphur odour, N/S	D. Kousbroek
	19-May-21	20.74	5.89	NM	3.588	N	Clear, mod sulphur odour, N/S	D. Kousbroek
	16-Jun-21	20.74	5.89	NM	3.683	N	Clear, slight sulphur odour, N/S	D. Kousbroek
	14-Jul-21	20.74	5.89	NM	3.41	N	Clear, mod sulphur odour, N/S	D. Kousbroek
	18-Aug-21	20.74	5.89	NM	3.658	N	Slight yellow, mod sulphur odour, N/S	D. Kousbroek
	05-May-22	20.74	5.89	2.25400	3.636	N	Very slight Yellow, No/NS	M. Ferguson
	16-Jun-22	20.74	5.89	2.22800	3.662	N	Clear, No/NS	M. Ferguson
	28-Jul-22	20.74	5.89	2.83600	3.054	N	Clear	M Ferguson
	11-Aug-22	20.64	5.89	2.91200	2.978	N	Clear	M Ferguson
	15-Sep-22	20.585	5.89	2.77100	3.119	N	Clear	J Roby
	25-Oct-22	20.41	5.89	2.61500	3.275	N	Good Condition	JR, AK
	17-Nov-22	20.41	5.89	2.57500	3.315	N	Clear, NO/NS	J. Roby
	15-Dec-22	20.41	5.89	2.37200	3.518	N	Odor, Clear	M Ferguson
	18-Jan-23	20.356	5.89	2.12500	3.765	N	Weak Odor, Clear	A king
	14-Feb-23	20.356	5.89	2.00100	3.889	N	Clear, NO/NS	A.King
	14-Mar-23	20.655	5.89	1.92500	3.965	N	Clear	A King
	17-Apr-23	20	5.89	1.92500	3.965	N	Odor, Lt yellow	A King
	15-May-23	20	5.89	1.86800	4.022	N	Clear	A King
	15-Jun-23	20.7	5.89	1.73200	4.158	N	Clear, no odour/sheen	M. Ferguson
	25-Jul-23	20.33	5.89	1.75400	4.136	N	Clear	A King
	16-Aug-23	20.34	5.89	1.73100	4.159	N	Clear, no odor, no sheen	AK
	12-Sep-23	20.345	5.89	1.62800	4.262	N	Clear	A King
	25-Oct-23	20.33	5.89	1.40700	4.483	N	Clear, low sulphur odour, no sheen	TJ
	15-Nov-23	20.361	5.89	1.30600	4.584	N	clear colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	20.322	5.89	1.28900	4.601	N	Clear, no odour, no sheen	TJ
	19-Jan-24	20.325	5.89	1.21000	4.68	N	Odor, Clear	T Jeffery
	14-Feb-24	20.335	5.89	1.16700	4.723	N	Clear	T Jeffery
	13-Mar-24	20.445	5.89	1.05000	4.84	N	Clear	T Jeffery
	18-Apr-24	20.3	5.89	1.26300	4.627	N	Clear, no sheen, no odour, Clear	T Jeffery
	20-May-24	20.304	5.89	1.70600	4.184	N	Weak Odor, Clear	T Jeffery
	18-Jun-24	20.555	5.89	1.97100	3.919	N	Clear	C Waddell
	15-Jul-24	20.478	5.89	2.10900	3.781	N	Odor, Clear	C Waddell
	20-Aug-24	20.308	5.89	2.13400	3.756	N	Clear, no sheen, no odour, Clear	T Jeffery

Table 4
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Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
	23-Sep-24	19.335	5.89	1.99200	3.898	N	Odor, Clear with Light Brown Suspended Solids	C Waddell
	28-Oct-24	20.363	5.89	2.01200	3.878	N	Weak Odor, Clear	C Waddell
BH6	08-Sep-20	21	5.42	NM	5.439	N	Light brown, sulphur odour, N/S	D. Kousbroek
	12-Oct-20	21	5.42	NM	5.376	N	Light brown, sulphur odour, N/S	D. Kousbroek
	10-Nov-20	21	5.42	0.636000	4.784	N	Light brown, sulphur odour, N/S	D. Kousbroek
	10-Dec-20	21	5.42	NM	5.574	N	Light brown, sulphur odour, N/S	D. Kousbroek
	12-Jan-21	21	5.42	NM	5.269	N	Clear, slight sulphur odour, N/S	D. Kousbroek
	10-Feb-21	21	5.42	NM	5.388	N	Slight brown, slight sulphur odour, N/S	D. Kousbroek
	10-Mar-21	21	5.42	NM	5.228	N	Slight yellow/brown, Slight sulphur odour, N/S	D. Kousbroek
	21-Apr-21	21	5.42	NM	4.756	N	Slight brown, slight sulphur odour, N/S	D. Kousbroek
	19-May-21	21	5.42	NM	4.487	N	very slight yellow, slight sulfur odour, N/S	D. Kousbroek
	16-Jun-21	21	5.42	NM	4.952	N	Slight yellow, N/O, N/S	D. Kousbroek
	14-Jul-21	21	5.42	NM	4.114	N	Slight yellow, mod sulphur odour, N/S	D. Kousbroek
	18-Aug-21	21	5.42	NM	4.44	N	Slight yellow, mod sulphur odour, N/S	D. Kousbroek
	05-May-22	21	5.42	1.16700	4.253	N	Yellow, No/NS	M. Ferguson
	16-Jun-22	21	5.42	1.13200	4.288	--	Very light Yellow, No/NS	M. Ferguson
	28-Jul-22	21	5.42	1.61900	3.801	N	Yellow	M Ferguson
	11-Aug-22	20.66	5.42	1.72000	3.7	N	Weak Odor, Light brown	M Ferguson
	15-Sep-22	20.68	5.42	1.49500	3.925	N	Clear	J Roby
	25-Oct-22	20.485	5.42	1.06800	4.352	N	Good Condition	JR, AK
	17-Nov-22	20.485	5.42	1.47000	3.95	N	Clear, NO/NS	J. Roby
	15-Dec-22	20.485	5.42	1.26900	4.151	N	Odor, Clear	M Ferguson
	18-Jan-23	20.43	5.42	0.994000	4.426	N	Clear	A king
	14-Feb-23	20.43	5.42	1.08900	4.331	N	Clear, NO/NS	A.King
	14-Mar-23	20.557	5.42	1.05100	4.369	N	Clear	A King
	17-Apr-23	20	5.42	1.10300	4.317	N	Clear	A King
	15-May-23	20	5.42	1.12200	4.298	N	Clear	A King
	15-Jun-23	20.59	5.42	0.850000	4.57	N	Light yellow, no odour/sheen	M. Ferguson
	25-Jul-23	20.46	5.42	1.08000	4.34	N	Clear	A King
	16-Aug-23	20.42	5.42	1.09000	4.33	N	Clear, no odor, no sheen	AK
	12-Sep-23	20.521	5.42	0.992000	4.428	N	Clear	A King
	25-Oct-23	20.7	5.42	0.648000	4.772	N	Clear, no odour, no sheen	TJ
	15-Nov-23	20.535	5.42	0.0479999	5.372	N	slight yellow colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	20.32	5.42	0.698000	4.722	N	Clear, no odour, no sheen	TJ
	19-Jan-24	20.395	5.42	0.600000	4.82	N	Odor, Clear	T Jeffery
	14-Feb-24	20.362	5.42	0.638000	4.782	N	Odor, Clear	T Jeffery
	13-Mar-24	21.69	5.42	0.410000	5.01	N	Clear	T Jeffery
	17-Apr-24	20.346	5.42	0.738000	4.682	N	Slight yellow, low sulphur odour, no sheen, Weak Odor, Slight yellow	T Jeffery
	20-May-24	20.42	5.42	1.20700	4.213	N	Slight yellow, low sulphur odour, no sheen, Weak Odor, Slight yellow	T Jeffery
	18-Jun-24	20.664	5.42	1.22700	4.193	N	Clear	C Waddell
	15-Jul-24	20.591	5.42	1.29200	4.128	N	Clear	C Waddell
	20-Aug-24	20.362	5.42	1.29000	4.13	N	Yellow, moderate sulphur odour, no sheen, Odor, Yellow	T Jeffery
	23-Sep-24	20.432	5.42	1.12900	4.291	N	Clear	C Waddell
	23-Oct-24	20.575	5.42	1.27500	4.145	N	Clear	C Waddell
	08-Sep-20	20.5	5.49	NM	4.368	N	Light brown, N/O, N/S	D. Kousbroek
	12-Oct-20	20.5	5.49	NM	4.384	N	Light brown, N/O, N/S	D. Kousbroek
	10-Nov-20	20.5	5.49	2.19300	3.297	N	Light brown, N/O, N/S	D. Kousbroek
	10-Dec-20	20.5	5.49	NM	4.422	N	Light brown, N/O, N/S	D. Kousbroek
	12-Jan-21	20.5	5.49	NM	4.273	N	Clear, slight sulphur odour, N/S	D. Kousbroek
	10-Feb-21	20.5	5.49	NM	4.352	N	Clear, N/O, N/S	D. Kousbroek
	10-Mar-21	20.5	5.49	NM	4.324	N	Clear, N/O, N/S	D. Kousbroek
	21-Apr-21	20.5	5.49	NM	3.442	N	Light brown, slight sulphur odour, N/S	D. Kousbroek

Table 4
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Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
BH7	19-May-21	20.5	5.49	NM	3.515	N	slight yellow, N/O, N/S	D. Kousbroek
	16-Jun-21	20.5	5.49	NM	3.604	N	Clear, N/O, N/S	D. Kousbroek
	14-Jul-21	20.5	5.49	NM	3.342	N	Light orange-brown, N/O, N/S	D. Kousbroek
	18-Aug-21	20.5	5.49	NM	3.626	N	Light yellow, slight sulphur odour, N/S	D. Kousbroek
	05-May-22	20.5	5.49	1.96200	3.528	N	Very Slight Yellow, low sulfur odour, NS	M. Ferguson
	16-Jun-22	20.5	5.49	1.94900	3.541	N	Clear, No/NS	M. Ferguson
	28-Jul-22	20.5	5.49	2.41800	3.072	N	Very light yellow	M Ferguson
	11-Aug-22	20.52	5.49	2.47900	3.011	N	Odor, Clear	M Ferguson
	15-Sep-22	13.19	5.49	2.30000	3.19	N	Clear	J Roby
	25-Oct-22	20.46	5.49	2.20400	3.286	N	Good Condition	JR, AK
	17-Nov-22	20.46	5.49	2.17000	3.32	N	Clear, low sulfur odour, NS	J. Roby
	15-Dec-22	20.46	5.49	1.98600	3.504	N	Clear	M Ferguson
	18-Jan-23	20.266	5.49	1.73200	3.758	N	Weak Odor, Clear	A king
	14-Feb-23	20.266	5.49	1.66200	3.828	N	Clear, moderate Sulphur odour, NS	A.King
	13-Mar-23	20.353	5.49	1.61100	3.879	N	Clear	A King
	17-Apr-23	20	5.49	1.62600	3.864	N	Clear	A King
	15-May-23	20	5.49	0.589000	4.901	N	Clear	A King
	15-Jun-23	20.42	5.49	0.348000	5.142	N	Clear, no odour/sheen	M. Ferguson
	25-Jul-23	20.18	5.49	1.48500	4.005	N	Clear	A King
	16-Aug-23	20.17	5.49	1.48300	4.007	N	Clear, no odor, no sheen	AK
	12-Sep-23	20.167	5.49	1.37400	4.116	N	Clear	A King
	25-Oct-23	20.177	5.49	1.14700	4.343	N	Slight yellow, moderate Sulphur odour, no sheen	TJ
	15-Nov-23	20.2	5.49	1.09000	4.4	N	clear colouration, no odour, no sheen, fast recharge	TJ
	20-Dec-23	20.338	5.49	1.06100	4.429	N	Slight yellow, moderate Sulphur odour, no sheen	TJ
	19-Jan-24	20.155	5.49	1.03500	4.455	N	Odor, Clear	T Jeffery
	14-Feb-24	20.155	5.49	0.985000	4.505	N	Clear	T Jeffery
	13-Mar-24	21.453	5.49	0.82000	4.67	N	Strong Odor, Slight yellow	T Jeffery
	17-Apr-24	20.152	5.49	1.08600	4.404	N	Clear, no sheen, low sulphur odour, Weak Odor, Clear	T Jeffery
	20-May-24	20.15	5.49	1.56500	3.925	N	Clear, no odour, no sheen, Weak Odor, Clear	T Jeffery
	18-Jun-24	20.519	5.49	1.73700	3.753	N	Odor, Light Yellow	C Waddell
	15-Jul-24	20.356	5.49	1.84700	3.643	N	Odor, Light Yellow	C Waddell
	20-Aug-24	20.421	5.49	1.83100	3.659	N	Yellow, strong sulphur odour, no sheen, Strong Odor, Yellow	T Jeffery
	23-Sep-24	20.545	5.49	1.67200	3.818	N	Odor, Clear	C Waddell
	23-Oct-24	20.174	5.49	1.79800	3.692	N	Clear	C Waddell
MW1	05-May-22	9.25	9.3	3.66100	5.639	N	Slight yellow, No/NS	M. Ferguson
	16-Jun-22	9.25	9.3	3.59200	5.708	N	Yellow, No/NS	M. Ferguson
	28-Jul-22	9.24	9.3	3.91500	5.385	N	Light yellow	M Ferguson
	11-Aug-22	9	9.3	3.84100	5.459	N	Clear	M Ferguson
	15-Sep-22	9	9.3	3.64700	5.653	N	Clear	J Roby
	25-Oct-22	9.108	9.3	3.66000	5.64	N	Good Condition	JR, AK
	17-Nov-22	9.108	9.3	3.54000	5.76	N	Clear, NO/NS	J. Roby
	15-Dec-22	9.108	9.3	3.41400	5.886	N	Light yellow	M Ferguson
	18-Jan-23	9.05	9.3	3.30800	5.992	N	Odor, Clear	A king
	14-Feb-23	9.05	9.3	3.26800	6.032	N	Clear, moderate Sulphur odour, NS	A.King
	13-Mar-23	8.909	9.3	3.25600	6.044	N	Odor, Light yellow	A King
	17-Apr-23	8	9.3	3.43700	5.863	N	Odor, Clear	A King
	15-May-23	8	9.3	3.34300	5.957	N	Odor, Clear	A King
	15-Jun-23	8.89	9.3	3.37400	5.926	N	Light yellow, slight sulfur odour, no sheen	M. Ferguson
	25-Jul-23	8.864	9.3	3.34600	5.954	N	Lt yellow	A King
	16-Aug-23	8.84	9.3	3.28900	6.011	N	Clear, no odor, no sheen	AK
	12-Sep-23	8.785	9.3	3.22500	6.075	N	Odor, Clear	A King
	25-Oct-23	8.755	9.3	3.10800	6.192	N	Slight yellow, moderate Sulphur odour, no sheen	TJ

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Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
	15-Nov-23	8.771	9.3	3.18200	6.118	N	yellow colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	8.738	9.3	3.11300	6.187	N	Slight yellow, moderate Sulphur odour, no sheen	TJ
	29-Jan-24	8.734	9.3	2.99100	6.309	N	Odor, Clear	T Jeffery
	14-Feb-24	8.781	9.3	2.96200	6.338	N	Yellow	T Jeffery
	13-Mar-24	9.695	9.3	2.90000	6.4	N	Odor, Yellow	T Jeffery
	17-Apr-24	8.678	9.3	3.22600	6.074	N	Slight yellow, moderate sulphur odour, no sheen, Odor, Slight yellow	T Jeffery
	20-May-24	8.675	9.3	3.73300	5.567	N	Yellow, no odour, no sheen, Yellow	T Jeffery
	19-Jun-24	8.7	9.3	3.89800	5.402	N	Light Yellow	C Waddell
	15-Jul-24	8.663	9.3	3.82900	5.471	N	Clear	C Waddell
	20-Aug-24	8.583	9.3	3.57200	5.728	N	Yellow, slight sulphur odour, no sheen, Weak Odor, Yellow	T Jeffery
	23-Sep-24	8.675	9.3	3.38500	5.915	N	Light Brown, with Light Brown Suspended Solids	C Waddell
	23-Oct-24	8.551	9.3	3.37500	5.925	N	Light Brown	C Waddell
MW3	05-May-22	12.28	4.49	2.43700	2.053	N	Yellow, Moderate odour sulfiur, NS	M. Ferguson
	16-Jun-22	12.28	4.49	2.41000	2.08	N	Yellow, Moderate Sulfur odour, NS	M. Ferguson
	11-Aug-22	NM	4.49	NM	NC	--	--	M Ferguson
	15-Sep-22	NM	4.49	NM	NC	--	--	J Roby
	25-Oct-22	12.01	4.49	3.02500	1.465	N	Half buried in sediment, cap off, water in cavity	JR, AK
	17-Nov-22	12.01	4.49	2.90000	1.59	N	Light yellow, low sulfur odour, NS	J. Roby
	15-Dec-22	12.01	4.49	2.71200	1.778	N	Odor, Yellow	M Ferguson
	18-Jan-23	11.778	4.49	2.45200	2.038	N	Lt yellow	A king
	14-Feb-23	11.778	4.49	2.31100	2.179	N	Light yellow, moderate Sulphur odour, NS	A.King
	13-Mar-23	11.804	4.49	2.20000	2.29	N	Light green, moderate sulfur odour, no sheen	A.King
	17-Apr-23	11	4.49	2.22800	2.262	N	Odor, Yellow	A King
	15-May-23	11	4.49	2.13500	2.355	N	Odor, Lt yellow	A King
	15-Jun-23	11.78	4.49	2.01900	2.471	N	Light yellow, slight sulfur odour, no sheen	M. Ferguson
	25-Jul-23	11.69	4.49	1.99200	2.498	N	Strong Odor, L green	A King
	16-Aug-23	11.63	4.49	1.95700	2.533	N	Light yellow, strong Sulphur odor, no sheen	AK
	12-Sep-23	11.616	4.49	1.97400	2.516	N	Odor, Light yellow	A King
	25-Oct-23	11.623	4.49	1.68600	2.804	N	Yellow, strong Sulphur odour, no sheen	TJ
	15-Nov-23	11.627	4.49	1.66000	2.83	N	yellow colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	11.547	4.49	1.56200	2.928	N	Yellow, Sulphur odour, no sheen	TJ
	19-Jan-24	11.537	4.49	1.47100	3.019	N	Clear	T Jeffery
	14-Feb-24	11.648	4.49	1.43300	3.057	N	Odor, Yellow	T Jeffery
	13-Mar-24	12.44	4.49	1.31000	3.18	N	Odor, Yellow	T Jeffery
	17-Apr-24	11.492	4.49	1.53000	2.96	N	Yellow, no sheen, strong sulphur odour, Strong Odor, Yellow	T Jeffery
	20-May-24	11.5	4.49	2.04800	2.442	N	Brown, stong sulphur odour, no sheen, Strong Odor, Brown	T Jeffery
	18-Jun-24	11.634	4.49	2.36300	2.127	N	Odor, Dark Yellow	C Waddell
	15-Jul-24	11.485	4.49	2.50500	1.985	N	Odor, Light Yellow	C Waddell
	26-Aug-24	11.374	4.49	2.47200	2.018	N	Yellow, moderate sulphur odour, no sheen, Odor, Yellow	T Jeffery
	23-Sep-24	11.597	4.49	2.32500	2.165	N	Slight Yellow	C Waddell
	23-Oct-24	11.347	4.49	2.31300	2.177	N	Weak Odor, Clear	C Waddell
	05-May-22	6.05	5.47	2.56600	2.904	N	Deep Yellow, No/NS	M. Ferguson
	16-Jun-22	6.05	5.47	2.53000	2.94	N	Yellow, No/NS	M. Ferguson
	28-Jul-22	6.02	5.47	3.03100	2.439	N	Deep yellow	M Ferguson
	11-Aug-22	6	5.47	2.99300	2.477	N	Strong Odor, Yellow-brown	M Ferguson
	15-Sep-22	6.07	5.47	2.77500	2.695	N	Light brown	J Roby
	25-Oct-22	6.045	5.47	2.89800	2.572	N	Good Condition	JR, AK
	17-Nov-22	6.045	5.47	2.77100	2.699	N	Clear, NO/NS	J. Roby
	15-Dec-22	6.045	5.47	2.66600	2.804	N	Odor, Yellow	M Ferguson
	18-Jan-23	6.05	5.47	2.50500	2.965	N	Weak Odor, Yellow	A king
	14-Feb-23	6.05	5.47	2.41600	3.054	N	Light yellow, strong Sulphur odour, NS	A.King
	13-Mar-23	6.023	5.47	2.36500	3.105	N	Odor, Yellow	A King

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
MW5	17-Apr-23	6	5.47	2.51600	2.954	N	Odor, Lt yellow	A King
	15-May-23	6	5.47	2.37300	3.097	N	Odor, Lt yellow	A King
	15-Jun-23	6.05	5.47	2.42400	3.046	N	Yellow, slight sulfur odour, no sheen	M. Ferguson
	25-Jul-23	6.03	5.47	2.33800	3.132	N	Odor, Lt yellow	A King
	16-Aug-23	6.03	5.47	2.33500	3.135	N	Yellow, low odor, no sheen	AK
	12-Sep-23	6.022	5.47	2.28700	3.183	N	Odor, Brown	A King
	25-Oct-23	6.015	5.47	2.10500	3.365	N	Yellow, low odour, no sheen	TJ
	15-Nov-23	6.03	5.47	2.25600	3.214	N	yellow colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	6.02	5.47	1.97800	3.492	N	Light Yellow, no odour, no sheen	TJ
	19-Jan-24	6.01	5.47	1.91700	3.553	N	Odor, Brown	T Jeffery
	14-Feb-24	6.024	5.47	1.90000	3.57	N	Odor, Yellow	T Jeffery
	13-Mar-24	7.035	5.47	1.87500	3.595	N	Weak Odor, Light brown	T Jeffery
	17-Apr-24	6.012	5.47	2.11400	3.356	N	Brown, low sulphur odour,no sheen, Weak Odor, Brown	T Jeffery
	20-May-24	6.007	5.47	2.57200	2.898	N	Light brown, no odour, no sheen, Light brown	T Jeffery
	18-Jun-24	6.108	5.47	2.64700	2.823	N	Light Yellow/Green	C Waddell
	15-Jul-24	5.979	5.47	2.62800	2.842	N	Clear	C Waddell
	20-Aug-24	5.01	5.47	2.43600	3.034	N	Yellow, no sheen, no odour, Yellow	T Jeffery
MW6	27-Sep-24	6.075	5.47	2.31800	3.152	N	Moderate Yellow	C Waddell
	23-Oct-24	6.102	5.47	2.26100	3.209	N	Light Yellow	C Waddell
	05-May-22	7.38	5.78	2.37000	3.41	N	Yellow, No/NS	M. Ferguson
	16-Jun-22	7.38	5.78	2.34500	3.435	N	Grey/Yellow, No/NS	M. Ferguson
	28-Jul-22	7.36	5.78	2.64200	3.138	N	Light yellow	M Ferguson
	11-Aug-22	7	5.78	2.59300	3.187	N	Strong Odor, Light brown	M Ferguson
	15-Sep-22	7.415	5.78	2.31900	3.461	N	Clear	J Roby
	25-Oct-22	7.372	5.78	2.34500	3.435	N	Good Condition	JR, AK
	17-Nov-22	7.372	5.78	2.18000	3.6	N	Clear, NO/NS	J. Roby
	15-Dec-22	7.372	5.78	2.06100	3.719	N	Light yellow	M Ferguson
	18-Jan-23	7.351	5.78	2.02700	3.753	N	Weak Odor, Clear	A king
	14-Feb-23	7.351	5.78	1.96800	3.812	N	Light brown, low Sulphur odour, NS	A.King
	14-Mar-23	7.36	5.78	1.97500	3.805	N	Clear	A King
	17-Apr-23	7	5.78	2.11100	3.669	N	Odor, Light brrown to yellow	A King
	15-May-23	7	5.78	2.07400	3.706	N	Odor, Lt yellow	A King
	15-Jun-23	7.42	5.78	2.05800	3.722	N	Yellow, no odour/sheen	M. Ferguson
	25-Jul-23	7.345	5.78	2.00200	3.778	N	Weak Odor, Lt yellow	A King
	16-Aug-23	7.35	5.78	1.98600	3.794	N	Light yellow low Sulphur odor, no sheen	AK
	12-Sep-23	7.33	5.78	1.95400	3.826	N	Odor, Lt yellow	A King
	25-Oct-23	7.342	5.78	2.40800	3.372	N	Yellow no odour, no sheen	TJ
	15-Nov-23	7.357	5.78	1.92400	3.856	N	yellow colouration, no odour, no sheen, fast recharge	TJ
	20-Dec-23	7.321	5.78	1.85900	3.921	N	Slight Yellow no odour, no sheen	TJ
	19-Jan-24	7.33	5.78	1.85800	3.922	N	Odor, Slight yellow	T Jeffery
	14-Feb-24	7.33	5.78	1.86700	3.913	N	Clear	T Jeffery
	13-Mar-24	8.86	5.78	1.80200	3.978	N	Weak Odor, Yellow	T Jeffery
	17-Apr-24	7.312	5.78	2.09200	3.688	N	Light brown, low sulphur odour, no sheen, Weak Odor, Light brown	T Jeffery
	20-May-24	7.32	5.78	2.55400	3.226	N	Light brown, moderate sulphur odour, no sheen, Odor, Light brown	T Jeffery
	18-Jun-24	7.336	5.78	2.57400	3.206	N	Moderate Yellow	C Waddell
	15-Jul-24	7.318	5.78	2.44800	3.332	N	Light Yellow	C Waddell
	20-Aug-24	7.31	5.78	2.28200	3.498	N	Yellow, moderate sulphur odour, no sheen, Odor, Yellow	T Jeffery
	23-Sep-24	7.311	5.78	2.17300	3.607	N	Clear	C Waddell
	23-Oct-24	7.292	5.78	2.11200	3.668	N	Clear	C Waddell
	05-May-22	7.965	5.89	1.95600	3.934	N	Deep Yellow Brown, No/NS	M. Ferguson
	16-Jun-22	7.965	5.89	1.94200	3.948	N	Deep Yellow, Strong Sulfur odour	M. Ferguson
	28-Jul-22	7.96	5.89	2.41600	3.474	N	Deep yellow/orange	M Ferguson

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Well ID	Date	Well Depth (m)	TOC (mAHD)	Water Table Elevation (mAHD)	DTW (mBTC)	Dry Indicator (Y/N)	Remark	Technician
MW7	11-Aug-22	NM	5.89	2.47600	3.414	N	Strong Odor, Yellow	M Ferguson
	15-Sep-22	7.76	5.89	2.51500	3.375	N	Brown	J Roby
	25-Oct-22	7.756	5.89	2.41500	3.475	N	Good Condition	JR, AK
	17-Nov-22	7.756	5.89	2.38500	3.505	N	Yellow, low sulfur odour, NS	J. Roby
	15-Dec-22	7.756	5.89	2.19000	3.7	N	Light yellow	M Ferguson
	18-Jan-23	7.743	5.89	1.94300	3.947	N	Weak Odor, Lt yellow	A king
	14-Feb-23	7.743	5.89	1.86400	4.026	N	light yellow, low Sulphur odour, NS	A.King
	13-Mar-23	7.643	5.89	1.81400	4.076	N	Odor, Light yellow	A King
	17-Apr-23	7	5.89	1.82700	4.063	N	Odor, Lt yellow	A King
	15-May-23	7	5.89	1.79300	4.097	N	Odor, Lt yellow	A King
	15-Jun-23	7.58	5.89	1.54900	4.341	N	Yellow, moderate sulfur odour, no sheen	M. Ferguson
	25-Jul-23	7.745	5.89	1.67900	4.211	N	Odor, Lyellow	A King
	16-Aug-23	7.78	5.89	1.68200	4.208	N	Brown, moderate Sulphur odor, no sheen	AK
	12-Sep-23	6.5	5.89	1.57800	4.312	N	Brown	A King
	25-Oct-23	7.721	5.89	1.34500	4.545	N	Yellow, moderate Sulphur odour, no sheen	TJ
	15-Nov-23	7.718	5.89	1.27800	4.612	N	yellow colouration, Sulphur odour, no sheen, fast recharge	TJ
	20-Dec-23	7.73	5.89	1.26400	4.626	N	Yellow, moderate Sulphur odour, no sheen	TJ
	19-Jan-24	7.722	5.89	1.20400	4.686	N	Odor, Yellow	T Jeffery
	14-Feb-24	7.715	5.89	1.17800	4.712	N	Odor, Yellow	T Jeffery
	13-Mar-24	8.64	5.89	1.02500	4.865	N	Weak Odor, Yellow	T Jeffery
	17-Apr-24	7.716	5.89	1.28400	4.606	N	Brown, moderate sulphur odour, no sheen, Odor, Brown	T Jeffery
	20-May-24	7.717	5.89	1.77000	4.12	N	Brown, no odour, no sheen, Brown	T Jeffery
	18-Jun-24	7.713	5.89	1.90600	3.984	N	Really Dark Yellow	C Waddell
	15-Jul-24	7.749	5.89	2.06000	3.83	N	Dark Yellow	C Waddell
	20-Aug-24	7.714	5.89	2.03000	3.86	N	Rown, slight sulphur odour, no sheen, Weak Odor, Brown	T Jeffery
	23-Sep-24	7.808	5.89	1.88500	4.005	N	Odor, Dark Yellow	C Waddell
	23-Oct-24	7.722	5.89	1.93800	3.952	N	Weak Odor, Dark Yellow	C Waddell

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
BH1	08-Sep-20	3.64	77	5.95	258	167	18.55	
	12-Oct-20	0.04	27.4	6.04	258	186	20	
	10-Nov-20	1.35	28	6.04	268	171	20.86	
	10-Nov-20	1.35	28	6.04	268		20.86	
	10-Dec-20	3.25	89	5.95	274	178	19.4	
	12-Jan-21	2.88	62	7.4	302	197	23.2	
	10-Feb-21	4.66	33	6.82	3.52	228	20.1	
	10-Mar-21	2.92	28.5	7.2	278	180	20.43	
	21-Apr-21	0.2	-92.1	5.47	173	112	20.12	
	19-May-21	0.26	-21	5.91	233	151	18.8	
	16-Jun-21	3.6	-141	5.79	251	163	18.5	
	14-Jul-21	0.2	-194.9	6.09	265.1	172	18.8	
	18-Aug-21	0.1	-162	6.13	215	159	18.6	
	05-May-22	1.83	-63.7	6.22	319.7	208	18.9	10.49
	16-Jun-22	8.08	-53	6.19	224	146	19.3	18
	28-Jul-22	6.15	26.7	5.93	0.225	147	18	34
	10-Aug-22	0	-102	5.8	0.256		18.7	13.4
	15-Sep-22	0.86	-117.5	5.88	214.4	159	18.6	7.87
	25-Oct-22	4.19	-129.3	5.93	216.9	160	18.6	
	17-Nov-22	0.36	-78.6	5.85	217.9	160	19	
	15-Dec-22	6.83	-71	5.99	248	161	18.7	31
	18-Jan-23	0.26	-135.9	5.85	236.7	173	19.2	5.01
	14-Feb-23	-0.1	-105.7	5.91	230.3	171	18.6	
	13-Mar-23	0.18	-106.6	5.97	237.6	173	19.9	5.69
	17-Apr-23	0	-107.9	6.02	233.8	167	18.3	120.9
	15-May-23	0.61	-61.9	5.81	210.2	156	18.3	2.5
	15-Jun-23	4	32.8	5.45	257.3	167	13.8	2.23
	25-Jul-23	0.28	-110.4	5.66	219.3	164	18.2	14
	16-Aug-23	0.7	-98	5.8	266.2	173	18	3
	12-Sep-23	0.16	-155.2	5.6	191.4	142	18.4	4.5
	24-Oct-23	0.35	-86.5	6.79	209.5	150	20.1	2.3
	15-Nov-23	0.27	-172.9	6.25	183.7	135	18.9	4
	20-Dec-23	0.28	-137.7	5.81	281.4	204	19.5	1.93
	19-Jan-24	0.2	-177.9	5.75	217.4	156	20	0.2
	14-Feb-24	8.72	-70.4	5.84	202.9	146	19.8	30.78
	13-Mar-24	0.37	196.3	6.07	232.2	167	19.1	0.3
	17-Apr-24	1.43	-98.2	5.89	236.1	170	20.1	4.3
	20-May-24	1.54	-120.6	5.92	224.6	171	17.4	8.92
	19-Jun-24	4.62	-69.7	5.96	198.9	145	19.1	7.35

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW

Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
	15-Jul-24	2.13	-7.3	5.82	182.4	135	18.7	3.7
	20-Aug-24	4.56	52.4	5.3	179.5	133	18.6	34
	23-Sep-24	0.31	130.7	5.04	173.3	125	19.8	21.45
	23-Oct-24	5.77	146.2	5.83	172.5	126	19.4	17.7
BH2	08-Sep-20	1.56	120	5.18	199	129	18.74	
	12-Oct-20	0.4	144	4.92	209	136	19.8	
	10-Nov-20	0.08	120	5.36	196	125	22.38	
	10-Nov-20	0.08	120	5.36	196		22.38	
	10-Dec-20	1.07	189	5.26	218	141	19.9	
	12-Jan-21	3.85	131	6.6	218	138	22.38	
	10-Feb-21	6.19	98	6.24	292	185	20.5	
	10-Mar-21	2.21	129	6.37	230	150	20.5	
	21-Apr-21	0.2	-43	5.19	180	117	20.8	
	19-May-21	0.2	83	5.22	199	130	18.9	
	16-Jun-21	9.37	-11	5.53	175	114.4	18.4	
	14-Jul-21	0.2	-101.2	5.18	177	115	18.6	
	18-Aug-21	4.4	-50.1	5.43	153	114	18.3	
	05-May-22	3.17	-70.9	5.51	224.8	146	18.9	66
	16-Jun-22	7.95	-10	5.21	178	113	19.1	14
	28-Jul-22	5.11	-110	5.32	0.197	128	16.9	120
	11-Aug-22	0	-62	5.01	0.171		18.5	34
	15-Sep-22	0.22	-38	5.14	145.4	108	18.6	154
	25-Oct-22	4.22	-92.1	5.32	144.3	105	19.4	
	17-Nov-22	1.02	-84.2	5.13	141.7	104	18.8	
	15-Dec-22	4.39	-31	5.28	156	102	18.7	2.6
	18-Jan-23	3.9	-55.9	5.25	132.3	96	19.7	6.29
	14-Feb-23	0.9	-53	5.2	124.5	90	19.9	
	13-Mar-23	1.3	-0.7	5.14	117.6	86	19.4	6.45
	17-Apr-23	0.12	-33.8	5.29	111.2	81	19.1	5.35
	15-May-23	4.81	-17.8	5.37	107.6	79	19.1	8
	15-Jun-23	5.1	-45.2	5.9	134.6	88	17.1	-1.4
	25-Jul-23	0.97	-58.9	5.05	94.7	70	18.8	53
	16-Aug-23	0.9	-41.3	5.26	105.2	68	18.6	6
	12-Sep-23	0.66	-91.5	5.23	86	63	19	9
	24-Oct-23	0.39	-9.9	6.72	78.2	57	19.6	15.1
	15-Nov-23	1.3	-75.4	5.92	73.3	53	20.1	2.6
	20-Dec-23	0.79	-87	5.23	95.9	70	19.6	2.65
	19-Jan-24	0.31	-112	5.2	76.6	0.55	20.1	0.55
	14-Feb-24	0.63	-42.4	5.32	75.8	54	20.6	4.32

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QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW

Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
	13-Mar-24	5.22	-12.7	6.26	83.1	60	20.2	1.28
	18-Apr-24	0.72	-44	5.47	73.7	53	19.3	8.1
	20-May-24	2.65	-62.2	5.37	71.2	52	18.8	6.48
	19-Jun-24	9.83	153.6	7.19	69.6	52	18.6	15.49
	15-Jul-24	4.08	103.9	5.52	64.6	48	18.4	6.22
	20-Aug-24	9.91	40.9	6.93	83.2	61	19	6.94
	23-Sep-24	53	158.8	4.93	73.2	53	19.9	0.21
	23-Oct-24	3.32	166.5	5.42	84.3	61	19.8	6.66
BH3	08-Sep-20	3.42	342	4.45	163	108	50.4	
	12-Oct-20	1.39	284	4.43	159	116	19.9	
	10-Nov-20	1.52	194	5.2	145	92.8	21.67	
	10-Nov-20	1.52	194	5.2	145		21.67	
	10-Dec-20	1.58	286	5.17	157	102	19.7	
	12-Jan-21	3.76	223	6.21	171	111	21.8	
	10-Feb-21	2.29	159	6.19	198	129	20.1	
	10-Mar-21	1.28	137	6.14	149	96	20.3	
	21-Apr-21		122	5.2	124	81	20.3	
	19-May-21	0.13	103	5.35	144	94	18.7	
	16-Jun-21	0.21	27	5.29	121	78	18.3	
	14-Jul-21	0.2	-43.3	5.27	126.3	82	19	
	18-Aug-21	2.3	-17.7	5.25	124.5	91	19.1	
	05-May-22	3.29	19.9	5.55	88.8	58	19.2	8.8
	16-Jun-22	7.76	28	5.56	66	43	19.3	15
	28-Jul-22	5.58	101.7	5.38	0.0801	52	16.9	123
	11-Aug-22	0	-50	5.42	0.071		19.1	20
	15-Sep-22	0.4	125.6	5.32	62.8	46	19.1	25.9
	25-Oct-22	4.81	-80	5.53	58.5	43	19.4	
	17-Nov-22	2.87	90.6	5.38	58.7	43	19.1	
	15-Dec-22	2.72	132.9	5.4	66.2	43	19.2	3.35
	18-Jan-23	1.95	166.2	5.18	62	43	22.2	14.13
	14-Feb-23	0.5	156	4.98	57.5	42	19.7	
	13-Mar-23	0.14	161.3	4.99	51.7	37	19.7	2.18
	17-Apr-23	0.04	159	5.27	52.2	38	19.5	5.43
	15-May-23	2.14	166.3	5.21	50.1	37	19.3	16
	15-Jun-23	3.3	137.8	5.4	63.9	42	17.1	0.18
	25-Jul-23	0.69	-31.2	5.11	53.9	40	19	5
	16-Aug-23	-0.9	-14.2	5.21	66.1	43	18.8	7
	12-Sep-23	0.29	-50	5.15	54.4	40	19.3	5.26
	24-Oct-23	1.07	96.7	6.43	57.5	41	20.2	4.59

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW

Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
	15-Nov-23	1.43	149.3	5.61	55.4	40	20.3	1.68
	20-Dec-23	1.21	86.1	4.97	76.2	55	19.8	5
	19-Jan-24	3.52	102.1	4.88	57.7	41	20.2	3.01
	14-Feb-24	0.73	91.1	5	59.8	42	20.6	1.8
	13-Mar-24	1.98	112.3	5.21	63.9	45	20.8	44.04
	17-Apr-24	3.1	114.7	4.94	67.8	48	20.6	4.85
	20-May-24	0.69	88.5	4.68	62.2	45	19.3	5.7
	19-Jun-24	2.83	97.2	5.21	51.7	37	19.1	9.11
	15-Jul-24	3.69	123.2	5.13	51.4	39	18.8	17.74
	20-Aug-24	5.08	104	4.99	60.6	43	20.7	0.81
	23-Sep-24	42	110.7	4.61	59.4	42	20.6	0.41
	23-Oct-24	3.8	186.1	5.15	63.1	45	19.9	4.06
BH4	08-Sep-20	2.83	347	4.45	210	137	19.92	
	12-Oct-20	0.48	242	4.77	163	119	19	
	10-Nov-20	2.88	155	5.32	201	129	19.8	
	10-Nov-20	2.88	155	5.32	201		19.8	
	10-Dec-20	3.77	187	5.19	290	188	19.2	
	12-Jan-21	5.62	-9.6	6.08	289	189	21.5	
	10-Feb-21	4.22	-42	5.76	495	320	20.58	
	10-Mar-21	1.88	-171	5.66	419	269	20.5	
	21-Apr-21		-81	4.79	337	218	21.42	
	19-May-21	0.41	95	4.74	469	305	19.2	
	16-Jun-21	0.69	-63.7	4.83	334	217	18.7	
	14-Jul-21	0.9	1.8	4.66	265.3	172	17.7	
	18-Aug-21	0.4	-115.8	4.79	248.6	188	17.7	
	05-May-22	2.6	16.6	4.97	268	195	20.1	13.3
	16-Jun-22	7.77	40	4.93	229	149	18.9	16
	28-Jul-22	4.3	134	4.6	0.2485	162	17.4	159
	11-Aug-22	3.97	106	4.98	0.236		18.3	3.99
	15-Sep-22	0.04	-30.9	4.73		166	17.2	12.56
	25-Oct-22	2.18	-83.3	4.81	213.2	160	17.9	
	17-Nov-22	3.41	-72.6	4.88	213.3	158	18.5	
	15-Dec-22	0.28	-44.9	4.76	233	152	18.7	7.7
	18-Jan-23	0.23	-88.9	4.92	210.9	151	20.1	11.28
	14-Feb-23	2.3	-50.6	4.82	206.3	148	20.1	
	13-Mar-23	0.22	4.4	8.81	202.9	14.8	20.6	1.76
	17-Apr-23	0.53	-42.8	4.92	201.8	149	19.7	38.5
	15-May-23	0.37	-35.4	4.83	203.7	147	19.7	8.2
	15-Jun-23	3.5	153.9	5.02	231.1	150	17.7	-5.58

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
	25-Jul-23	0.33	13	4.74	191.9	143	28.4	51
	16-Aug-23	0.3	-8.7	4.84	224	146	18.1	4
	12-Sep-23	1.87	-32.7	4.88	184.7	137	18.5	23.51
	24-Oct-23	0.2	11.4	6.19	181.7	133	19.2	3.26
	15-Nov-23	0.36	-30	5.43	169	123	19.7	4
	20-Dec-23	0.72	-50.2	4.73	226.1	166	19	3.69
	19-Jan-24	0.26	-51.9	4.82	181.6	131	19.7	0.1
	14-Feb-24	0.3	-49.9	4.83	179.6	129	20.2	3.18
	13-Mar-24	0.34	-85.3	20.9	182.7	130	20.9	0.9
	17-Apr-24	5.61	-33	4.97	129	129	21.3	4.71
	20-May-24	3.52	-5.8	4.84	171.5	125	19.5	0.51
	18-Jun-24	4.33	-28.7	4.77	176.7	130	18.7	1.65
	15-Jul-24	1.5	-26.9	4.75	172.7	135	17.5	1.37
	20-Aug-24	2.45	-12.8	5.39	191.2	144	17.9	0.38
	27-Sep-24	1.24	24.2	4.2	197	145	18.9	3.59
	23-Oct-24	0.27	112.9	4.74	208.3	152	19.2	0.43
BH5	08-Sep-20	3.71	339	4.76	207	134	21.02	
	12-Oct-20	2.61	225	4.66	196	143	19.5	
	10-Nov-20	2.29	-17.8	5.31	214	137	21.45	
	10-Nov-20	2.29	-17.8	5.31	214		21.45	
	10-Dec-20	0.5	31	5.13	235	157	20.4	
	12-Jan-21	4	-85	5.87	249	163	22.93	
	10-Feb-21	4.61	-184	5.84	360	236	22.4	
	10-Mar-21	2.44	-193	5.8	263	171	21.3	
	21-Apr-21		-110	5.18	204	134	22.2	
	19-May-21	1.9	48.4	5.41	265	172	21	
	16-Jun-21	2.15	-58	5.29	234	152	19.9	
	14-Jul-21	0.4	-104	5.27	233.5	152	18.3	
	18-Aug-21	0.9	-80.6	5.24	193.1	143	18.5	
	05-May-22	1.82	-59	5.13	193	126	20.3	2.41
	16-Jun-22	7.4	180	5.28	154	100	20.2	25
	28-Jul-22	3.4	116.3	5.01	0.176	115	17.7	149
	11-Aug-22	3.61	41	5.23	0.167		17.9	55
	15-Sep-22	0.89	-31	5.12	164	17.8	17.8	25.5
	25-Oct-22	1.4	-71.5	5.07	165	122	18.9	
	17-Nov-22	1.7	-69.8	5.07	167.1	122	19.4	
	15-Dec-22	0	-53	5.06	189.6	123	19.5	3.76
	18-Jan-23	3.17	-72.9	5.06	192.6	133	21.7	13.97
	14-Feb-23	0.5	-50.1	5.03	202	135	23.6	

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW

Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
	14-Mar-23	0.52	-8	5.01	185.8	133	20.2	1.67
	17-Apr-23	-0.07	-66.3	5.11	176.2	127	19.9	6.71
	15-May-23	0.15	-41	4.93	185.4	132	20.4	0.75
	15-Jun-23	5.5	109.9	5.48	197.3	128	19.6	-4.72
	25-Jul-23	0.26	78.6	4.99	144.9	107	18.6	1.5
	16-Aug-23	-0.8	94.9	5.02	174.4	113	18.5	2
	12-Sep-23	0.43	108.1	5.08	148	109	19	3.59
	24-Oct-23	0.18	69.8	6.37	158.2	112	20.8	44
	15-Nov-23	8.23	60	6.24	147	103	21	5
	20-Dec-23	0.51	-37.8	4.92	199.8	143	20.1	0.8
	19-Jan-24	0.31	-52.8	5.04	168.9	118	21.4	0.1
	14-Feb-24	0.74	-43.8	5.09	179	119	24	1.8
	13-Mar-24	0.53	-67.1	5.25	181.7	121	23.6	2.22
	18-Apr-24	0.67	-55.7	4.99	178.9	120	23.2	0.95
	20-May-24	0.83	-33.6	4.99	162.8	116	20.6	0.12
	18-Jun-24	4.12	110.1	5.14	151.8	110	19.8	3.6
	15-Jul-24	1.88	7	5.13	138.8	106	17.6	1.27
	20-Aug-24	2.49	-65.3	5.61	177.1	129	19.3	0.59
	23-Sep-24	0.21	-78.7	4.48	180.1	129	20.2	3.84
	23-Oct-24	135	112.7	4.96	187.2	135	19.8	1.96
	08-Sep-20	4.37	0.3	6.3	454	297	21.6	
	12-Oct-20	4.37	0.3	6.3	454	297	21.6	
	10-Nov-20	4.11	-50	6.55	558	362	18.6	
	10-Nov-20	4.11	-50	6.55	558	362	18.6	
	10-Dec-20	1.55	-16.2	6.44	536	344	19.4	
	12-Jan-21	2.49	-124	6.9	492	319	23.6	
	10-Feb-21	3.92	-118	6.64	708	461	22.4	
	10-Mar-21	2.31	-168	6.32	559	362	20.8	
	21-Apr-21		-112	6.16	507	335	21.3	
	19-May-21	5.9	-48.9	6.61	535	347	20.6	
	16-Jun-21	0.07	-113	6.26	522	340	19.2	
	14-Jul-21	0.2	-93.8	6.25	531	345	18.3	
	18-Aug-21	3.4	-41.6	6.34	466.3	351	17.8	
	05-May-22	4.23	-5.3	6.39	584	380	20.8	22.1
	16-Jun-22	7.65	-27	6.31	565	369	19.4	13
	28-Jul-22	7	27.4	6.02	0.238	155	17.4	34
	11-Aug-22	3.9	-18.4	6.2	0.604		17.8	79.51
	15-Sep-22	-0.01	-113.4	6.2	545	412	17.6	21.38
	25-Oct-22	0.08	-145.3	6.19	553	408	18.8	

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
BH6	17-Nov-22	1.7	-0.08	6.16	561	413	18.9	
	15-Dec-22	0.15	-129.7	6.19	635	413	18.8	0.14
	18-Jan-23	6.85	-50.4	6.35	661	430	24.9	12.64
	14-Feb-23	0.2	-106.5	6.19	602	430	20.3	
	14-Mar-23	0.14	-72.6	6.16	613	439	20.2	3.86
	17-Apr-23	-0.03	-74.5	6.26	612	442	19.8	11.72
	15-May-23	4.28	-35	6.3	607	440	19.6	7.02
	15-Jun-23	2.5	4.5	6.48	653	424	18.1	7.52
	25-Jul-23	0.47	-93	6.12	582	436	18.1	89
	16-Aug-23	-0.9	-125.1	6.22	683	444	18.2	4
	12-Sep-23	0.15	-94.6	6.22	572	425	18.4	3.61
	24-Oct-23	1.19	-45	7.4	578	414	20.1	5.9
	15-Nov-23	1.5	-63	6.85	258	386	20.5	5
	20-Dec-23	8.84	-59.2	6.85	704	517	18.9	0.05
	19-Jan-24	0.25	-94.8	6.18	577	409	20.6	0.1
	14-Feb-24	0.31	-91.9	6.25	628	412	24.6	2.99
	13-Mar-24	0.9	-57.7	6.42	587	405	22	0.91
	17-Apr-24	1.88	-57	6.18	558	2.9	20.5	2.9
	20-May-24	0.28	-43.3	6.19	522	380	19.4	0.12
	18-Jun-24	3.41	7.1	6.26	427.5	318	18.4	33.42
	15-Jul-24	4.14	16.4	6.36	465	353	17.5	11.71
	20-Aug-24	7.85	28.3	7.92	575	403	21	41
	23-Sep-24	0.31	-10.7	5.62	531	388	19.2	3.21
	23-Oct-24	5.02	39.7	6.39	569	404	19.6	8.63
	08-Sep-20	6.11	9.3	5.9	251	163	19.91	
	12-Oct-20	6.11	9.3	5.9	251	163	19.91	
	10-Nov-20	1.34	39.4	5.89	249	159	19.92	
	10-Nov-20	1.34	39.4	5.89	249		19.92	
	10-Dec-20	0.16	59	5.83	271	172	19.4	
	12-Jan-21	3.55	-12	6.58	274	179	21.4	
	10-Feb-21	3.6	-4.2	6.28	359	233	20.7	
	10-Mar-21	2.26	-62	6.15	278	180	20.9	
	21-Apr-21		-40	3.59	192	125	20.27	
	19-May-21	1.62	128	5.82	258	168	17.7	
	16-Jun-21	1.48	173	5.55	230	150	17.9	
	14-Jul-21	0.2	-77	5.34	239.6	154	17.7	
	18-Aug-21	2.9	-36.2	5.34	196.1	149	17.5	
	05-May-22	2.79	-53	5.06	261	170	20.2	4.93
	16-Jun-22	7.88	118	5.33	200	130	19	15

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
BH7	28-Jul-22	4.33	-7.9	4.98	0.224	146	17.3	141
	11-Aug-22	2.84	-32.8	5.64	0.2416		18.3	125.6
	15-Sep-22	7.44	-51.7	5.18	184.7	139	17.9	19.15
	25-Oct-22	1.14	-93.1	5.05	220.6	162	19.1	
	17-Nov-22	0.83	-98.7	5.03	212.7	156	19	
	15-Dec-22	0.11	-71.4	4.99	261.5	170	19.5	1.59
	18-Jan-23	2.8	-84	5.02	224.4	157	21.3	27.82
	14-Feb-23	5	-56.9	5.18	216.8	157	19.8	
	13-Mar-23	0.1	-9.6	5.1	223.2	160	20.2	4.55
	17-Apr-23	0.38	-78.6	5.35	215.9	156	19.7	34.14
	15-May-23	2.93	-42	5.31	220	161	19.1	6.08
	15-Jun-23	5.8	152.7	5.52	267.3	174	17.5	-1.43
	25-Jul-23	3.59	-45.8	5.17	242.1	181	18.2	1
	16-Aug-23	-0.8	-62.2	5.25	278.7	181	18.1	4
	12-Sep-23	0.42	-77.4	5.2	226.8	-1.28	18.3	8.28
	24-Oct-23	3.76	-12.7	6.78	225.6	165	19.1	42
	15-Nov-23	0.29	-103.4	5.72	213.9	154	19.9	5
	20-Dec-23	0.29	-98	5.01	296.4	217	19.1	4.21
	19-Jan-24	0.31	-105.7	5.16	252.6	179	20.6	1.1
	14-Feb-24	0.39	-92.7	5.33	267.8	186	21.6	1.94
	13-Mar-24	1.68	-157.1	5.76	262.8	187	20.6	2.6
	17-Apr-24	3.08	-102.6	5.62	291.4	193	24	7.6
	20-May-24	3.2	0.2	5.5	242.2	177	19.2	39.5
	18-Jun-24	6.8	95	5.35	211.1	156	18.5	7.53
	15-Jul-24	7.15	128.8	5.59	199.7	153	17	36.49
	20-Aug-24	5.05	-86.4	6.12		155	18.1	5.18
	23-Sep-24	0.25	41.1	4.45	213.7	158	18.8	0.65
	23-Oct-24	3.71	164.8	5.05	232.5	170	19.2	5.19
	05-May-22	1.41	-68.5	6.77	606	394	20.4	15.64
	16-Jun-22	7.96	-34	6.74	312	203	20.4	17
	28-Jul-22	4.81	59	6.33	0.462	301	17	86
	11-Aug-22	0.93	-37.8	6.53	0.408		17.8	14
	15-Sep-22	0.74	-90.8	6.75	266.9	203	17.3	18.33
	25-Oct-22	3.48	-110.2	6.54	277.1	206	18.5	
	17-Nov-22	4.09	-68.8	6.5	269.1	203	17.9	
	15-Dec-22	4.71	-94.4	6.66	366.1	238	18.6	7.41
	18-Jan-23	0.31	-170.7	6.39	292.6	211	19.8	28.54
	14-Feb-23	0.7	-155.5	6.41	280.8	204	19.5	
	13-Mar-23	1.52	-127.8	6.46	286.5	209	19.3	26.3

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW

Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
MW1	17-Apr-23	3.65	-91	6.76	395	288	19.4	41.1
	15-May-23	6.45	-59	6.8	303.2	223	1.9	0.6
	15-Jun-23	2.6	-103.7	6.42	299.4	195	13.6	-4.24
	25-Jul-23	0.28	-156.9	6.21	253.3	191	18	6
	16-Aug-23	0	-118.5	6.42	298.6	194	17.7	17
	12-Sep-23	0.19	-165.7	6.46	240.3	179	18.3	9
	24-Oct-23	0.12	-83.4	7.89	246.9	180	19.1	15.3
	15-Nov-23	0.2	-157.4	7.03	245.7	180	19.1	3.5
	20-Dec-23	1.24	-144.7	6.92	350.8	253	19.8	7
	29-Jan-24	0.23	-169.9	6.41	294.2	209	20.4	0.19
	14-Feb-24	2.48	-14.8	6.37	317.6	214	23.1	14
	13-Mar-24	4.18	8.5	6.54	2833	200	21	15.27
	17-Apr-24	0.31	-10.4	6.33	384	270	21	14.48
	20-May-24	0.72	8.2	6.6	438.7	312	20	40.1
	19-Jun-24	8.75	7.3	6.99	321.3	320	19.2	16.5
	15-Jul-24	6.31	154.3	6.66	295.3	233	15.8	120.15
	20-Aug-24	5.89	66	5.64	286.7	217	17.7	25
	23-Sep-24	2.64	109.3	5.96	241.3	177	19	60.36
	23-Oct-24	7.97	115.3	6.44	321.4	236	18.8	10.04
MW3	05-May-22	1.74	-82	5.42	181.1	118	20.4	22
	16-Jun-22	7.82	-28	5.18	159	102	19.5	10
	17-Nov-22	-0.05	-99.7	5.02	130.1	93	20.3	
	15-Dec-22	-0.12	-66.5	5.03	139.4	91	22.2	63.7
	18-Jan-23	1.6	-91.9	4.98	162.3	101	27.7	115.83
	14-Feb-23	0	-100.2	5.12	166.4	117	21.1	
	13-Mar-23	0	-16.5	5	132.7	92	21.8	6.51
	17-Apr-23	0.04	-76.4	5.2	125.8	88	21.3	177.4
	15-May-23	0.83	-62	5.19	115	81	20.8	114
	15-Jun-23	3.1	-109.8	5.42	118.9	77	16.8	10.13
	25-Jul-23	1.69	-84.1	5.16	102.3	74	19.5	181
	16-Aug-23	-0.8	-81.2	5.26	120.6	78	18.8	16
	12-Sep-23	0.05	-121.5	5.27	100.7	71	20.6	16.91
	24-Oct-23	0.07	-60.3	6.88	108.2	74	22.3	93.1
	15-Nov-23	0.16	-117	5.83	96	67	21.7	9
	20-Dec-23	0.55	-49.6	5.24	147.3	103	21.4	37.7
	19-Jan-24	0.19	-138.2	5.09	183.9	122	23.8	0.21
	14-Feb-24	4.78	-34.7	5.04	180.9	110	28.7	29.85
	13-Mar-24	0.23	-166.8	5.41	145.2	94	25	0.6
	17-Apr-24	0.25	-135.7	5.13	124.7	85	22.4	5.2

Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
	20-May-24	0.31	-114.8	5.08	118.9	84	20.6	230
	18-Jun-24	3.41	-88.8	5.24	110	81	19.1	163.38
	15-Jul-24	1.23	-93.2	5.31	101.6	76	18.2	12.75
	26-Aug-24	9.38	-110.5	6.01	124.5	95	17.6	10.4
	23-Sep-24	1.48	-124.1	4.82	130.8	93	20.4	4.33
	23-Oct-24	2.73	13	5.38	137.8	96	21.8	6.51
MW5	05-May-22	2.55	39.4	5.69	268	175	21.7	35.6
	16-Jun-22	7.32	69	5.93	232	157	19.5	28
	28-Jul-22	3.58	-20.3	5.27	0.2269	147	17.6	121
	11-Aug-22	6.51	-55	5.64	0.197		16.9	42
	15-Sep-22	-0.14	-91.8	5.42	175.6	134	17.1	15.7
	25-Oct-22	7.64	-44.3	6.06	199.3	147	18.8	
	17-Nov-22	1.74	-107.6	5.41	163.6	118	19.9	
	15-Dec-22	7.25	-41.1	5.51	192.8	125	20.2	33.8
	18-Jan-23	2.59	-83.1	5.15	190.6	129	22.7	154.87
	14-Feb-23	2.2	-75.9	4.99	180.8	125	22	
	13-Mar-23	0.12	-21.9	5.06	17.5	118	22.3	23.75
	17-Apr-23	1.26	-49.1	5.13	153.9	106	22	301.72
	15-May-23	0.3	-55.6	5.02	159.8	113	21	42.35
	15-Jun-23	3	-99.3	5.48	183.1	119	20.7	5.75
	25-Jul-23	0.34	-80	4.97	156.4	118	17.7	10
	16-Aug-23	0.5	-36.6	4.97	182.5	119	17.5	29
	12-Sep-23	6.31	-34.4	5.16	154.4	115	18.2	54
	24-Oct-23	2.59	9	6.38	151	109	19.9	24.9
	15-Nov-23	0.31	5	5.38	136	92	22.3	11
	20-Dec-23	4.86	61.8	4.87	198.8	139	21.3	28.8
	19-Jan-24	2.66	53.5	5.01	200.7	125	27.2	25.16
	14-Feb-24	0.34	-67.6	4.95	192.2	126	24.4	7.32
	13-Mar-24	1.99	-66.02	5.05	185.5	125	23.2	32.04
	17-Apr-24	2.83	12.2	4.92	154.4	102	24	89.05
	20-May-24	3.23	113	4.15	89.9	65	19.9	23.2
	18-Jun-24	4.11	97.3	4.2	79.8	59	18.8	19.68
	15-Jul-24	1.15	13.7	4.55	137.3	106	16.6	20.09
	20-Aug-24	0.68	-70.1	5.37	153.1	114	18.3	12.59
	27-Sep-24	0.41	-53.7	3.98	176.3	129	19.1	1.7
	23-Oct-24	1.14	-32.1	4.68	208.9	153	19.4	10.8
	05-May-22	1.89	-7.8	6.24	269	175	20.8	212
	16-Jun-22	7.71	-41	6.44	325	211	19.4	152
	28-Jul-22	3.73	2.2	5.79	0.358	233	17.5	12.5

Table 4
QAQC Analytical Data - Metals
Holcim Sand Quarry Monthly GME
Oakvale Drive, Salt Ash, NSW



Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
MW6	11-Aug-22	3.29	-26.6	6.2	0.3497		17.5	50
	15-Sep-22	4.92	-18.3	6.21		276	17.2	870.1
	25-Oct-22	-0.04	-96.5	6.09	376.5	280	18.5	
	17-Nov-22	-0.04	-71.5	6.08	341.2	253	18.6	
	15-Dec-22	4.92	9.4	6.3	449	292	20.6	22
	18-Jan-23	0.18	-94.8	6	448.1	304	22.8	16.32
	14-Feb-23	0.1	-49.5	6.06	410.7	291	20.9	
	14-Mar-23	0.04	-85.2	6.05	410.8	295	20.1	19.51
	17-Apr-23	0.2	-101.6	6.18	416.5	298	20.2	53.11
	15-May-23	-0.05	-100.9	6.06	42.3	298	19.8	35.29
	15-Jun-23	4	-39.1	6.52	410.2	267	18.2	32.01
	25-Jul-23	4.55	-3.3	6.23	401	297	18.5	25
	16-Aug-23	-0.7	-33.8	6.11	468.8	305	17.9	49
	12-Sep-23	0.48	-82.2	6.1	378.8	284	18.1	32
	24-Oct-23	0.11	-33.7	7.36	401	294	19	93
	15-Nov-23	0.29	-75	6.72	346	248	20	17
	20-Dec-23	1.66	-86	6.09	498	366	19.1	15
	19-Jan-24	2.51	-33.1	6.23	462.8	315	22.6	30.1
	14-Feb-24	0.86	-83	6.17	478.9	324	22.9	19.35
	13-Mar-24	1.84	-31.08	6.36	402	280	21.6	13.08
	17-Apr-24	0.79	-47.8	6.1	333.3	234	21.1	38.2
	20-May-24	0.42	31.5	6.08	316.9	231	19.3	17.5
	18-Jun-24	3.05	38.7	6.15	304.7	226	18.6	78.49
	15-Jul-24	0.69	11.6	6.18	335	253	17.6	55.58
	20-Aug-24	4.7	46.5	7.06	452	329	19.4	40
	23-Sep-24	3.77	24.8	5.67	386.4	290	18	10.09
	23-Oct-24	0.2	60.8	6.09	414.4	308	18.4	15
	05-May-22	2.28	-52.8	5.09	221	144	20	24.7
	16-Jun-22	7.78	-65	5.46	183	119	18.9	18
	28-Jul-22	4.01	173	3.67	0.1461	95	17.6	122
	11-Aug-22	3.88	-65.2	4.99	0.158		17.9	23
	15-Sep-22	6.73	38.2	3.98	164.7	124	17.8	35.25
	25-Oct-22	1.74	-43.7	5.16	161.8	118	19.4	
	17-Nov-22	0.83	-121.2	5.39	151.6	113	18.4	
	15-Dec-22	0.04	-103.3	5.38	189.1	123	18.4	21.86
	18-Jan-23	0.17	-135.8	5.24	201.5	146	19.6	29.74
	14-Feb-23	0.3	-107.8	5.24	207.2	153	18.7	
	13-Mar-23	1.16	-45	5.37	196.5	141	20	70.52
	17-Apr-23	-0.1	-121.3	5.52	173.2	127	19.2	51.3

Parameters		DO	ORP	PH	SC	TDS	TEMP	TURB
Units		mg/L	mV	pH units	uS/cm	mg/L	deg C	NTU
Well	Measurement Date							
MW7	15-May-23	0.53	-98	5.33	163.8	120	18.9	12.79
	15-Jun-23	2.8	121	5.41	197	128	17.5	0.58
	25-Jul-23	0.46	-97.3	5.3	152.9	114	18.3	125
	16-Aug-23	-0.9	-87	5.41	194.9	126	18	116
	12-Sep-23	0.09	-137	5.46	158.6	118	18.4	116.98
	24-Oct-23	0.65	-63.2	6.83	181.4	131	19.7	24.2
	15-Nov-23	0.28	-121	6.02	191	134	21	15
	20-Dec-23	5.64	-78	5.57	265	193	19.5	17.7
	19-Jan-24	1.79	-97.6	5.46	216	153	20.6	13
	14-Feb-24	0.81	-100.9	5.64	226.8	156	22	12.66
	13-Mar-24	0.55	-151.3	5.63	215.5	155	20.4	28.29
	17-Apr-24	2.45	-119.7	5.44	216.3	155	20	45.1
	20-May-24	1.13	100.6	3.54	136.9	101	18.8	14.83
	18-Jun-24	4.12	152.1	3.43	255	191	17.9	56.11
	15-Jul-24	3.13	184.2	3.46	178.6	137	17.2	3.66
	20-Aug-24	8.64	102.8	4.66	166.6	121	19.2	23
	23-Sep-24	0.16	-36.3	4.43	213.4	158	18.7	27.46
	23-Oct-24	3.14	158.8	5.28	242.5	177	19.4	46.28

APPENDIX C

Statistical Analysis & Pro UCL Outputs

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Uncensored Full Data Sets											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.2 6/06/2025 1:50:10 PM								
5	From File			Book2.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	Aluminum											
12												
13	General Statistics											
14	Total Number of Observations				327		Number of Distinct Observations				131	
15							Number of Missing Observations				0	
16	Minimum				0.02		Mean				0.62	
17	Maximum				4.28		Median				0.32	
18	SD				0.742		Std. Error of Mean				0.041	
19	Coefficient of Variation				1.197		Skewness				2.167	
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic				0.722		Shapiro Wilk GOF Test					
23	1% Shapiro Wilk P Value				0		Data Not Normal at 1% Significance Level					
24	Lilliefors Test Statistic				0.256		Lilliefors GOF Test					
25	1% Lilliefors Critical Value				0.0571		Data Not Normal at 1% Significance Level					
26	Data Not Normal at 1% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
30	95% Student's-t UCL				0.688		95% Adjusted-CLT UCL (Chen-1995)				0.693	
31							95% Modified-t UCL (Johnson-1978)				0.688	
32												
33	Gamma GOF Test											
34	A-D Test Statistic				7.128		Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value				0.786		Data Not Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic				0.158		Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value				0.0518		Data Not Gamma Distributed at 5% Significance Level					
38	Data Not Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)				0.965		k star (bias corrected MLE)				0.958	
42	Theta hat (MLE)				0.642		Theta star (bias corrected MLE)				0.647	
43	nu hat (MLE)				631.2		nu star (bias corrected)				626.8	
44	MLE Mean (bias corrected)				0.62		MLE Sd (bias corrected)				0.633	
45						Approximate Chi Square Value (0.05)				569.7		
46	Adjusted Level of Significance				0.0493		Adjusted Chi Square Value				569.4	
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL				0.682		95% Adjusted Gamma UCL				0.682	
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic				0.967		Shapiro Wilk Lognormal GOF Test					
53	10% Shapiro Wilk P Value				1.0353E-4		Data Not Lognormal at 10% Significance Level					
54	Lilliefors Test Statistic				0.0813		Lilliefors Lognormal GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
55	10% Lilliefors Critical Value					0.0452	Data Not Lognormal at 10% Significance Level						
56	Data Not Lognormal at 10% Significance Level												
57													
58	Lognormal Statistics												
59	Minimum of Logged Data					-3.912	Mean of logged Data					-1.079	
60	Maximum of Logged Data					1.454	SD of logged Data					1.117	
61													
62	Assuming Lognormal Distribution												
63	95% H-UCL					0.728	90% Chebyshev (MVUE) UCL					0.78	
64	95% Chebyshev (MVUE) UCL					0.847	97.5% Chebyshev (MVUE) UCL					0.94	
65	99% Chebyshev (MVUE) UCL					1.123							
66													
67	Nonparametric Distribution Free UCL Statistics												
68	Data do not follow a Discernible Distribution												
69													
70	Nonparametric Distribution Free UCLs												
71	95% CLT UCL					0.687	95% BCA Bootstrap UCL					0.692	
72	95% Standard Bootstrap UCL					0.686	95% Bootstrap-t UCL					0.692	
73	95% Hall's Bootstrap UCL					0.692	95% Percentile Bootstrap UCL					0.69	
74	90% Chebyshev(Mean, Sd) UCL					0.743	95% Chebyshev(Mean, Sd) UCL					0.799	
75	97.5% Chebyshev(Mean, Sd) UCL					0.876	99% Chebyshev(Mean, Sd) UCL					1.028	
76													
77	Suggested UCL to Use												
78	95% Student's-t UCL					0.688							
79													
80	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.												
81	Please verify the data were collected from random locations.												
82	If the data were collected using judgmental or other non-random methods,												
83	then contact a statistician to correctly calculate UCLs.												
84													
85	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
86	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.												
87	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
88													
89													
90	Arsenic												
91													
92	General Statistics												
93	Total Number of Observations					327	Number of Distinct Observations					29	
94							Number of Missing Observations					0	
95	Minimum					5.0000E-4	Mean					0.0037	
96	Maximum					0.088	Median					5.0000E-4	
97	SD					0.00781	Std. Error of Mean					4.3198E-4	
98	Coefficient of Variation					2.114	Skewness					5.277	
99													
100	Normal GOF Test												
101	Shapiro Wilk Test Statistic					0.488	Shapiro Wilk GOF Test						
102	1% Shapiro Wilk P Value					0	Data Not Normal at 1% Significance Level						
103	Lilliefors Test Statistic					0.341	Lilliefors GOF Test						
104	1% Lilliefors Critical Value					0.0571	Data Not Normal at 1% Significance Level						
105	Data Not Normal at 1% Significance Level												
106													
107	Assuming Normal Distribution												
108	95% Normal UCL						95% UCLs (Adjusted for Skewness)						

	A	B	C	D	E	F	G	H	I	J	K	L
109	95% Student's-t UCL				0.00441	95% Adjusted-CLT UCL (Chen-1995)						0.00454
110						95% Modified-t UCL (Johnson-1978)						0.00443
111												
112	Gamma GOF Test											
113	A-D Test Statistic				46.26	Anderson-Darling Gamma GOF Test						
114	5% A-D Critical Value				0.816	Data Not Gamma Distributed at 5% Significance Level						
115	K-S Test Statistic				0.353	Kolmogorov-Smirnov Gamma GOF Test						
116	5% K-S Critical Value				0.0529	Data Not Gamma Distributed at 5% Significance Level						
117	Data Not Gamma Distributed at 5% Significance Level											
118												
119	Gamma Statistics											
120	k hat (MLE)				0.564	k star (bias corrected MLE)						0.561
121	Theta hat (MLE)				0.00655	Theta star (bias corrected MLE)						0.00659
122	nu hat (MLE)				369.1	nu star (bias corrected)						367
123	MLE Mean (bias corrected)				0.0037	MLE Sd (bias corrected)						0.00493
124						Approximate Chi Square Value (0.05)						323.6
125	Adjusted Level of Significance				0.0493	Adjusted Chi Square Value						323.4
126												
127	Assuming Gamma Distribution											
128	95% Approximate Gamma UCL				0.00419	95% Adjusted Gamma UCL						0.00419
129												
130	Lognormal GOF Test											
131	Shapiro Wilk Test Statistic				0.7	Shapiro Wilk Lognormal GOF Test						
132	10% Shapiro Wilk P Value				0	Data Not Lognormal at 10% Significance Level						
133	Lilliefors Test Statistic				0.362	Lilliefors Lognormal GOF Test						
134	10% Lilliefors Critical Value				0.0452	Data Not Lognormal at 10% Significance Level						
135	Data Not Lognormal at 10% Significance Level											
136												
137	Lognormal Statistics											
138	Minimum of Logged Data				-7.601	Mean of logged Data						-6.706
139	Maximum of Logged Data				-2.43	SD of logged Data						1.307
140												
141	Assuming Lognormal Distribution											
142	95% H-UCL				0.00342	90% Chebyshev (MVUE) UCL						0.0037
143	95% Chebyshev (MVUE) UCL				0.00408	97.5% Chebyshev (MVUE) UCL						0.0046
144	99% Chebyshev (MVUE) UCL				0.00564							
145												
146	Nonparametric Distribution Free UCL Statistics											
147	Data do not follow a Discernible Distribution											
148												
149	Nonparametric Distribution Free UCLs											
150	95% CLT UCL				0.00441	95% BCA Bootstrap UCL						0.0046
151	95% Standard Bootstrap UCL				0.0044	95% Bootstrap-t UCL						0.00461
152	95% Hall's Bootstrap UCL				0.00469	95% Percentile Bootstrap UCL						0.00442
153	90% Chebyshev(Mean, Sd) UCL				0.00499	95% Chebyshev(Mean, Sd) UCL						0.00558
154	97.5% Chebyshev(Mean, Sd) UCL				0.00639	99% Chebyshev(Mean, Sd) UCL						0.00799
155												
156	Suggested UCL to Use											
157	95% Student's-t UCL				0.00441							
158												
159	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.											
160	Please verify the data were collected from random locations.											
161	If the data were collected using judgmental or other non-random methods,											
162	then contact a statistician to correctly calculate UCLs.											

	A	B	C	D	E	F	G	H	I	J	K	L	
163													
164	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
165	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.												
166	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
167													
168													
169	Boron												
170													
171	General Statistics												
172	Total Number of Observations					318		Number of Distinct Observations				2	
173								Number of Missing Observations				9	
174	Minimum					0.025		Mean				0.0251	
175	Maximum					0.06		Median				0.025	
176	SD					0.00196		Std. Error of Mean				1.1006E-4	
177	Coefficient of Variation					0.0782		Skewness				17.83	
178													
179	Normal GOF Test												
180	Shapiro Wilk Test Statistic					0.0562		Shapiro Wilk GOF Test					
181	1% Shapiro Wilk P Value					0		Data Not Normal at 1% Significance Level					
182	Lilliefors Test Statistic					0.519		Lilliefors GOF Test					
183	1% Lilliefors Critical Value					0.0579		Data Not Normal at 1% Significance Level					
184	Data Not Normal at 1% Significance Level												
185													
186	Assuming Normal Distribution												
187	95% Normal UCL					95% UCLs (Adjusted for Skewness)							
188	95% Student's-t UCL					0.0253		95% Adjusted-CLT UCL (Chen-1995)				0.0254	
189								95% Modified-t UCL (Johnson-1978)				0.0253	
190													
191	Gamma GOF Test												
192	A-D Test Statistic					3.145E+28		Anderson-Darling Gamma GOF Test					
193	5% A-D Critical Value					0.752		Data Not Gamma Distributed at 5% Significance Level					
194	K-S Test Statistic					0.52		Kolmogorov-Smirnov Gamma GOF Test					
195	5% K-S Critical Value					0.0507		Data Not Gamma Distributed at 5% Significance Level					
196	Data Not Gamma Distributed at 5% Significance Level												
197													
198	Gamma Statistics												
199	k hat (MLE)					305.1		k star (bias corrected MLE)				302.2	
200	Theta hat (MLE)					8.2306E-5		Theta star (bias corrected MLE)				8.3090E-5	
201	nu hat (MLE)					194031		nu star (bias corrected)				192202	
202	MLE Mean (bias corrected)					0.0251		MLE Sd (bias corrected)				0.00144	
203								Approximate Chi Square Value (0.05)				191183	
204	Adjusted Level of Significance					0.0492		Adjusted Chi Square Value				191179	
205													
206	Assuming Gamma Distribution												
207	95% Approximate Gamma UCL					0.0252		95% Adjusted Gamma UCL				0.0252	
208													
209	Lognormal GOF Test												
210	Shapiro Wilk Test Statistic					0.0562		Shapiro Wilk Lognormal GOF Test					
211	10% Shapiro Wilk P Value					0		Data Not Lognormal at 10% Significance Level					
212	Lilliefors Test Statistic					0.519		Lilliefors Lognormal GOF Test					
213	10% Lilliefors Critical Value					0.0458		Data Not Lognormal at 10% Significance Level					
214	Data Not Lognormal at 10% Significance Level												
215													
216	Lognormal Statistics												

	A	B	C	D	E	F	G	H	I	J	K	L
217	Minimum of Logged Data					-3.689	Mean of logged Data					-3.686
218	Maximum of Logged Data					-2.813	SD of logged Data					0.0491
219												
220	Assuming Lognormal Distribution											
221	95% H-UCL					N/A	90% Chebyshev (MVUE) UCL					0.0253
222	95% Chebyshev (MVUE) UCL					0.0254	97.5% Chebyshev (MVUE) UCL					0.0255
223	99% Chebyshev (MVUE) UCL					0.0258						
224												
225	Nonparametric Distribution Free UCL Statistics											
226	Data do not follow a Discernible Distribution											
227												
228	Nonparametric Distribution Free UCLs											
229	95% CLT UCL					0.0253	95% BCA Bootstrap UCL					N/A
230	95% Standard Bootstrap UCL					N/A	95% Bootstrap-t UCL					N/A
231	95% Hall's Bootstrap UCL					N/A	95% Percentile Bootstrap UCL					N/A
232	90% Chebyshev(Mean, Sd) UCL					0.0254	95% Chebyshev(Mean, Sd) UCL					0.0256
233	97.5% Chebyshev(Mean, Sd) UCL					0.0258	99% Chebyshev(Mean, Sd) UCL					0.0262
234												
235	Suggested UCL to Use											
236	95% Student's-t UCL					0.0253						
237												
238	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
239	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
240	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
241												
242												
243	Cadmium											
244												
245	General Statistics											
246	Total Number of Observations					327	Number of Distinct Observations					4
247							Number of Missing Observations					0
248	Minimum					5.0000E-5	Mean					5.2599E-5
249	Maximum					4.0000E-4	Median					5.0000E-5
250	SD					2.3188E-5	Std. Error of Mean					1.2823E-6
251	Coefficient of Variation					N/A	Skewness					12.07
252												
253	Normal GOF Test											
254	Shapiro Wilk Test Statistic					0.121	Shapiro Wilk GOF Test					
255	1% Shapiro Wilk P Value					0	Data Not Normal at 1% Significance Level					
256	Lilliefors Test Statistic					0.523	Lilliefors GOF Test					
257	1% Lilliefors Critical Value					0.0571	Data Not Normal at 1% Significance Level					
258	Data Not Normal at 1% Significance Level											
259												
260	Assuming Normal Distribution											
261	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
262	95% Student's-t UCL					5.4715E-5	95% Adjusted-CLT UCL (Chen-1995)					5.5623E-5
263							95% Modified-t UCL (Johnson-1978)					5.4857E-5
264												
265	Gamma GOF Test											
266	A-D Test Statistic					3.058E+28	Anderson-Darling Gamma GOF Test					
267	5% A-D Critical Value					0.752	Data Not Gamma Distributed at 5% Significance Level					
268	K-S Test Statistic					0.533	Kolmogorov-Smirnov Gamma GOF Test					
269	5% K-S Critical Value					0.0501	Data Not Gamma Distributed at 5% Significance Level					
270	Data Not Gamma Distributed at 5% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
271												
272	Gamma Statistics											
273	k hat (MLE)				18.44	k star (bias corrected MLE)				18.27		
274	Theta hat (MLE)				2.8529E-6	Theta star (bias corrected MLE)				2.8790E-6		
275	nu hat (MLE)				12058	nu star (bias corrected)				11948		
276	MLE Mean (bias corrected)				5.2599E-5	MLE Sd (bias corrected)				1.2306E-5		
277						Approximate Chi Square Value (0.05)				11695		
278	Adjusted Level of Significance				0.0493	Adjusted Chi Square Value				11694		
279												
280	Assuming Gamma Distribution											
281	95% Approximate Gamma UCL				5.3738E-5	95% Adjusted Gamma UCL				5.3743E-5		
282												
283	Lognormal GOF Test											
284	Shapiro Wilk Test Statistic				0.141	Shapiro Wilk Lognormal GOF Test						
285	10% Shapiro Wilk P Value				0	Data Not Lognormal at 10% Significance Level						
286	Lilliefors Test Statistic				0.532	Lilliefors Lognormal GOF Test						
287	10% Lilliefors Critical Value				0.0452	Data Not Lognormal at 10% Significance Level						
288	Data Not Lognormal at 10% Significance Level											
289												
290	Lognormal Statistics											
291	Minimum of Logged Data				-9.903	Mean of logged Data				-9.88		
292	Maximum of Logged Data				-7.824	SD of logged Data				0.174		
293												
294	Assuming Lognormal Distribution											
295	95% H-UCL				5.2811E-5	90% Chebyshev (MVUE) UCL				5.3475E-5		
296	95% Chebyshev (MVUE) UCL				5.4161E-5	97.5% Chebyshev (MVUE) UCL				5.5113E-5		
297	99% Chebyshev (MVUE) UCL				5.6983E-5							
298												
299	Nonparametric Distribution Free UCL Statistics											
300	Data do not follow a Discernible Distribution											
301												
302	Nonparametric Distribution Free UCLs											
303	95% CLT UCL				5.4709E-5	95% BCA Bootstrap UCL				N/A		
304	95% Standard Bootstrap UCL				N/A	95% Bootstrap-t UCL				N/A		
305	95% Hall's Bootstrap UCL				N/A	95% Percentile Bootstrap UCL				N/A		
306	90% Chebyshev(Mean, Sd) UCL				5.6446E-5	95% Chebyshev(Mean, Sd) UCL				5.8189E-5		
307	97.5% Chebyshev(Mean, Sd) UCL				6.0607E-5	99% Chebyshev(Mean, Sd) UCL				6.5358E-5		
308												
309	Suggested UCL to Use											
310	95% Student's-t UCL				5.4715E-5							
311												
312	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
313	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
314	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
315												
316												
317	Chromium											
318												
319	General Statistics											
320	Total Number of Observations				325	Number of Distinct Observations				6		
321						Number of Missing Observations				2		
322	Minimum				5.0000E-4	Mean				0.0016		
323	Maximum				0.006	Median				0.002		
324	SD				9.0974E-4	Std. Error of Mean				5.0463E-5		

	A	B	C	D	E	F	G	H	I	J	K	L
325	Coefficient of Variation					0.568	Skewness					1.109
326												
327	Normal GOF Test											
328	Shapiro Wilk Test Statistic					0.839	Shapiro Wilk GOF Test					
329	1% Shapiro Wilk P Value					0	Data Not Normal at 1% Significance Level					
330	Lilliefors Test Statistic					0.217	Lilliefors GOF Test					
331	1% Lilliefors Critical Value					0.0573	Data Not Normal at 1% Significance Level					
332	Data Not Normal at 1% Significance Level											
333												
334	Assuming Normal Distribution											
335	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
336	95% Student's-t UCL					0.00168	95% Adjusted-CLT UCL (Chen-1995)					0.00169
337							95% Modified-t UCL (Johnson-1978)					0.00169
338												
339	Gamma GOF Test											
340	A-D Test Statistic					17.22	Anderson-Darling Gamma GOF Test					
341	5% A-D Critical Value					0.76	Data Not Gamma Distributed at 5% Significance Level					
342	K-S Test Statistic					0.253	Kolmogorov-Smirnov Gamma GOF Test					
343	5% K-S Critical Value					0.0507	Data Not Gamma Distributed at 5% Significance Level					
344	Data Not Gamma Distributed at 5% Significance Level											
345												
346	Gamma Statistics											
347	k hat (MLE)					3.099	k star (bias corrected MLE)					3.072
348	Theta hat (MLE)					5.1687E-4	Theta star (bias corrected MLE)					5.2134E-4
349	nu hat (MLE)					2014	nu star (bias corrected)					1997
350	MLE Mean (bias corrected)					0.0016	MLE Sd (bias corrected)					9.1375E-4
351							Approximate Chi Square Value (0.05)					1894
352	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					1894
353												
354	Assuming Gamma Distribution											
355	95% Approximate Gamma UCL					0.00169	95% Adjusted Gamma UCL					0.00169
356												
357	Lognormal GOF Test											
358	Shapiro Wilk Test Statistic					0.854	Shapiro Wilk Lognormal GOF Test					
359	10% Shapiro Wilk P Value					0	Data Not Lognormal at 10% Significance Level					
360	Lilliefors Test Statistic					0.27	Lilliefors Lognormal GOF Test					
361	10% Lilliefors Critical Value					0.0453	Data Not Lognormal at 10% Significance Level					
362	Data Not Lognormal at 10% Significance Level											
363												
364	Lognormal Statistics											
365	Minimum of Logged Data					-7.601	Mean of logged Data					-6.607
366	Maximum of Logged Data					-5.116	SD of logged Data					0.608
367												
368	Assuming Lognormal Distribution											
369	95% H-UCL					0.00173	90% Chebyshev (MVUE) UCL					0.0018
370	95% Chebyshev (MVUE) UCL					0.00188	97.5% Chebyshev (MVUE) UCL					0.002
371	99% Chebyshev (MVUE) UCL					0.00222						
372												
373	Nonparametric Distribution Free UCL Statistics											
374	Data do not follow a Discernible Distribution											
375												
376	Nonparametric Distribution Free UCLs											
377	95% CLT UCL					0.00168	95% BCA Bootstrap UCL					0.00169
378	95% Standard Bootstrap UCL					0.00168	95% Bootstrap-t UCL					0.00169

	A	B	C	D	E	F	G	H	I	J	K	L
379	95% Hall's Bootstrap UCL					0.00169	95% Percentile Bootstrap UCL					0.00169
380	90% Chebyshev(Mean, Sd) UCL					0.00175	95% Chebyshev(Mean, Sd) UCL					0.00182
381	97.5% Chebyshev(Mean, Sd) UCL					0.00192	99% Chebyshev(Mean, Sd) UCL					0.0021
382												
383	Suggested UCL to Use											
384	95% Student's-t UCL					0.00168						
385												
386	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
387	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
388	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
389												
390												
391	Copper											
392												
393	General Statistics											
394	Total Number of Observations					326	Number of Distinct Observations					24
395							Number of Missing Observations					1
396	Minimum					5.0000E-4	Mean					0.00377
397	Maximum					0.108	Median					0.001
398	SD					0.00901	Std. Error of Mean					4.9880E-4
399	Coefficient of Variation					2.39	Skewness					7.861
400												
401	Normal GOF Test											
402	Shapiro Wilk Test Statistic					0.372	Shapiro Wilk GOF Test					
403	1% Shapiro Wilk P Value					0	Data Not Normal at 1% Significance Level					
404	Lilliefors Test Statistic					0.358	Lilliefors GOF Test					
405	1% Lilliefors Critical Value					0.0572	Data Not Normal at 1% Significance Level					
406	Data Not Normal at 1% Significance Level											
407												
408	Assuming Normal Distribution											
409	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
410	95% Student's-t UCL					0.00459	95% Adjusted-CLT UCL (Chen-1995)					0.00482
411							95% Modified-t UCL (Johnson-1978)					0.00463
412												
413	Gamma GOF Test											
414	A-D Test Statistic					21.47	Anderson-Darling Gamma GOF Test					
415	5% A-D Critical Value					0.802	Data Not Gamma Distributed at 5% Significance Level					
416	K-S Test Statistic					0.202	Kolmogorov-Smirnov Gamma GOF Test					
417	5% K-S Critical Value					0.0525	Data Not Gamma Distributed at 5% Significance Level					
418	Data Not Gamma Distributed at 5% Significance Level											
419												
420	Gamma Statistics											
421	k hat (MLE)					0.697	k star (bias corrected MLE)					0.692
422	Theta hat (MLE)					0.00541	Theta star (bias corrected MLE)					0.00544
423	nu hat (MLE)					454.2	nu star (bias corrected)					451.3
424	MLE Mean (bias corrected)					0.00377	MLE Sd (bias corrected)					0.00453
425							Approximate Chi Square Value (0.05)					403.1
426	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					402.9
427												
428	Assuming Gamma Distribution											
429	95% Approximate Gamma UCL					0.00422	95% Adjusted Gamma UCL					0.00422
430												
431	Lognormal GOF Test											
432	Shapiro Wilk Test Statistic					0.845	Shapiro Wilk Lognormal GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
433	10% Shapiro Wilk P Value					0	Data Not Lognormal at 10% Significance Level						
434	Lilliefors Test Statistic					0.237	Lilliefors Lognormal GOF Test						
435	10% Lilliefors Critical Value					0.0453	Data Not Lognormal at 10% Significance Level						
436	Data Not Lognormal at 10% Significance Level												
437													
438	Lognormal Statistics												
439	Minimum of Logged Data					-7.601	Mean of logged Data					-6.449	
440	Maximum of Logged Data					-2.226	SD of logged Data					1.181	
441													
442	Assuming Lognormal Distribution												
443	95% H-UCL					0.00369	90% Chebyshev (MVUE) UCL					0.00396	
444	95% Chebyshev (MVUE) UCL					0.00433	97.5% Chebyshev (MVUE) UCL					0.00483	
445	99% Chebyshev (MVUE) UCL					0.00582							
446													
447	Nonparametric Distribution Free UCL Statistics												
448	Data do not follow a Discernible Distribution												
449													
450	Nonparametric Distribution Free UCLs												
451	95% CLT UCL					0.00459	95% BCA Bootstrap UCL					0.00487	
452	95% Standard Bootstrap UCL					0.0046	95% Bootstrap-t UCL					0.00501	
453	95% Hall's Bootstrap UCL					0.00565	95% Percentile Bootstrap UCL					0.00471	
454	90% Chebyshev(Mean, Sd) UCL					0.00526	95% Chebyshev(Mean, Sd) UCL					0.00594	
455	97.5% Chebyshev(Mean, Sd) UCL					0.00688	99% Chebyshev(Mean, Sd) UCL					0.00873	
456													
457	Suggested UCL to Use												
458	95% Student's-t UCL					0.00459							
459													
460	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.												
461	Please verify the data were collected from random locations.												
462	If the data were collected using judgmental or other non-random methods,												
463	then contact a statistician to correctly calculate UCLs.												
464													
465	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
466	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.												
467	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
468													
469													
470	Iron												
471													
472	General Statistics												
473	Total Number of Observations					327	Number of Distinct Observations					176	
474							Number of Missing Observations					0	
475	Minimum					0.025	Mean					1.137	
476	Maximum					6.9	Median					0.7	
477	SD					1.202	Std. Error of Mean					0.0665	
478	Coefficient of Variation					1.058	Skewness					1.884	
479													
480	Normal GOF Test												
481	Shapiro Wilk Test Statistic					0.776	Shapiro Wilk GOF Test						
482	1% Shapiro Wilk P Value					0	Data Not Normal at 1% Significance Level						
483	Lilliefors Test Statistic					0.207	Lilliefors GOF Test						
484	1% Lilliefors Critical Value					0.0571	Data Not Normal at 1% Significance Level						
485	Data Not Normal at 1% Significance Level												
486													

	A	B	C	D	E	F	G	H	I	J	K	L
487	Assuming Normal Distribution											
488	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
489	95% Student's-t UCL				1.247		95% Adjusted-CLT UCL (Chen-1995)					1.254
490							95% Modified-t UCL (Johnson-1978)					1.248
491												
492	Gamma GOF Test											
493	A-D Test Statistic				2.097		Anderson-Darling Gamma GOF Test					
494	5% A-D Critical Value				0.785		Data Not Gamma Distributed at 5% Significance Level					
495	K-S Test Statistic				0.0754		Kolmogorov-Smirnov Gamma GOF Test					
496	5% K-S Critical Value				0.0518		Data Not Gamma Distributed at 5% Significance Level					
497	Data Not Gamma Distributed at 5% Significance Level											
498												
499	Gamma Statistics											
500	k hat (MLE)				0.992		k star (bias corrected MLE)					0.985
501	Theta hat (MLE)				1.146		Theta star (bias corrected MLE)					1.154
502	nu hat (MLE)				648.7		nu star (bias corrected)					644.1
503	MLE Mean (bias corrected)				1.137		MLE Sd (bias corrected)					1.146
504							Approximate Chi Square Value (0.05)					586.2
505	Adjusted Level of Significance				0.0493		Adjusted Chi Square Value					586
506												
507	Assuming Gamma Distribution											
508	95% Approximate Gamma UCL				1.249		95% Adjusted Gamma UCL					1.25
509												
510	Lognormal GOF Test											
511	Shapiro Wilk Test Statistic				0.924		Shapiro Wilk Lognormal GOF Test					
512	10% Shapiro Wilk P Value				0		Data Not Lognormal at 10% Significance Level					
513	Lilliefors Test Statistic				0.0807		Lilliefors Lognormal GOF Test					
514	10% Lilliefors Critical Value				0.0452		Data Not Lognormal at 10% Significance Level					
515	Data Not Lognormal at 10% Significance Level											
516												
517	Lognormal Statistics											
518	Minimum of Logged Data				-3.689		Mean of logged Data					-0.454
519	Maximum of Logged Data				1.932		SD of logged Data					1.238
520												
521	Assuming Lognormal Distribution											
522	95% H-UCL				1.603		90% Chebyshev (MVUE) UCL					1.729
523	95% Chebyshev (MVUE) UCL				1.895		97.5% Chebyshev (MVUE) UCL					2.126
524	99% Chebyshev (MVUE) UCL				2.58							
525												
526	Nonparametric Distribution Free UCL Statistics											
527	Data do not follow a Discernible Distribution											
528												
529	Nonparametric Distribution Free UCLs											
530	95% CLT UCL				1.246		95% BCA Bootstrap UCL					1.254
531	95% Standard Bootstrap UCL				1.243		95% Bootstrap-t UCL					1.255
532	95% Hall's Bootstrap UCL				1.255		95% Percentile Bootstrap UCL					1.244
533	90% Chebyshev(Mean, Sd) UCL				1.336		95% Chebyshev(Mean, Sd) UCL					1.427
534	97.5% Chebyshev(Mean, Sd) UCL				1.552		99% Chebyshev(Mean, Sd) UCL					1.798
535												
536	Suggested UCL to Use											
537	95% Student's-t UCL				1.247							
538												
539	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.											
540	Please verify the data were collected from random locations.											

	A	B	C	D	E	F	G	H	I	J	K	L
541	If the data were collected using judgmental or other non-random methods,											
542	then contact a statistician to correctly calculate UCLs.											
543												
544	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
545	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
546	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
547												
548												
549	Lead											
550												
551	General Statistics											
552	Total Number of Observations				327		Number of Distinct Observations				9	
553							Number of Missing Observations				0	
554	Minimum				5.0000E-4		Mean				6.8349E-4	
555	Maximum				0.015		Median				5.0000E-4	
556	SD				0.00123		Std. Error of Mean				6.8142E-5	
557	Coefficient of Variation				1.803		Skewness				9.178	
558												
559	Normal GOF Test											
560	Shapiro Wilk Test Statistic				0.162		Shapiro Wilk GOF Test					
561	1% Shapiro Wilk P Value				0		Data Not Normal at 1% Significance Level					
562	Lilliefors Test Statistic				0.51		Lilliefors GOF Test					
563	1% Lilliefors Critical Value				0.0571		Data Not Normal at 1% Significance Level					
564	Data Not Normal at 1% Significance Level											
565												
566	Assuming Normal Distribution											
567	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
568	95% Student's-t UCL				7.9589E-4		95% Adjusted-CLT UCL (Chen-1995)				8.3252E-4	
569							95% Modified-t UCL (Johnson-1978)				8.0165E-4	
570												
571	Gamma GOF Test											
572	A-D Test Statistic				3.058E+28		Anderson-Darling Gamma GOF Test					
573	5% A-D Critical Value				0.764		Data Not Gamma Distributed at 5% Significance Level					
574	K-S Test Statistic				0.543		Kolmogorov-Smirnov Gamma GOF Test					
575	5% K-S Critical Value				0.0508		Data Not Gamma Distributed at 5% Significance Level					
576	Data Not Gamma Distributed at 5% Significance Level											
577												
578	Gamma Statistics											
579	k hat (MLE)				2.354		k star (bias corrected MLE)				2.334	
580	Theta hat (MLE)				2.9041E-4		Theta star (bias corrected MLE)				2.9284E-4	
581	nu hat (MLE)				1539		nu star (bias corrected)				1526	
582	MLE Mean (bias corrected)				6.8349E-4		MLE Sd (bias corrected)				4.4738E-4	
583							Approximate Chi Square Value (0.05)				1437	
584	Adjusted Level of Significance				0.0493		Adjusted Chi Square Value				1436	
585												
586	Assuming Gamma Distribution											
587	95% Approximate Gamma UCL				7.2617E-4		95% Adjusted Gamma UCL				7.2637E-4	
588												
589	Lognormal GOF Test											
590	Shapiro Wilk Test Statistic				0.223		Shapiro Wilk Lognormal GOF Test					
591	10% Shapiro Wilk P Value				0		Data Not Lognormal at 10% Significance Level					
592	Lilliefors Test Statistic				0.531		Lilliefors Lognormal GOF Test					
593	10% Lilliefors Critical Value				0.0452		Data Not Lognormal at 10% Significance Level					
594	Data Not Lognormal at 10% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
595												
596	Lognormal Statistics											
597	Minimum of Logged Data					-7.601	Mean of logged Data					-7.516
598	Maximum of Logged Data					-4.2	SD of logged Data					0.422
599												
600	Assuming Lognormal Distribution											
601	95% H-UCL					6.2031E-4	90% Chebyshev (MVUE) UCL					6.3863E-4
602	95% Chebyshev (MVUE) UCL					6.5832E-4	97.5% Chebyshev (MVUE) UCL					6.8565E-4
603	99% Chebyshev (MVUE) UCL					7.3933E-4						
604												
605	Nonparametric Distribution Free UCL Statistics											
606	Data do not follow a Discernible Distribution											
607												
608	Nonparametric Distribution Free UCLs											
609	95% CLT UCL					7.9557E-4	95% BCA Bootstrap UCL					8.3639E-4
610	95% Standard Bootstrap UCL					7.9705E-4	95% Bootstrap-t UCL					8.9315E-4
611	95% Hall's Bootstrap UCL					8.5811E-4	95% Percentile Bootstrap UCL					8.0734E-4
612	90% Chebyshev(Mean, Sd) UCL					8.8791E-4	95% Chebyshev(Mean, Sd) UCL					9.8051E-4
613	97.5% Chebyshev(Mean, Sd) UCL					0.00111	99% Chebyshev(Mean, Sd) UCL					0.00136
614												
615	Suggested UCL to Use											
616	95% Student's-t UCL					7.9589E-4						
617												
618	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.											
619	Please verify the data were collected from random locations.											
620	If the data were collected using judgmental or other non-random methods,											
621	then contact a statistician to correctly calculate UCLs.											
622												
623	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
624	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
625	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
626												
627												
628	Manganese											
629												
630	General Statistics											
631	Total Number of Observations					326	Number of Distinct Observations					86
632							Number of Missing Observations					1
633	Minimum					5.0000E-4	Mean					0.0291
634	Maximum					0.273	Median					0.009
635	SD					0.0479	Std. Error of Mean					0.00266
636	Coefficient of Variation					1.648	Skewness					2.709
637												
638	Normal GOF Test											
639	Shapiro Wilk Test Statistic					0.597	Shapiro Wilk GOF Test					
640	1% Shapiro Wilk P Value					0	Data Not Normal at 1% Significance Level					
641	Lilliefors Test Statistic					0.287	Lilliefors GOF Test					
642	1% Lilliefors Critical Value					0.0572	Data Not Normal at 1% Significance Level					
643	Data Not Normal at 1% Significance Level											
644												
645	Assuming Normal Distribution											
646	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
647	95% Student's-t UCL					0.0335	95% Adjusted-CLT UCL (Chen-1995)					0.0339
648							95% Modified-t UCL (Johnson-1978)					0.0335

	A	B	C	D	E	F	G	H	I	J	K	L
649												
650	Gamma GOF Test											
651	A-D Test Statistic					13.69	Anderson-Darling Gamma GOF Test					
652	5% A-D Critical Value					0.808	Data Not Gamma Distributed at 5% Significance Level					
653	K-S Test Statistic					0.183	Kolmogorov-Smirnov Gamma GOF Test					
654	5% K-S Critical Value					0.0527	Data Not Gamma Distributed at 5% Significance Level					
655	Data Not Gamma Distributed at 5% Significance Level											
656												
657	Gamma Statistics											
658	k hat (MLE)					0.637	k star (bias corrected MLE)					0.634
659	Theta hat (MLE)					0.0456	Theta star (bias corrected MLE)					0.0459
660	nu hat (MLE)					415.6	nu star (bias corrected)					413.1
661	MLE Mean (bias corrected)					0.0291	MLE Sd (bias corrected)					0.0365
662							Approximate Chi Square Value (0.05)					367
663	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					366.8
664												
665	Assuming Gamma Distribution											
666	95% Approximate Gamma UCL					0.0327	95% Adjusted Gamma UCL					0.0328
667												
668	Lognormal GOF Test											
669	Shapiro Wilk Test Statistic					0.955	Shapiro Wilk Lognormal GOF Test					
670	10% Shapiro Wilk P Value					8.969E-10	Data Not Lognormal at 10% Significance Level					
671	Lilliefors Test Statistic					0.0923	Lilliefors Lognormal GOF Test					
672	10% Lilliefors Critical Value					0.0453	Data Not Lognormal at 10% Significance Level					
673	Data Not Lognormal at 10% Significance Level											
674												
675	Lognormal Statistics											
676	Minimum of Logged Data					-7.601	Mean of logged Data					-4.498
677	Maximum of Logged Data					-1.298	SD of logged Data					1.379
678												
679	Assuming Lognormal Distribution											
680	95% H-UCL					0.0347	90% Chebyshev (MVUE) UCL					0.0377
681	95% Chebyshev (MVUE) UCL					0.0418	97.5% Chebyshev (MVUE) UCL					0.0474
682	99% Chebyshev (MVUE) UCL					0.0586						
683												
684	Nonparametric Distribution Free UCL Statistics											
685	Data do not follow a Discernible Distribution											
686												
687	Nonparametric Distribution Free UCLs											
688	95% CLT UCL					0.0335	95% BCA Bootstrap UCL					0.0339
689	95% Standard Bootstrap UCL					0.0335	95% Bootstrap-t UCL					0.034
690	95% Hall's Bootstrap UCL					0.0339	95% Percentile Bootstrap UCL					0.0336
691	90% Chebyshev(Mean, Sd) UCL					0.0371	95% Chebyshev(Mean, Sd) UCL					0.0407
692	97.5% Chebyshev(Mean, Sd) UCL					0.0457	99% Chebyshev(Mean, Sd) UCL					0.0555
693												
694	Suggested UCL to Use											
695	95% Student's-t UCL					0.0335						
696												
697	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.											
698	Please verify the data were collected from random locations.											
699	If the data were collected using judgmental or other non-random methods,											
700	then contact a statistician to correctly calculate UCLs.											
701												
702	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

	A	B	C	D	E	F	G	H	I	J	K	L
703	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
704	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
705												
706												
707	Mercury											
708												
709	General Statistics											
710	Total Number of Observations				327		Number of Distinct Observations				1	
711							Number of Missing Observations				0	
712	Minimum				5.0000E-5		Mean				5.0000E-5	
713	Maximum				5.0000E-5		Median				5.0000E-5	
714												
715	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
716	ProUCL (or any other software) should not be used on such a data set!											
717	The data set for variable Mercury was not processed!											
718												
719	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
720	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
721												
722												
723												
724	Nickel											
725												
726	General Statistics											
727	Total Number of Observations				326		Number of Distinct Observations				35	
728							Number of Missing Observations				1	
729	Minimum				5.0000E-4		Mean				0.00885	
730	Maximum				0.062		Median				0.007	
731	SD				0.00858		Std. Error of Mean				4.7501E-4	
732	Coefficient of Variation				0.969		Skewness				2.813	
733												
734	Normal GOF Test											
735	Shapiro Wilk Test Statistic				0.76		Shapiro Wilk GOF Test					
736	1% Shapiro Wilk P Value				0		Data Not Normal at 1% Significance Level					
737	Lilliefors Test Statistic				0.168		Lilliefors GOF Test					
738	1% Lilliefors Critical Value				0.0572		Data Not Normal at 1% Significance Level					
739	Data Not Normal at 1% Significance Level											
740												
741	Assuming Normal Distribution											
742	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
743	95% Student's-t UCL				0.00964		95% Adjusted-CLT UCL (Chen-1995)				0.00971	
744							95% Modified-t UCL (Johnson-1978)				0.00965	
745												
746	Gamma GOF Test											
747	A-D Test Statistic				1.641		Anderson-Darling Gamma GOF Test					
748	5% A-D Critical Value				0.778		Data Not Gamma Distributed at 5% Significance Level					
749	K-S Test Statistic				0.067		Kolmogorov-Smirnov Gamma GOF Test					
750	5% K-S Critical Value				0.0515		Data Not Gamma Distributed at 5% Significance Level					
751	Data Not Gamma Distributed at 5% Significance Level											
752												
753	Gamma Statistics											
754	k hat (MLE)				1.277		k star (bias corrected MLE)				1.267	
755	Theta hat (MLE)				0.00693		Theta star (bias corrected MLE)				0.00699	
756	nu hat (MLE)				832.5		nu star (bias corrected)				826.2	

	A	B	C	D	E	F	G	H	I	J	K	L
757	MLE Mean (bias corrected)					0.00885	MLE Sd (bias corrected)					0.00786
758							Approximate Chi Square Value (0.05)					760.5
759	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					760.2
760												
761	Assuming Gamma Distribution											
762	95% Approximate Gamma UCL					0.00962	95% Adjusted Gamma UCL					0.00962
763												
764	Lognormal GOF Test											
765	Shapiro Wilk Test Statistic					0.92	Shapiro Wilk Lognormal GOF Test					
766	10% Shapiro Wilk P Value					0	Data Not Lognormal at 10% Significance Level					
767	Lilliefors Test Statistic					0.12	Lilliefors Lognormal GOF Test					
768	10% Lilliefors Critical Value					0.0453	Data Not Lognormal at 10% Significance Level					
769	Data Not Lognormal at 10% Significance Level											
770												
771	Lognormal Statistics											
772	Minimum of Logged Data					-7.601	Mean of logged Data					-5.167
773	Maximum of Logged Data					-2.781	SD of logged Data					1.051
774												
775	Assuming Lognormal Distribution											
776	95% H-UCL					0.0112	90% Chebyshev (MVUE) UCL					0.012
777	95% Chebyshev (MVUE) UCL					0.013	97.5% Chebyshev (MVUE) UCL					0.0143
778	99% Chebyshev (MVUE) UCL					0.0169						
779												
780	Nonparametric Distribution Free UCL Statistics											
781	Data do not follow a Discernible Distribution											
782												
783	Nonparametric Distribution Free UCLs											
784	95% CLT UCL					0.00963	95% BCA Bootstrap UCL					0.00971
785	95% Standard Bootstrap UCL					0.00962	95% Bootstrap-t UCL					0.00968
786	95% Hall's Bootstrap UCL					0.00969	95% Percentile Bootstrap UCL					0.00968
787	90% Chebyshev(Mean, Sd) UCL					0.0103	95% Chebyshev(Mean, Sd) UCL					0.0109
788	97.5% Chebyshev(Mean, Sd) UCL					0.0118	99% Chebyshev(Mean, Sd) UCL					0.0136
789												
790	Suggested UCL to Use											
791	95% Student's-t UCL					0.00964						
792												
793	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
794	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
795	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
796												
797												
798	Zinc											
799												
800	General Statistics											
801	Total Number of Observations					326	Number of Distinct Observations					100
802							Number of Missing Observations					1
803	Minimum					0.0025	Mean					0.0465
804	Maximum					0.562	Median					0.034
805	SD					0.0516	Std. Error of Mean					0.00286
806	Coefficient of Variation					1.111	Skewness					5.542
807												
808	Normal GOF Test											
809	Shapiro Wilk Test Statistic					0.586	Shapiro Wilk GOF Test					
810	1% Shapiro Wilk P Value					0	Data Not Normal at 1% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L	
811	Lilliefors Test Statistic					0.197	Lilliefors GOF Test						
812	1% Lilliefors Critical Value					0.0572	Data Not Normal at 1% Significance Level						
813	Data Not Normal at 1% Significance Level												
814													
815	Assuming Normal Distribution												
816	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
817	95% Student's-t UCL					0.0512	95% Adjusted-CLT UCL (Chen-1995)					0.0521	
818							95% Modified-t UCL (Johnson-1978)					0.0513	
819													
820	Gamma GOF Test												
821	A-D Test Statistic					4.148	Anderson-Darling Gamma GOF Test						
822	5% A-D Critical Value					0.771	Data Not Gamma Distributed at 5% Significance Level						
823	K-S Test Statistic					0.0887	Kolmogorov-Smirnov Gamma GOF Test						
824	5% K-S Critical Value					0.0512	Data Not Gamma Distributed at 5% Significance Level						
825	Data Not Gamma Distributed at 5% Significance Level												
826													
827	Gamma Statistics												
828	k hat (MLE)					1.6	k star (bias corrected MLE)					1.587	
829	Theta hat (MLE)					0.029	Theta star (bias corrected MLE)					0.0293	
830	nu hat (MLE)					1043	nu star (bias corrected)					1035	
831	MLE Mean (bias corrected)					0.0465	MLE Sd (bias corrected)					0.0369	
832							Approximate Chi Square Value (0.05)					961.3	
833	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					961	
834													
835	Assuming Gamma Distribution												
836	95% Approximate Gamma UCL					0.05	95% Adjusted Gamma UCL					0.0501	
837													
838	Lognormal GOF Test												
839	Shapiro Wilk Test Statistic					0.942	Shapiro Wilk Lognormal GOF Test						
840	10% Shapiro Wilk P Value					1.110E-16	Data Not Lognormal at 10% Significance Level						
841	Lilliefors Test Statistic					0.0989	Lilliefors Lognormal GOF Test						
842	10% Lilliefors Critical Value					0.0453	Data Not Lognormal at 10% Significance Level						
843	Data Not Lognormal at 10% Significance Level												
844													
845	Lognormal Statistics												
846	Minimum of Logged Data					-5.991	Mean of logged Data					-3.413	
847	Maximum of Logged Data					-0.576	SD of logged Data					0.861	
848													
849	Assuming Lognormal Distribution												
850	95% H-UCL					0.0526	90% Chebyshev (MVUE) UCL					0.0556	
851	95% Chebyshev (MVUE) UCL					0.0592	97.5% Chebyshev (MVUE) UCL					0.0642	
852	99% Chebyshev (MVUE) UCL					0.074							
853													
854	Nonparametric Distribution Free UCL Statistics												
855	Data do not follow a Discernible Distribution												
856													
857	Nonparametric Distribution Free UCLs												
858	95% CLT UCL					0.0512	95% BCA Bootstrap UCL					0.0519	
859	95% Standard Bootstrap UCL					0.0512	95% Bootstrap-t UCL					0.0523	
860	95% Hall's Bootstrap UCL					0.0528	95% Percentile Bootstrap UCL					0.0515	
861	90% Chebyshev(Mean, Sd) UCL					0.0551	95% Chebyshev(Mean, Sd) UCL					0.0589	
862	97.5% Chebyshev(Mean, Sd) UCL					0.0643	99% Chebyshev(Mean, Sd) UCL					0.0749	
863													
864	Suggested UCL to Use												

	A	B	C	D	E	F	G	H	I	J	K	L
865	95% Student's-t UCL					0.0512						
866												
867	The calculated UCLs are based on assumptions that the data were collected in a random and unbiased manner.											
868	Please verify the data were collected from random locations.											
869	If the data were collected using judgmental or other non-random methods,											
870	then contact a statistician to correctly calculate UCLs.											
871												
872	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
873	Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.											
874	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
875												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Uncensored Full Data Sets											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.15/06/2025 3:01:49 PM								
5	From File			Book1.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	Sodium											
12												
13	General Statistics											
14	Total Number of Observations				327		Number of Distinct Observations				40	
15							Number of Missing Observations				0	
16	Minimum				6		Mean				22.81	
17	Maximum				53		Median				24	
18	SD				9.191		Std. Error of Mean				0.508	
19	Coefficient of Variation				0.403		Skewness				-0.0143	
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic				0.955		Shapiro Wilk GOF Test					
23	5% Shapiro Wilk P Value				9.631E-10		Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic				0.0926		Lilliefors GOF Test					
25	5% Lilliefors Critical Value				0.0494		Data Not Normal at 5% Significance Level					
26	Data Not Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
30	95% Student's-t UCL				23.65		95% Adjusted-CLT UCL (Chen-1995)				23.65	
31							95% Modified-t UCL (Johnson-1978)				23.65	
32												
33	Gamma GOF Test											
34	A-D Test Statistic				6.741		Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value				0.757		Data Not Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic				0.138		Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value				0.0504		Data Not Gamma Distributed at 5% Significance Level					
38	Data Not Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)				5.1		k star (bias corrected MLE)				5.055	
42	Theta hat (MLE)				4.473		Theta star (bias corrected MLE)				4.512	
43	nu hat (MLE)				3335		nu star (bias corrected)				3306	
44	MLE Mean (bias corrected)				22.81		MLE Sd (bias corrected)				10.15	
45						Approximate Chi Square Value (0.05)				3174		
46	Adjusted Level of Significance				0.0493		Adjusted Chi Square Value				3173	
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))				23.76		95% Adjusted Gamma UCL (use when n<50)				23.77	
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic				0.902		Shapiro Wilk Lognormal GOF Test					
53	5% Shapiro Wilk P Value				0		Data Not Lognormal at 5% Significance Level					
54	Lilliefors Test Statistic				0.156		Lilliefors Lognormal GOF Test					

	A	B	C	D	E	F	G	H	I	J	K	L	
55	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level						
56	Data Not Lognormal at 5% Significance Level												
57													
58	Lognormal Statistics												
59	Minimum of Logged Data					1.792	Mean of logged Data					3.026	
60	Maximum of Logged Data					3.97	SD of logged Data					0.483	
61													
62	Assuming Lognormal Distribution												
63	95% H-UCL					24.29	90% Chebyshev (MVUE) UCL					25.11	
64	95% Chebyshev (MVUE) UCL					26	97.5% Chebyshev (MVUE) UCL					27.23	
65	99% Chebyshev (MVUE) UCL					29.64							
66													
67	Nonparametric Distribution Free UCL Statistics												
68	Data do not follow a Discernible Distribution (0.05)												
69													
70	Nonparametric Distribution Free UCLs												
71	95% CLT UCL					23.65	95% Jackknife UCL					23.65	
72	95% Standard Bootstrap UCL					23.65	95% Bootstrap-t UCL					23.64	
73	95% Hall's Bootstrap UCL					23.68	95% Percentile Bootstrap UCL					23.64	
74	95% BCA Bootstrap UCL					23.58							
75	90% Chebyshev(Mean, Sd) UCL					24.34	95% Chebyshev(Mean, Sd) UCL					25.03	
76	97.5% Chebyshev(Mean, Sd) UCL					25.98	99% Chebyshev(Mean, Sd) UCL					27.87	
77													
78	Suggested UCL to Use												
79	95% Student's-t UCL					23.65	or 95% Modified-t UCL					23.65	
80													
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
82	Recommendations are based upon data size, data distribution, and skewness.												
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
85													
86	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be												
87	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.												
88													
89													
90	Calcium												
91													
92	General Statistics												
93	Total Number of Observations					327	Number of Distinct Observations					29	
94							Number of Missing Observations					0	
95	Minimum					0.5	Mean					6.176	
96	Maximum					93	Median					2	
97	SD					14.12	Std. Error of Mean					0.781	
98	Coefficient of Variation					2.286	Skewness					3.496	
99													
100	Normal GOF Test												
101	Shapiro Wilk Test Statistic					0.423	Shapiro Wilk GOF Test						
102	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level						
103	Lilliefors Test Statistic					0.417	Lilliefors GOF Test						
104	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level						
105	Data Not Normal at 5% Significance Level												
106													
107	Assuming Normal Distribution												
108	95% Normal UCL						95% UCLs (Adjusted for Skewness)						

	A	B	C	D	E	F	G	H	I	J	K	L
109	95% Student's-t UCL				7.464	95% Adjusted-CLT UCL (Chen-1995)						7.621
110						95% Modified-t UCL (Johnson-1978)						7.489
111												
112	Gamma GOF Test											
113	A-D Test Statistic				40.85	Anderson-Darling Gamma GOF Test						
114	5% A-D Critical Value				0.815	Data Not Gamma Distributed at 5% Significance Level						
115	K-S Test Statistic				0.293	Kolmogorov-Smirnov Gamma GOF Test						
116	5% K-S Critical Value				0.0529	Data Not Gamma Distributed at 5% Significance Level						
117	Data Not Gamma Distributed at 5% Significance Level											
118												
119	Gamma Statistics											
120	k hat (MLE)				0.572	k star (bias corrected MLE)						0.569
121	Theta hat (MLE)				10.79	Theta star (bias corrected MLE)						10.85
122	nu hat (MLE)				374.3	nu star (bias corrected)						372.2
123	MLE Mean (bias corrected)				6.176	MLE Sd (bias corrected)						8.187
124						Approximate Chi Square Value (0.05)						328.5
125	Adjusted Level of Significance				0.0493	Adjusted Chi Square Value						328.3
126												
127	Assuming Gamma Distribution											
128	95% Approximate Gamma UCL (use when n>=50))				6.998	95% Adjusted Gamma UCL (use when n<50)						7.002
129												
130	Lognormal GOF Test											
131	Shapiro Wilk Test Statistic				0.83	Shapiro Wilk Lognormal GOF Test						
132	5% Shapiro Wilk P Value				0	Data Not Lognormal at 5% Significance Level						
133	Lilliefors Test Statistic				0.186	Lilliefors Lognormal GOF Test						
134	5% Lilliefors Critical Value				0.0494	Data Not Lognormal at 5% Significance Level						
135	Data Not Lognormal at 5% Significance Level											
136												
137	Lognormal Statistics											
138	Minimum of Logged Data				-0.693	Mean of logged Data						0.733
139	Maximum of Logged Data				4.533	SD of logged Data						1.211
140												
141	Assuming Lognormal Distribution											
142	95% H-UCL				5.055	90% Chebyshev (MVUE) UCL						5.446
143	95% Chebyshev (MVUE) UCL				5.958	97.5% Chebyshev (MVUE) UCL						6.668
144	99% Chebyshev (MVUE) UCL				8.063							
145												
146	Nonparametric Distribution Free UCL Statistics											
147	Data do not follow a Discernible Distribution (0.05)											
148												
149	Nonparametric Distribution Free UCLs											
150	95% CLT UCL				7.46	95% Jackknife UCL						7.464
151	95% Standard Bootstrap UCL				7.461	95% Bootstrap-t UCL						7.705
152	95% Hall's Bootstrap UCL				7.639	95% Percentile Bootstrap UCL						7.479
153	95% BCA Bootstrap UCL				7.624							
154	90% Chebyshev(Mean, Sd) UCL				8.518	95% Chebyshev(Mean, Sd) UCL						9.579
155	97.5% Chebyshev(Mean, Sd) UCL				11.05	99% Chebyshev(Mean, Sd) UCL						13.94
156												
157	Suggested UCL to Use											
158	95% Chebyshev (Mean, Sd) UCL				9.579							
159												
160	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
161	Recommendations are based upon data size, data distribution, and skewness.											
162	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											

	A	B	C	D	E	F	G	H	I	J	K	L
163	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
164												
165												
166	Magnesium											
167												
168	General Statistics											
169	Total Number of Observations				327		Number of Distinct Observations				13	
170							Number of Missing Observations				0	
171	Minimum				0.5		Mean				3.882	
172	Maximum				13		Median				3	
173	SD				2.165		Std. Error of Mean				0.12	
174	Coefficient of Variation				0.558		Skewness				1.037	
175												
176	Normal GOF Test											
177	Shapiro Wilk Test Statistic				0.907		Shapiro Wilk GOF Test					
178	5% Shapiro Wilk P Value				0		Data Not Normal at 5% Significance Level					
179	Lilliefors Test Statistic				0.191		Lilliefors GOF Test					
180	5% Lilliefors Critical Value				0.0494		Data Not Normal at 5% Significance Level					
181	Data Not Normal at 5% Significance Level											
182												
183	Assuming Normal Distribution											
184	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
185	95% Student's-t UCL				4.08		95% Adjusted-CLT UCL (Chen-1995)				4.087	
186							95% Modified-t UCL (Johnson-1978)				4.081	
187												
188	Gamma GOF Test											
189	A-D Test Statistic				5.191		Anderson-Darling Gamma GOF Test					
190	5% A-D Critical Value				0.76		Data Not Gamma Distributed at 5% Significance Level					
191	K-S Test Statistic				0.156		Kolmogorov-Smirnov Gamma GOF Test					
192	5% K-S Critical Value				0.0506		Data Not Gamma Distributed at 5% Significance Level					
193	Data Not Gamma Distributed at 5% Significance Level											
194												
195	Gamma Statistics											
196	k hat (MLE)				3.055		k star (bias corrected MLE)				3.029	
197	Theta hat (MLE)				1.271		Theta star (bias corrected MLE)				1.282	
198	nu hat (MLE)				1998		nu star (bias corrected)				1981	
199	MLE Mean (bias corrected)				3.882		MLE Sd (bias corrected)				2.231	
200							Approximate Chi Square Value (0.05)				1878	
201	Adjusted Level of Significance				0.0493		Adjusted Chi Square Value				1878	
202												
203	Assuming Gamma Distribution											
204	95% Approximate Gamma UCL (use when n>=50))				4.094		95% Adjusted Gamma UCL (use when n<50)				4.095	
205												
206	Lognormal GOF Test											
207	Shapiro Wilk Test Statistic				0.91		Shapiro Wilk Lognormal GOF Test					
208	5% Shapiro Wilk P Value				0		Data Not Lognormal at 5% Significance Level					
209	Lilliefors Test Statistic				0.196		Lilliefors Lognormal GOF Test					
210	5% Lilliefors Critical Value				0.0494		Data Not Lognormal at 5% Significance Level					
211	Data Not Lognormal at 5% Significance Level											
212												
213	Lognormal Statistics											
214	Minimum of Logged Data				-0.693		Mean of logged Data				1.184	
215	Maximum of Logged Data				2.565		SD of logged Data				0.637	
216												

	A	B	C	D	E	F	G	H	I	J	K	L
217	Assuming Lognormal Distribution											
218	95% H-UCL					4.273	90% Chebyshev (MVUE) UCL					4.46
219	95% Chebyshev (MVUE) UCL					4.669	97.5% Chebyshev (MVUE) UCL					4.96
220	99% Chebyshev (MVUE) UCL					5.53						
221												
222	Nonparametric Distribution Free UCL Statistics											
223	Data do not follow a Discernible Distribution (0.05)											
224												
225	Nonparametric Distribution Free UCLs											
226	95% CLT UCL					4.079	95% Jackknife UCL					4.08
227	95% Standard Bootstrap UCL					4.075	95% Bootstrap-t UCL					4.089
228	95% Hall's Bootstrap UCL					4.078	95% Percentile Bootstrap UCL					4.08
229	95% BCA Bootstrap UCL					4.072						
230	90% Chebyshev(Mean, Sd) UCL					4.241	95% Chebyshev(Mean, Sd) UCL					4.404
231	97.5% Chebyshev(Mean, Sd) UCL					4.63	99% Chebyshev(Mean, Sd) UCL					5.074
232												
233	Suggested UCL to Use											
234	95% Chebyshev (Mean, Sd) UCL					4.404						
235												
236	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
237	Recommendations are based upon data size, data distribution, and skewness.											
238	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
239	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
240												
241												
242	Potassium											
243												
244	General Statistics											
245	Total Number of Observations					327	Number of Distinct Observations					5
246							Number of Missing Observations					0
247	Minimum					0.5	Mean					1.882
248	Maximum					4	Median					2
249	SD					0.667	Std. Error of Mean					0.0369
250	Coefficient of Variation					0.355	Skewness					0.282
251												
252	Normal GOF Test											
253	Shapiro Wilk Test Statistic					0.771	Shapiro Wilk GOF Test					
254	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
255	Lilliefors Test Statistic					0.344	Lilliefors GOF Test					
256	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
257	Data Not Normal at 5% Significance Level											
258												
259	Assuming Normal Distribution											
260	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
261	95% Student's-t UCL					1.943	95% Adjusted-CLT UCL (Chen-1995)					1.944
262							95% Modified-t UCL (Johnson-1978)					1.943
263												
264	Gamma GOF Test											
265	A-D Test Statistic					40.75	Anderson-Darling Gamma GOF Test					
266	5% A-D Critical Value					0.756	Data Not Gamma Distributed at 5% Significance Level					
267	K-S Test Statistic					0.387	Kolmogorov-Smirnov Gamma GOF Test					
268	5% K-S Critical Value					0.0503	Data Not Gamma Distributed at 5% Significance Level					
269	Data Not Gamma Distributed at 5% Significance Level											
270												

	A	B	C	D	E	F	G	H	I	J	K	L	
271	Gamma Statistics												
272	k hat (MLE)					6.64	k star (bias corrected MLE)					6.581	
273	Theta hat (MLE)					0.283	Theta star (bias corrected MLE)					0.286	
274	nu hat (MLE)					4343	nu star (bias corrected)					4304	
275	MLE Mean (bias corrected)					1.882	MLE Sd (bias corrected)					0.734	
276							Approximate Chi Square Value (0.05)					4153	
277	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					4152	
278													
279	Assuming Gamma Distribution												
280	95% Approximate Gamma UCL (use when n>=50))					1.951	95% Adjusted Gamma UCL (use when n<50)					1.951	
281													
282	Lognormal GOF Test												
283	Shapiro Wilk Test Statistic					0.733	Shapiro Wilk Lognormal GOF Test						
284	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level						
285	Lilliefors Test Statistic					0.401	Lilliefors Lognormal GOF Test						
286	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level						
287	Data Not Lognormal at 5% Significance Level												
288													
289	Lognormal Statistics												
290	Minimum of Logged Data					-0.693	Mean of logged Data					0.555	
291	Maximum of Logged Data					1.386	SD of logged Data					0.426	
292													
293	Assuming Lognormal Distribution												
294	95% H-UCL					1.988	90% Chebyshev (MVUE) UCL					2.048	
295	95% Chebyshev (MVUE) UCL					2.111	97.5% Chebyshev (MVUE) UCL					2.2	
296	99% Chebyshev (MVUE) UCL					2.373							
297													
298	Nonparametric Distribution Free UCL Statistics												
299	Data do not follow a Discernible Distribution (0.05)												
300													
301	Nonparametric Distribution Free UCLs												
302	95% CLT UCL					1.943	95% Jackknife UCL					1.943	
303	95% Standard Bootstrap UCL					1.944	95% Bootstrap-t UCL					1.944	
304	95% Hall's Bootstrap UCL					1.945	95% Percentile Bootstrap UCL					1.942	
305	95% BCA Bootstrap UCL					1.942							
306	90% Chebyshev(Mean, Sd) UCL					1.993	95% Chebyshev(Mean, Sd) UCL					2.043	
307	97.5% Chebyshev(Mean, Sd) UCL					2.113	99% Chebyshev(Mean, Sd) UCL					2.249	
308													
309	Suggested UCL to Use												
310	95% Student's-t UCL					1.943	or 95% Modified-t UCL					1.943	
311													
312	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
313	Recommendations are based upon data size, data distribution, and skewness.												
314	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
315	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
316													
317													
318	Sulphate												
319													
320	General Statistics												
321	Total Number of Observations					327	Number of Distinct Observations					30	
322							Number of Missing Observations					0	
323	Minimum					0.5	Mean					7.313	
324	Maximum					49	Median					7	

	A	B	C	D	E	F	G	H	I	J	K	L
325	SD					7.259	Std. Error of Mean					0.401
326	Coefficient of Variation					0.993	Skewness					1.979
327												
328	Normal GOF Test											
329	Shapiro Wilk Test Statistic					0.809	Shapiro Wilk GOF Test					
330	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
331	Lilliefors Test Statistic					0.174	Lilliefors GOF Test					
332	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
333	Data Not Normal at 5% Significance Level											
334												
335	Assuming Normal Distribution											
336	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
337	95% Student's-t UCL					7.976	95% Adjusted-CLT UCL (Chen-1995)					8.021
338							95% Modified-t UCL (Johnson-1978)					7.983
339												
340	Gamma GOF Test											
341	A-D Test Statistic					15.18	Anderson-Darling Gamma GOF Test					
342	5% A-D Critical Value					0.792	Data Not Gamma Distributed at 5% Significance Level					
343	K-S Test Statistic					0.204	Kolmogorov-Smirnov Gamma GOF Test					
344	5% K-S Critical Value					0.0521	Data Not Gamma Distributed at 5% Significance Level					
345	Data Not Gamma Distributed at 5% Significance Level											
346												
347	Gamma Statistics											
348	k hat (MLE)					0.845	k star (bias corrected MLE)					0.839
349	Theta hat (MLE)					8.655	Theta star (bias corrected MLE)					8.714
350	nu hat (MLE)					552.6	nu star (bias corrected)					548.9
351	MLE Mean (bias corrected)					7.313	MLE Sd (bias corrected)					7.983
352							Approximate Chi Square Value (0.05)					495.6
353	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					495.3
354												
355	Assuming Gamma Distribution											
356	95% Approximate Gamma UCL (use when n>=50))					8.101	95% Adjusted Gamma UCL (use when n<50)					8.104
357												
358	Lognormal GOF Test											
359	Shapiro Wilk Test Statistic					0.803	Shapiro Wilk Lognormal GOF Test					
360	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
361	Lilliefors Test Statistic					0.219	Lilliefors Lognormal GOF Test					
362	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
363	Data Not Lognormal at 5% Significance Level											
364												
365	Lognormal Statistics											
366	Minimum of Logged Data					-0.693	Mean of logged Data					1.292
367	Maximum of Logged Data					3.892	SD of logged Data					1.399
368												
369	Assuming Lognormal Distribution											
370	95% H-UCL					11.74	90% Chebyshev (MVUE) UCL					12.74
371	95% Chebyshev (MVUE) UCL					14.15	97.5% Chebyshev (MVUE) UCL					16.1
372	99% Chebyshev (MVUE) UCL					19.93						
373												
374	Nonparametric Distribution Free UCL Statistics											
375	Data do not follow a Discernible Distribution (0.05)											
376												
377	Nonparametric Distribution Free UCLs											
378	95% CLT UCL					7.974	95% Jackknife UCL					7.976

	A	B	C	D	E	F	G	H	I	J	K	L
379	95% Standard Bootstrap UCL					7.955	95% Bootstrap-t UCL					8.039
380	95% Hall's Bootstrap UCL					8.032	95% Percentile Bootstrap UCL					7.991
381	95% BCA Bootstrap UCL					8.02						
382	90% Chebyshev(Mean, Sd) UCL					8.518	95% Chebyshev(Mean, Sd) UCL					9.063
383	97.5% Chebyshev(Mean, Sd) UCL					9.82	99% Chebyshev(Mean, Sd) UCL					11.31
384												
385	Suggested UCL to Use											
386	95% Chebyshev (Mean, Sd) UCL					9.063						
387												
388	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
389	Recommendations are based upon data size, data distribution, and skewness.											
390	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
391	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
392												
393												
394	Chloride											
395												
396	General Statistics											
397	Total Number of Observations					327	Number of Distinct Observations					68
398							Number of Missing Observations					0
399	Minimum					0.5	Mean					38.12
400	Maximum					104	Median					40
401	SD					17.94	Std. Error of Mean					0.992
402	Coefficient of Variation					0.471	Skewness					0.149
403												
404	Normal GOF Test											
405	Shapiro Wilk Test Statistic					0.96	Shapiro Wilk GOF Test					
406	5% Shapiro Wilk P Value					2.3439E-7	Data Not Normal at 5% Significance Level					
407	Lilliefors Test Statistic					0.0769	Lilliefors GOF Test					
408	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
409	Data Not Normal at 5% Significance Level											
410												
411	Assuming Normal Distribution											
412	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
413	95% Student's-t UCL					39.76	95% Adjusted-CLT UCL (Chen-1995)					39.76
414							95% Modified-t UCL (Johnson-1978)					39.76
415												
416	Gamma GOF Test											
417	A-D Test Statistic					6.739	Anderson-Darling Gamma GOF Test					
418	5% A-D Critical Value					0.759	Data Not Gamma Distributed at 5% Significance Level					
419	K-S Test Statistic					0.12	Kolmogorov-Smirnov Gamma GOF Test					
420	5% K-S Critical Value					0.0505	Data Not Gamma Distributed at 5% Significance Level					
421	Data Not Gamma Distributed at 5% Significance Level											
422												
423	Gamma Statistics											
424	k hat (MLE)					3.383	k star (bias corrected MLE)					3.354
425	Theta hat (MLE)					11.27	Theta star (bias corrected MLE)					11.36
426	nu hat (MLE)					2213	nu star (bias corrected)					2194
427	MLE Mean (bias corrected)					38.12	MLE Sd (bias corrected)					20.81
428							Approximate Chi Square Value (0.05)					2086
429	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					2085
430												
431	Assuming Gamma Distribution											
432	95% Approximate Gamma UCL (use when n>=50))					40.09	95% Adjusted Gamma UCL (use when n<50)					40.1

	A	B	C	D	E	F	G	H	I	J	K	L
433												
434	Lognormal GOF Test											
435	Shapiro Wilk Test Statistic					0.852	Shapiro Wilk Lognormal GOF Test					
436	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
437	Lilliefors Test Statistic					0.145	Lilliefors Lognormal GOF Test					
438	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
439	Data Not Lognormal at 5% Significance Level											
440												
441	Lognormal Statistics											
442	Minimum of Logged Data					-0.693	Mean of logged Data					3.486
443	Maximum of Logged Data					4.644	SD of logged Data					0.649
444												
445	Assuming Lognormal Distribution											
446	95% H-UCL					43.12	90% Chebyshev (MVUE) UCL					45.04
447	95% Chebyshev (MVUE) UCL					47.19	97.5% Chebyshev (MVUE) UCL					50.19
448	99% Chebyshev (MVUE) UCL					56.06						
449												
450	Nonparametric Distribution Free UCL Statistics											
451	Data do not follow a Discernible Distribution (0.05)											
452												
453	Nonparametric Distribution Free UCLs											
454	95% CLT UCL					39.75	95% Jackknife UCL					39.76
455	95% Standard Bootstrap UCL					39.76	95% Bootstrap-t UCL					39.75
456	95% Hall's Bootstrap UCL					39.8	95% Percentile Bootstrap UCL					39.68
457	95% BCA Bootstrap UCL					39.68						
458	90% Chebyshev(Mean, Sd) UCL					41.1	95% Chebyshev(Mean, Sd) UCL					42.44
459	97.5% Chebyshev(Mean, Sd) UCL					44.32	99% Chebyshev(Mean, Sd) UCL					47.99
460												
461	Suggested UCL to Use											
462	95% Chebyshev (Mean, Sd) UCL					42.44						
463												
464	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
465	Recommendations are based upon data size, data distribution, and skewness.											
466	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
467	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
468												
469												
470	Fluoride											
471												
472	General Statistics											
473	Total Number of Observations					327	Number of Distinct Observations					6
474							Number of Missing Observations					0
475	Minimum					0.05	Mean					0.063
476	Maximum					0.5	Median					0.05
477	SD					0.0568	Std. Error of Mean					0.00314
478	Coefficient of Variation					0.902	Skewness					5.535
479												
480	Normal GOF Test											
481	Shapiro Wilk Test Statistic					0.259	Shapiro Wilk GOF Test					
482	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
483	Lilliefors Test Statistic					0.508	Lilliefors GOF Test					
484	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
485	Data Not Normal at 5% Significance Level											
486												

	A	B	C	D	E	F	G	H	I	J	K	L
487	Assuming Normal Distribution											
488	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
489	95% Student's-t UCL					0.0682	95% Adjusted-CLT UCL (Chen-1995)					0.0692
490							95% Modified-t UCL (Johnson-1978)					0.0683
491												
492	Gamma GOF Test											
493	A-D Test Statistic					104.9	Anderson-Darling Gamma GOF Test					
494	5% A-D Critical Value					0.759	Data Not Gamma Distributed at 5% Significance Level					
495	K-S Test Statistic					0.528	Kolmogorov-Smirnov Gamma GOF Test					
496	5% K-S Critical Value					0.0504	Data Not Gamma Distributed at 5% Significance Level					
497	Data Not Gamma Distributed at 5% Significance Level											
498												
499	Gamma Statistics											
500	k hat (MLE)					4.078	k star (bias corrected MLE)					4.043
501	Theta hat (MLE)					0.0154	Theta star (bias corrected MLE)					0.0156
502	nu hat (MLE)					2667	nu star (bias corrected)					2644
503	MLE Mean (bias corrected)					0.063	MLE Sd (bias corrected)					0.0313
504							Approximate Chi Square Value (0.05)					2525
505	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					2525
506												
507	Assuming Gamma Distribution											
508	95% Approximate Gamma UCL (use when n>=50))					0.066	95% Adjusted Gamma UCL (use when n<50)					0.066
509												
510	Lognormal GOF Test											
511	Shapiro Wilk Test Statistic					0.305	Shapiro Wilk Lognormal GOF Test					
512	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
513	Lilliefors Test Statistic					0.524	Lilliefors Lognormal GOF Test					
514	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
515	Data Not Lognormal at 5% Significance Level											
516												
517	Lognormal Statistics											
518	Minimum of Logged Data					-2.996	Mean of logged Data					-2.892
519	Maximum of Logged Data					-0.693	SD of logged Data					0.382
520												
521	Assuming Lognormal Distribution											
522	95% H-UCL					0.0619	90% Chebyshev (MVUE) UCL					0.0636
523	95% Chebyshev (MVUE) UCL					0.0653	97.5% Chebyshev (MVUE) UCL					0.0678
524	99% Chebyshev (MVUE) UCL					0.0726						
525												
526	Nonparametric Distribution Free UCL Statistics											
527	Data do not follow a Discernible Distribution (0.05)											
528												
529	Nonparametric Distribution Free UCLs											
530	95% CLT UCL					0.0682	95% Jackknife UCL					0.0682
531	95% Standard Bootstrap UCL					0.0681	95% Bootstrap-t UCL					0.0694
532	95% Hall's Bootstrap UCL					0.0693	95% Percentile Bootstrap UCL					0.0683
533	95% BCA Bootstrap UCL					0.0691						
534	90% Chebyshev(Mean, Sd) UCL					0.0724	95% Chebyshev(Mean, Sd) UCL					0.0767
535	97.5% Chebyshev(Mean, Sd) UCL					0.0826	99% Chebyshev(Mean, Sd) UCL					0.0943
536												
537	Suggested UCL to Use											
538	95% Student's-t UCL					0.0682	or 95% Modified-t UCL					0.0683
539												
540	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											

	A	B	C	D	E	F	G	H	I	J	K	L
541	Recommendations are based upon data size, data distribution, and skewness.											
542	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
543	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
544												
545												
546	Reactive phosphorus as P											
547												
548	General Statistics											
549	Total Number of Observations					327	Number of Distinct Observations					12
550							Number of Missing Observations					0
551	Minimum					0.005	Mean					0.012
552	Maximum					0.13	Median					0.005
553	SD					0.0155	Std. Error of Mean					8.5814E-4
554	Coefficient of Variation					1.296	Skewness					4.013
555												
556	Normal GOF Test											
557	Shapiro Wilk Test Statistic					0.518	Shapiro Wilk GOF Test					
558	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
559	Lilliefors Test Statistic					0.34	Lilliefors GOF Test					
560	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
561	Data Not Normal at 5% Significance Level											
562												
563	Assuming Normal Distribution											
564	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
565	95% Student's-t UCL					0.0134	95% Adjusted-CLT UCL (Chen-1995)					0.0136
566							95% Modified-t UCL (Johnson-1978)					0.0134
567												
568	Gamma GOF Test											
569	A-D Test Statistic					47	Anderson-Darling Gamma GOF Test					
570	5% A-D Critical Value					0.774	Data Not Gamma Distributed at 5% Significance Level					
571	K-S Test Statistic					0.365	Kolmogorov-Smirnov Gamma GOF Test					
572	5% K-S Critical Value					0.0512	Data Not Gamma Distributed at 5% Significance Level					
573	Data Not Gamma Distributed at 5% Significance Level											
574												
575	Gamma Statistics											
576	k hat (MLE)					1.438	k star (bias corrected MLE)					1.426
577	Theta hat (MLE)					0.00833	Theta star (bias corrected MLE)					0.00839
578	nu hat (MLE)					940.1	nu star (bias corrected)					932.9
579	MLE Mean (bias corrected)					0.012	MLE Sd (bias corrected)					0.01
580							Approximate Chi Square Value (0.05)					863
581	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					862.7
582												
583	Assuming Gamma Distribution											
584	95% Approximate Gamma UCL (use when n>=50))					0.0129	95% Adjusted Gamma UCL (use when n<50)					0.0129
585												
586	Lognormal GOF Test											
587	Shapiro Wilk Test Statistic					0.681	Shapiro Wilk Lognormal GOF Test					
588	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
589	Lilliefors Test Statistic					0.374	Lilliefors Lognormal GOF Test					
590	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
591	Data Not Lognormal at 5% Significance Level											
592												
593	Lognormal Statistics											
594	Minimum of Logged Data					-5.298	Mean of logged Data					-4.812

	A	B	C	D	E	F	G	H	I	J	K	L
595	Maximum of Logged Data					-2.04	SD of logged Data					0.752
596												
597	Assuming Lognormal Distribution											
598	95% H-UCL					0.0117	90% Chebyshev (MVUE) UCL					0.0123
599	95% Chebyshev (MVUE) UCL					0.013	97.5% Chebyshev (MVUE) UCL					0.0139
600	99% Chebyshev (MVUE) UCL					0.0158						
601												
602	Nonparametric Distribution Free UCL Statistics											
603	Data do not follow a Discernible Distribution (0.05)											
604												
605	Nonparametric Distribution Free UCLs											
606	95% CLT UCL					0.0134	95% Jackknife UCL					0.0134
607	95% Standard Bootstrap UCL					0.0134	95% Bootstrap-t UCL					0.0136
608	95% Hall's Bootstrap UCL					0.0137	95% Percentile Bootstrap UCL					0.0135
609	95% BCA Bootstrap UCL					0.0136						
610	90% Chebyshev(Mean, Sd) UCL					0.0145	95% Chebyshev(Mean, Sd) UCL					0.0157
611	97.5% Chebyshev(Mean, Sd) UCL					0.0173	99% Chebyshev(Mean, Sd) UCL					0.0205
612												
613	Suggested UCL to Use											
614	95% Chebyshev (Mean, Sd) UCL					0.0157						
615												
616	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
617	Recommendations are based upon data size, data distribution, and skewness.											
618	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
619	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
620												
621												
622	Total Phosphorus											
623												
624	General Statistics											
625	Total Number of Observations					322	Number of Distinct Observations					35
626							Number of Missing Observations					5
627	Minimum					0.005	Mean					0.0682
628	Maximum					1.18	Median					0.04
629	SD					0.125	Std. Error of Mean					0.00699
630	Coefficient of Variation					1.838	Skewness					5.768
631												
632	Normal GOF Test											
633	Shapiro Wilk Test Statistic					0.438	Shapiro Wilk GOF Test					
634	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
635	Lilliefors Test Statistic					0.31	Lilliefors GOF Test					
636	5% Lilliefors Critical Value					0.0498	Data Not Normal at 5% Significance Level					
637	Data Not Normal at 5% Significance Level											
638												
639	Assuming Normal Distribution											
640	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
641	95% Student's-t UCL					0.0798	95% Adjusted-CLT UCL (Chen-1995)					0.0821
642							95% Modified-t UCL (Johnson-1978)					0.0801
643												
644	Gamma GOF Test											
645	A-D Test Statistic					12.23	Anderson-Darling Gamma GOF Test					
646	5% A-D Critical Value					0.788	Data Not Gamma Distributed at 5% Significance Level					
647	K-S Test Statistic					0.158	Kolmogorov-Smirnov Gamma GOF Test					
648	5% K-S Critical Value					0.0523	Data Not Gamma Distributed at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L
649	Data Not Gamma Distributed at 5% Significance Level											
650												
651	Gamma Statistics											
652	k hat (MLE)				0.925		k star (bias corrected MLE)				0.919	
653	Theta hat (MLE)				0.0737		Theta star (bias corrected MLE)				0.0743	
654	nu hat (MLE)				596		nu star (bias corrected)				591.8	
655	MLE Mean (bias corrected)				0.0682		MLE Sd (bias corrected)				0.0712	
656							Approximate Chi Square Value (0.05)				536.3	
657	Adjusted Level of Significance				0.0493		Adjusted Chi Square Value				536.1	
658												
659	Assuming Gamma Distribution											
660	95% Approximate Gamma UCL (use when n>=50))				0.0753		95% Adjusted Gamma UCL (use when n<50)				0.0753	
661												
662	Lognormal GOF Test											
663	Shapiro Wilk Test Statistic				0.937		Shapiro Wilk Lognormal GOF Test					
664	5% Shapiro Wilk P Value				0		Data Not Lognormal at 5% Significance Level					
665	Lilliefors Test Statistic				0.143		Lilliefors Lognormal GOF Test					
666	5% Lilliefors Critical Value				0.0498		Data Not Lognormal at 5% Significance Level					
667	Data Not Lognormal at 5% Significance Level											
668												
669	Lognormal Statistics											
670	Minimum of Logged Data				-5.298		Mean of logged Data				-3.314	
671	Maximum of Logged Data				0.166		SD of logged Data				1.057	
672												
673	Assuming Lognormal Distribution											
674	95% H-UCL				0.0723		90% Chebyshev (MVUE) UCL				0.0773	
675	95% Chebyshev (MVUE) UCL				0.0836		97.5% Chebyshev (MVUE) UCL				0.0923	
676	99% Chebyshev (MVUE) UCL				0.109							
677												
678	Nonparametric Distribution Free UCL Statistics											
679	Data do not follow a Discernible Distribution (0.05)											
680												
681	Nonparametric Distribution Free UCLs											
682	95% CLT UCL				0.0797		95% Jackknife UCL				0.0798	
683	95% Standard Bootstrap UCL				0.0793		95% Bootstrap-t UCL				0.083	
684	95% Hall's Bootstrap UCL				0.0833		95% Percentile Bootstrap UCL				0.0803	
685	95% BCA Bootstrap UCL				0.0819							
686	90% Chebyshev(Mean, Sd) UCL				0.0892		95% Chebyshev(Mean, Sd) UCL				0.0987	
687	97.5% Chebyshev(Mean, Sd) UCL				0.112		99% Chebyshev(Mean, Sd) UCL				0.138	
688												
689	Suggested UCL to Use											
690	95% Chebyshev (Mean, Sd) UCL				0.0987							
691												
692	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
693	Recommendations are based upon data size, data distribution, and skewness.											
694	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
695	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
696												
697												
698	Nitrite as N											
699												
700	General Statistics											
701	Total Number of Observations				327		Number of Distinct Observations				7	
702							Number of Missing Observations				0	

	A	B	C	D	E	F	G	H	I	J	K	L
703	Minimum					0.005	Mean					0.00642
704	Maximum					0.1	Median					0.005
705	SD					0.00824	Std. Error of Mean					4.5546E-4
706	Coefficient of Variation					1.282	Skewness					8.504
707												
708	Normal GOF Test											
709	Shapiro Wilk Test Statistic					0.193	Shapiro Wilk GOF Test					
710	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
711	Lilliefors Test Statistic					0.498	Lilliefors GOF Test					
712	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
713	Data Not Normal at 5% Significance Level											
714												
715	Assuming Normal Distribution											
716	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
717	95% Student's-t UCL					0.00717	95% Adjusted-CLT UCL (Chen-1995)					0.0074
718							95% Modified-t UCL (Johnson-1978)					0.00721
719												
720	Gamma GOF Test											
721	A-D Test Statistic					3.058E+28	Anderson-Darling Gamma GOF Test					
722	5% A-D Critical Value					0.759	Data Not Gamma Distributed at 5% Significance Level					
723	K-S Test Statistic					0.528	Kolmogorov-Smirnov Gamma GOF Test					
724	5% K-S Critical Value					0.0505	Data Not Gamma Distributed at 5% Significance Level					
725	Data Not Gamma Distributed at 5% Significance Level											
726												
727	Gamma Statistics											
728	k hat (MLE)					3.319	k star (bias corrected MLE)					3.29
729	Theta hat (MLE)					0.00193	Theta star (bias corrected MLE)					0.00195
730	nu hat (MLE)					2171	nu star (bias corrected)					2152
731	MLE Mean (bias corrected)					0.00642	MLE Sd (bias corrected)					0.00354
732							Approximate Chi Square Value (0.05)					2045
733	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					2045
734												
735	Assuming Gamma Distribution											
736	95% Approximate Gamma UCL (use when n>=50))					0.00676	95% Adjusted Gamma UCL (use when n<50)					0.00676
737												
738	Lognormal GOF Test											
739	Shapiro Wilk Test Statistic					0.272	Shapiro Wilk Lognormal GOF Test					
740	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
741	Lilliefors Test Statistic					0.524	Lilliefors Lognormal GOF Test					
742	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
743	Data Not Lognormal at 5% Significance Level											
744												
745	Lognormal Statistics											
746	Minimum of Logged Data					-5.298	Mean of logged Data					-5.206
747	Maximum of Logged Data					-2.303	SD of logged Data					0.386
748												
749	Assuming Lognormal Distribution											
750	95% H-UCL					0.00613	90% Chebyshev (MVUE) UCL					0.0063
751	95% Chebyshev (MVUE) UCL					0.00647	97.5% Chebyshev (MVUE) UCL					0.00672
752	99% Chebyshev (MVUE) UCL					0.0072						
753												
754	Nonparametric Distribution Free UCL Statistics											
755	Data do not follow a Discernible Distribution (0.05)											
756												

	A	B	C	D	E	F	G	H	I	J	K	L
757	Nonparametric Distribution Free UCLs											
758	95% CLT UCL					0.00717	95% Jackknife UCL					0.00717
759	95% Standard Bootstrap UCL					0.00717	95% Bootstrap-t UCL					0.0077
760	95% Hall's Bootstrap UCL					0.00782	95% Percentile Bootstrap UCL					0.0072
761	95% BCA Bootstrap UCL					0.00758						
762	90% Chebyshev(Mean, Sd) UCL					0.00779	95% Chebyshev(Mean, Sd) UCL					0.00841
763	97.5% Chebyshev(Mean, Sd) UCL					0.00927	99% Chebyshev(Mean, Sd) UCL					0.011
764												
765	Suggested UCL to Use											
766	95% Student's-t UCL					0.00717	or 95% Modified-t UCL					0.00721
767												
768	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
769	Recommendations are based upon data size, data distribution, and skewness.											
770	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
771	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
772												
773												
774	Nitrate as N											
775												
776	General Statistics											
777	Total Number of Observations					327	Number of Distinct Observations					49
778							Number of Missing Observations					0
779	Minimum					0.005	Mean					0.162
780	Maximum					8.15	Median					0.01
781	SD					0.718	Std. Error of Mean					0.0397
782	Coefficient of Variation					4.422	Skewness					8.789
783												
784	Normal GOF Test											
785	Shapiro Wilk Test Statistic					0.237	Shapiro Wilk GOF Test					
786	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
787	Lilliefors Test Statistic					0.413	Lilliefors GOF Test					
788	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
789	Data Not Normal at 5% Significance Level											
790												
791	Assuming Normal Distribution											
792	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
793	95% Student's-t UCL					0.228	95% Adjusted-CLT UCL (Chen-1995)					0.248
794							95% Modified-t UCL (Johnson-1978)					0.231
795												
796	Gamma GOF Test											
797	A-D Test Statistic					45.59	Anderson-Darling Gamma GOF Test					
798	5% A-D Critical Value					0.866	Data Not Gamma Distributed at 5% Significance Level					
799	K-S Test Statistic					0.275	Kolmogorov-Smirnov Gamma GOF Test					
800	5% K-S Critical Value					0.0544	Data Not Gamma Distributed at 5% Significance Level					
801	Data Not Gamma Distributed at 5% Significance Level											
802												
803	Gamma Statistics											
804	k hat (MLE)					0.318	k star (bias corrected MLE)					0.317
805	Theta hat (MLE)					0.51	Theta star (bias corrected MLE)					0.512
806	nu hat (MLE)					208.2	nu star (bias corrected)					207.6
807	MLE Mean (bias corrected)					0.162	MLE Sd (bias corrected)					0.288
808							Approximate Chi Square Value (0.05)					175.3
809	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					175.2
810												

	A	B	C	D	E	F	G	H	I	J	K	L
811	Assuming Gamma Distribution											
812	95% Approximate Gamma UCL (use when n>=50))					0.192	95% Adjusted Gamma UCL (use when n<50)					0.193
813												
814	Lognormal GOF Test											
815	Shapiro Wilk Test Statistic					0.78	Shapiro Wilk Lognormal GOF Test					
816	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
817	Lilliefors Test Statistic					0.257	Lilliefors Lognormal GOF Test					
818	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
819	Data Not Lognormal at 5% Significance Level											
820												
821	Lognormal Statistics											
822	Minimum of Logged Data					-5.298	Mean of logged Data					-3.962
823	Maximum of Logged Data					2.098	SD of logged Data					1.689
824												
825	Assuming Lognormal Distribution											
826	95% H-UCL					0.102	90% Chebyshev (MVUE) UCL					0.112
827	95% Chebyshev (MVUE) UCL					0.127	97.5% Chebyshev (MVUE) UCL					0.148
828	99% Chebyshev (MVUE) UCL					0.189						
829												
830	Nonparametric Distribution Free UCL Statistics											
831	Data do not follow a Discernible Distribution (0.05)											
832												
833	Nonparametric Distribution Free UCLs											
834	95% CLT UCL					0.228	95% Jackknife UCL					0.228
835	95% Standard Bootstrap UCL					0.228	95% Bootstrap-t UCL					0.282
836	95% Hall's Bootstrap UCL					0.519	95% Percentile Bootstrap UCL					0.232
837	95% BCA Bootstrap UCL					0.262						
838	90% Chebyshev(Mean, Sd) UCL					0.282	95% Chebyshev(Mean, Sd) UCL					0.336
839	97.5% Chebyshev(Mean, Sd) UCL					0.411	99% Chebyshev(Mean, Sd) UCL					0.558
840												
841	Suggested UCL to Use											
842	95% Chebyshev (Mean, Sd) UCL					0.336						
843												
844	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
845	Recommendations are based upon data size, data distribution, and skewness.											
846	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
847	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
848												
849												
850	Nitrite + Nitrate as N											
851												
852	General Statistics											
853	Total Number of Observations					327	Number of Distinct Observations					48
854							Number of Missing Observations					0
855	Minimum					0.005	Mean					0.164
856	Maximum					8.15	Median					0.01
857	SD					0.72	Std. Error of Mean					0.0398
858	Coefficient of Variation					4.392	Skewness					8.741
859												
860	Normal GOF Test											
861	Shapiro Wilk Test Statistic					0.239	Shapiro Wilk GOF Test					
862	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
863	Lilliefors Test Statistic					0.413	Lilliefors GOF Test					
864	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L
865	Data Not Normal at 5% Significance Level											
866												
867	Assuming Normal Distribution											
868	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
869	95% Student's-t UCL					0.23	95% Adjusted-CLT UCL (Chen-1995)					0.25
870							95% Modified-t UCL (Johnson-1978)					0.233
871												
872	Gamma GOF Test											
873	A-D Test Statistic					45.16	Anderson-Darling Gamma GOF Test					
874	5% A-D Critical Value					0.866	Data Not Gamma Distributed at 5% Significance Level					
875	K-S Test Statistic					0.276	Kolmogorov-Smirnov Gamma GOF Test					
876	5% K-S Critical Value					0.0544	Data Not Gamma Distributed at 5% Significance Level					
877	Data Not Gamma Distributed at 5% Significance Level											
878												
879	Gamma Statistics											
880	k hat (MLE)					0.319	k star (bias corrected MLE)					0.318
881	Theta hat (MLE)					0.514	Theta star (bias corrected MLE)					0.516
882	nu hat (MLE)					208.4	nu star (bias corrected)					207.8
883	MLE Mean (bias corrected)					0.164	MLE Sd (bias corrected)					0.291
884							Approximate Chi Square Value (0.05)					175.5
885	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					175.4
886												
887	Assuming Gamma Distribution											
888	95% Approximate Gamma UCL (use when n>=50))					0.194	95% Adjusted Gamma UCL (use when n<50)					0.194
889												
890	Lognormal GOF Test											
891	Shapiro Wilk Test Statistic					0.783	Shapiro Wilk Lognormal GOF Test					
892	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
893	Lilliefors Test Statistic					0.255	Lilliefors Lognormal GOF Test					
894	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
895	Data Not Lognormal at 5% Significance Level											
896												
897	Lognormal Statistics											
898	Minimum of Logged Data					-5.298	Mean of logged Data					-3.951
899	Maximum of Logged Data					2.098	SD of logged Data					1.693
900												
901	Assuming Lognormal Distribution											
902	95% H-UCL					0.105	90% Chebyshev (MVUE) UCL					0.114
903	95% Chebyshev (MVUE) UCL					0.129	97.5% Chebyshev (MVUE) UCL					0.151
904	99% Chebyshev (MVUE) UCL					0.193						
905												
906	Nonparametric Distribution Free UCL Statistics											
907	Data do not follow a Discernible Distribution (0.05)											
908												
909	Nonparametric Distribution Free UCLs											
910	95% CLT UCL					0.229	95% Jackknife UCL					0.23
911	95% Standard Bootstrap UCL					0.229	95% Bootstrap-t UCL					0.287
912	95% Hall's Bootstrap UCL					0.49	95% Percentile Bootstrap UCL					0.237
913	95% BCA Bootstrap UCL					0.255						
914	90% Chebyshev(Mean, Sd) UCL					0.283	95% Chebyshev(Mean, Sd) UCL					0.338
915	97.5% Chebyshev(Mean, Sd) UCL					0.413	99% Chebyshev(Mean, Sd) UCL					0.56
916												
917	Suggested UCL to Use											
918	95% Chebyshev (Mean, Sd) UCL					0.338						

	A	B	C	D	E	F	G	H	I	J	K	L		
919														
920	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.													
921	Recommendations are based upon data size, data distribution, and skewness.													
922	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).													
923	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.													
924														
925														
926	Total Ammonia as Nitrogen													
927														
928	General Statistics													
929	Total Number of Observations					327		Number of Distinct Observations					69	
930								Number of Missing Observations					0	
931	Minimum					0.005		Mean					0.219	
932	Maximum					3.22		Median					0.12	
933	SD					0.301		Std. Error of Mean					0.0166	
934	Coefficient of Variation					1.372		Skewness					4.588	
935														
936	Normal GOF Test													
937	Shapiro Wilk Test Statistic					0.609		Shapiro Wilk GOF Test						
938	5% Shapiro Wilk P Value					0		Data Not Normal at 5% Significance Level						
939	Lilliefors Test Statistic					0.238		Lilliefors GOF Test						
940	5% Lilliefors Critical Value					0.0494		Data Not Normal at 5% Significance Level						
941	Data Not Normal at 5% Significance Level													
942														
943	Assuming Normal Distribution													
944	95% Normal UCL							95% UCLs (Adjusted for Skewness)						
945	95% Student's-t UCL					0.247		95% Adjusted-CLT UCL (Chen-1995)					0.251	
946								95% Modified-t UCL (Johnson-1978)					0.247	
947														
948	Gamma GOF Test													
949	A-D Test Statistic					5.85		Anderson-Darling Gamma GOF Test						
950	5% A-D Critical Value					0.785		Data Not Gamma Distributed at 5% Significance Level						
951	K-S Test Statistic					0.123		Kolmogorov-Smirnov Gamma GOF Test						
952	5% K-S Critical Value					0.0518		Data Not Gamma Distributed at 5% Significance Level						
953	Data Not Gamma Distributed at 5% Significance Level													
954														
955	Gamma Statistics													
956	k hat (MLE)					0.981		k star (bias corrected MLE)					0.974	
957	Theta hat (MLE)					0.224		Theta star (bias corrected MLE)					0.225	
958	nu hat (MLE)					641.3		nu star (bias corrected)					636.7	
959	MLE Mean (bias corrected)					0.219		MLE Sd (bias corrected)					0.222	
960								Approximate Chi Square Value (0.05)					579.2	
961	Adjusted Level of Significance					0.0493		Adjusted Chi Square Value					579	
962														
963	Assuming Gamma Distribution													
964	95% Approximate Gamma UCL (use when n>=50))					0.241		95% Adjusted Gamma UCL (use when n<50)					0.241	
965														
966	Lognormal GOF Test													
967	Shapiro Wilk Test Statistic					0.935		Shapiro Wilk Lognormal GOF Test						
968	5% Shapiro Wilk P Value					0		Data Not Lognormal at 5% Significance Level						
969	Lilliefors Test Statistic					0.113		Lilliefors Lognormal GOF Test						
970	5% Lilliefors Critical Value					0.0494		Data Not Lognormal at 5% Significance Level						
971	Data Not Lognormal at 5% Significance Level													
972														

	A	B	C	D	E	F	G	H	I	J	K	L
973	Lognormal Statistics											
974	Minimum of Logged Data					-5.298	Mean of logged Data					-2.108
975	Maximum of Logged Data					1.169	SD of logged Data					1.168
976												
977	Assuming Lognormal Distribution											
978	95% H-UCL					0.278	90% Chebyshev (MVUE) UCL					0.299
979	95% Chebyshev (MVUE) UCL					0.326	97.5% Chebyshev (MVUE) UCL					0.364
980	99% Chebyshev (MVUE) UCL					0.438						
981												
982	Nonparametric Distribution Free UCL Statistics											
983	Data do not follow a Discernible Distribution (0.05)											
984												
985	Nonparametric Distribution Free UCLs											
986	95% CLT UCL					0.247	95% Jackknife UCL					0.247
987	95% Standard Bootstrap UCL					0.246	95% Bootstrap-t UCL					0.25
988	95% Hall's Bootstrap UCL					0.255	95% Percentile Bootstrap UCL					0.249
989	95% BCA Bootstrap UCL					0.253						
990	90% Chebyshev(Mean, Sd) UCL					0.269	95% Chebyshev(Mean, Sd) UCL					0.292
991	97.5% Chebyshev(Mean, Sd) UCL					0.323	99% Chebyshev(Mean, Sd) UCL					0.385
992												
993	Suggested UCL to Use											
994	95% Chebyshev (Mean, Sd) UCL					0.292						
995												
996	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
997	Recommendations are based upon data size, data distribution, and skewness.											
998	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
999	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1000												
1001												
1002	Total Kjeldahl Nitrogen as N											
1003												
1004	General Statistics											
1005	Total Number of Observations					327	Number of Distinct Observations					40
1006							Number of Missing Observations					0
1007	Minimum					0.1	Mean					0.911
1008	Maximum					8.2	Median					0.5
1009	SD					1.036	Std. Error of Mean					0.0573
1010	Coefficient of Variation					1.138	Skewness					3.036
1011												
1012	Normal GOF Test											
1013	Shapiro Wilk Test Statistic					0.686	Shapiro Wilk GOF Test					
1014	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
1015	Lilliefors Test Statistic					0.231	Lilliefors GOF Test					
1016	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
1017	Data Not Normal at 5% Significance Level											
1018												
1019	Assuming Normal Distribution											
1020	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1021	95% Student's-t UCL					1.006	95% Adjusted-CLT UCL (Chen-1995)					1.016
1022							95% Modified-t UCL (Johnson-1978)					1.007
1023												
1024	Gamma GOF Test											
1025	A-D Test Statistic					10.44	Anderson-Darling Gamma GOF Test					
1026	5% A-D Critical Value					0.777	Data Not Gamma Distributed at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L	
1027	K-S Test Statistic					0.18	Kolmogorov-Smirnov Gamma GOF Test						
1028	5% K-S Critical Value					0.0514	Data Not Gamma Distributed at 5% Significance Level						
1029	Data Not Gamma Distributed at 5% Significance Level												
1030													
1031	Gamma Statistics												
1032	k hat (MLE)					1.301	k star (bias corrected MLE)					1.291	
1033	Theta hat (MLE)					0.7	Theta star (bias corrected MLE)					0.706	
1034	nu hat (MLE)					850.9	nu star (bias corrected)					844.4	
1035	MLE Mean (bias corrected)					0.911	MLE Sd (bias corrected)					0.802	
1036							Approximate Chi Square Value (0.05)					777.9	
1037	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					777.7	
1038													
1039	Assuming Gamma Distribution												
1040	95% Approximate Gamma UCL (use when n>=50))					0.989	95% Adjusted Gamma UCL (use when n<50)					0.989	
1041													
1042	Lognormal GOF Test												
1043	Shapiro Wilk Test Statistic					0.936	Shapiro Wilk Lognormal GOF Test						
1044	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level						
1045	Lilliefors Test Statistic					0.153	Lilliefors Lognormal GOF Test						
1046	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level						
1047	Data Not Lognormal at 5% Significance Level												
1048													
1049	Lognormal Statistics												
1050	Minimum of Logged Data					-2.303	Mean of logged Data					-0.524	
1051	Maximum of Logged Data					2.104	SD of logged Data					0.89	
1052													
1053	Assuming Lognormal Distribution												
1054	95% H-UCL					0.973	90% Chebyshev (MVUE) UCL					1.031	
1055	95% Chebyshev (MVUE) UCL					1.1	97.5% Chebyshev (MVUE) UCL					1.196	
1056	99% Chebyshev (MVUE) UCL					1.384							
1057													
1058	Nonparametric Distribution Free UCL Statistics												
1059	Data do not follow a Discernible Distribution (0.05)												
1060													
1061	Nonparametric Distribution Free UCLs												
1062	95% CLT UCL					1.005	95% Jackknife UCL					1.006	
1063	95% Standard Bootstrap UCL					1.002	95% Bootstrap-t UCL					1.024	
1064	95% Hall's Bootstrap UCL					1.018	95% Percentile Bootstrap UCL					1.005	
1065	95% BCA Bootstrap UCL					1.022							
1066	90% Chebyshev(Mean, Sd) UCL					1.083	95% Chebyshev(Mean, Sd) UCL					1.161	
1067	97.5% Chebyshev(Mean, Sd) UCL					1.269	99% Chebyshev(Mean, Sd) UCL					1.481	
1068													
1069	Suggested UCL to Use												
1070	95% Chebyshev (Mean, Sd) UCL					1.161							
1071													
1072	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
1073	Recommendations are based upon data size, data distribution, and skewness.												
1074	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
1075	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
1076													
1077													
1078	Nitrogen												
1079													
1080	General Statistics												

	A	B	C	D	E	F	G	H	I	J	K	L
1081	Total Number of Observations					322	Number of Distinct Observations					47
1082							Number of Missing Observations					5
1083	Minimum					0.1	Mean					1.079
1084	Maximum					10.4	Median					0.6
1085	SD					1.338	Std. Error of Mean					0.0745
1086	Coefficient of Variation					1.24	Skewness					3.519
1087												
1088	Normal GOF Test											
1089	Shapiro Wilk Test Statistic					0.641	Shapiro Wilk GOF Test					
1090	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
1091	Lilliefors Test Statistic					0.243	Lilliefors GOF Test					
1092	5% Lilliefors Critical Value					0.0498	Data Not Normal at 5% Significance Level					
1093	Data Not Normal at 5% Significance Level											
1094												
1095	Assuming Normal Distribution											
1096	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1097	95% Student's-t UCL					1.202	95% Adjusted-CLT UCL (Chen-1995)					1.217
1098							95% Modified-t UCL (Johnson-1978)					1.205
1099												
1100	Gamma GOF Test											
1101	A-D Test Statistic					10.23	Anderson-Darling Gamma GOF Test					
1102	5% A-D Critical Value					0.779	Data Not Gamma Distributed at 5% Significance Level					
1103	K-S Test Statistic					0.162	Kolmogorov-Smirnov Gamma GOF Test					
1104	5% K-S Critical Value					0.0519	Data Not Gamma Distributed at 5% Significance Level					
1105	Data Not Gamma Distributed at 5% Significance Level											
1106												
1107	Gamma Statistics											
1108	k hat (MLE)					1.208	k star (bias corrected MLE)					1.199
1109	Theta hat (MLE)					0.893	Theta star (bias corrected MLE)					0.9
1110	nu hat (MLE)					777.9	nu star (bias corrected)					772
1111	MLE Mean (bias corrected)					1.079	MLE Sd (bias corrected)					0.986
1112							Approximate Chi Square Value (0.05)					708.5
1113	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					708.2
1114												
1115	Assuming Gamma Distribution											
1116	95% Approximate Gamma UCL (use when n>=50))					1.176	95% Adjusted Gamma UCL (use when n<50)					1.176
1117												
1118	Lognormal GOF Test											
1119	Shapiro Wilk Test Statistic					0.945	Shapiro Wilk Lognormal GOF Test					
1120	5% Shapiro Wilk P Value					5.995E-15	Data Not Lognormal at 5% Significance Level					
1121	Lilliefors Test Statistic					0.138	Lilliefors Lognormal GOF Test					
1122	5% Lilliefors Critical Value					0.0498	Data Not Lognormal at 5% Significance Level					
1123	Data Not Lognormal at 5% Significance Level											
1124												
1125	Lognormal Statistics											
1126	Minimum of Logged Data					-2.303	Mean of logged Data					-0.392
1127	Maximum of Logged Data					2.342	SD of logged Data					0.92
1128												
1129	Assuming Lognormal Distribution											
1130	95% H-UCL					1.147	90% Chebyshev (MVUE) UCL					1.218
1131	95% Chebyshev (MVUE) UCL					1.303	97.5% Chebyshev (MVUE) UCL					1.421
1132	99% Chebyshev (MVUE) UCL					1.653						
1133												
1134	Nonparametric Distribution Free UCL Statistics											

	A	B	C	D	E	F	G	H	I	J	K	L
1135	Data do not follow a Discernible Distribution (0.05)											
1136												
1137	Nonparametric Distribution Free UCLs											
1138	95% CLT UCL				1.202	95% Jackknife UCL					1.202	
1139	95% Standard Bootstrap UCL				1.203	95% Bootstrap-t UCL					1.215	
1140	95% Hall's Bootstrap UCL				1.224	95% Percentile Bootstrap UCL					1.203	
1141	95% BCA Bootstrap UCL				1.223							
1142	90% Chebyshev(Mean, Sd) UCL				1.303	95% Chebyshev(Mean, Sd) UCL					1.404	
1143	97.5% Chebyshev(Mean, Sd) UCL				1.545	99% Chebyshev(Mean, Sd) UCL					1.821	
1144												
1145	Suggested UCL to Use											
1146	95% Chebyshev (Mean, Sd) UCL				1.404							
1147												
1148	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1149	Recommendations are based upon data size, data distribution, and skewness.											
1150	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1151	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1152												
1153												
1154	Total Cations											
1155												
1156	General Statistics											
1157	Total Number of Observations				327	Number of Distinct Observations					167	
1158						Number of Missing Observations					0	
1159	Minimum				0.34	Mean					1.663	
1160	Maximum				5.88	Median					1.56	
1161	SD				0.847	Std. Error of Mean					0.0468	
1162	Coefficient of Variation				0.509	Skewness					1.554	
1163												
1164	Normal GOF Test											
1165	Shapiro Wilk Test Statistic				0.884	Shapiro Wilk GOF Test						
1166	5% Shapiro Wilk P Value				0	Data Not Normal at 5% Significance Level						
1167	Lilliefors Test Statistic				0.141	Lilliefors GOF Test						
1168	5% Lilliefors Critical Value				0.0494	Data Not Normal at 5% Significance Level						
1169	Data Not Normal at 5% Significance Level											
1170												
1171	Assuming Normal Distribution											
1172	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1173	95% Student's-t UCL				1.741	95% Adjusted-CLT UCL (Chen-1995)					1.745	
1174						95% Modified-t UCL (Johnson-1978)					1.741	
1175												
1176	Gamma GOF Test											
1177	A-D Test Statistic				3.937	Anderson-Darling Gamma GOF Test						
1178	5% A-D Critical Value				0.759	Data Not Gamma Distributed at 5% Significance Level						
1179	K-S Test Statistic				0.0903	Kolmogorov-Smirnov Gamma GOF Test						
1180	5% K-S Critical Value				0.0504	Data Not Gamma Distributed at 5% Significance Level						
1181	Data Not Gamma Distributed at 5% Significance Level											
1182												
1183	Gamma Statistics											
1184	k hat (MLE)				4.103	k star (bias corrected MLE)					4.068	
1185	Theta hat (MLE)				0.405	Theta star (bias corrected MLE)					0.409	
1186	nu hat (MLE)				2684	nu star (bias corrected)					2660	
1187	MLE Mean (bias corrected)				1.663	MLE Sd (bias corrected)					0.825	
1188						Approximate Chi Square Value (0.05)					2542	

	A	B	C	D	E	F	G	H	I	J	K	L
1189	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					2541
1190												
1191	Assuming Gamma Distribution											
1192	95% Approximate Gamma UCL (use when n>=50))					1.741	95% Adjusted Gamma UCL (use when n<50)					1.741
1193												
1194	Lognormal GOF Test											
1195	Shapiro Wilk Test Statistic					0.941	Shapiro Wilk Lognormal GOF Test					
1196	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
1197	Lilliefors Test Statistic					0.121	Lilliefors Lognormal GOF Test					
1198	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
1199	Data Not Lognormal at 5% Significance Level											
1200												
1201	Lognormal Statistics											
1202	Minimum of Logged Data					-1.079	Mean of logged Data					0.382
1203	Maximum of Logged Data					1.772	SD of logged Data					0.525
1204												
1205	Assuming Lognormal Distribution											
1206	95% H-UCL					1.773	90% Chebyshev (MVUE) UCL					1.837
1207	95% Chebyshev (MVUE) UCL					1.908	97.5% Chebyshev (MVUE) UCL					2.006
1208	99% Chebyshev (MVUE) UCL					2.198						
1209												
1210	Nonparametric Distribution Free UCL Statistics											
1211	Data do not follow a Discernible Distribution (0.05)											
1212												
1213	Nonparametric Distribution Free UCLs											
1214	95% CLT UCL					1.74	95% Jackknife UCL					1.741
1215	95% Standard Bootstrap UCL					1.741	95% Bootstrap-t UCL					1.746
1216	95% Hall's Bootstrap UCL					1.747	95% Percentile Bootstrap UCL					1.737
1217	95% BCA Bootstrap UCL					1.744						
1218	90% Chebyshev(Mean, Sd) UCL					1.804	95% Chebyshev(Mean, Sd) UCL					1.867
1219	97.5% Chebyshev(Mean, Sd) UCL					1.956	99% Chebyshev(Mean, Sd) UCL					2.129
1220												
1221	Suggested UCL to Use											
1222	95% Chebyshev (Mean, Sd) UCL					1.867						
1223												
1224	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1225	Recommendations are based upon data size, data distribution, and skewness.											
1226	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1227	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1228												
1229												
1230	Total Anions											
1231												
1232	General Statistics											
1233	Total Number of Observations					327	Number of Distinct Observations					186
1234							Number of Missing Observations					0
1235	Minimum					0.04	Mean					1.661
1236	Maximum					5.54	Median					1.58
1237	SD					0.841	Std. Error of Mean					0.0465
1238	Coefficient of Variation					0.506	Skewness					1.409
1239												
1240	Normal GOF Test											
1241	Shapiro Wilk Test Statistic					0.903	Shapiro Wilk GOF Test					
1242	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L	
1243	Lilliefors Test Statistic					0.129	Lilliefors GOF Test						
1244	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level						
1245	Data Not Normal at 5% Significance Level												
1246													
1247	Assuming Normal Distribution												
1248	95% Normal UCL						95% UCLs (Adjusted for Skewness)						
1249	95% Student's-t UCL					1.738	95% Adjusted-CLT UCL (Chen-1995)					1.742	
1250							95% Modified-t UCL (Johnson-1978)					1.739	
1251													
1252	Gamma GOF Test												
1253	A-D Test Statistic					2.506	Anderson-Darling Gamma GOF Test						
1254	5% A-D Critical Value					0.759	Data Not Gamma Distributed at 5% Significance Level						
1255	K-S Test Statistic					0.0864	Kolmogorov-Smirnov Gamma GOF Test						
1256	5% K-S Critical Value					0.0505	Data Not Gamma Distributed at 5% Significance Level						
1257	Data Not Gamma Distributed at 5% Significance Level												
1258													
1259	Gamma Statistics												
1260	k hat (MLE)					3.946	k star (bias corrected MLE)					3.912	
1261	Theta hat (MLE)					0.421	Theta star (bias corrected MLE)					0.425	
1262	nu hat (MLE)					2581	nu star (bias corrected)					2558	
1263	MLE Mean (bias corrected)					1.661	MLE Sd (bias corrected)					0.84	
1264							Approximate Chi Square Value (0.05)					2442	
1265	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					2441	
1266													
1267	Assuming Gamma Distribution												
1268	95% Approximate Gamma UCL (use when n>=50))					1.741	95% Adjusted Gamma UCL (use when n<50)					1.741	
1269													
1270	Lognormal GOF Test												
1271	Shapiro Wilk Test Statistic					0.942	Shapiro Wilk Lognormal GOF Test						
1272	5% Shapiro Wilk P Value					1.110E-16	Data Not Lognormal at 5% Significance Level						
1273	Lilliefors Test Statistic					0.106	Lilliefors Lognormal GOF Test						
1274	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level						
1275	Data Not Lognormal at 5% Significance Level												
1276													
1277	Lognormal Statistics												
1278	Minimum of Logged Data					-3.219	Mean of logged Data					0.376	
1279	Maximum of Logged Data					1.712	SD of logged Data					0.555	
1280													
1281	Assuming Lognormal Distribution												
1282	95% H-UCL					1.795	90% Chebyshev (MVUE) UCL					1.864	
1283	95% Chebyshev (MVUE) UCL					1.94	97.5% Chebyshev (MVUE) UCL					2.045	
1284	99% Chebyshev (MVUE) UCL					2.252							
1285													
1286	Nonparametric Distribution Free UCL Statistics												
1287	Data do not follow a Discernible Distribution (0.05)												
1288													
1289	Nonparametric Distribution Free UCLs												
1290	95% CLT UCL					1.738	95% Jackknife UCL					1.738	
1291	95% Standard Bootstrap UCL					1.739	95% Bootstrap-t UCL					1.742	
1292	95% Hall's Bootstrap UCL					1.744	95% Percentile Bootstrap UCL					1.738	
1293	95% BCA Bootstrap UCL					1.745							
1294	90% Chebyshev(Mean, Sd) UCL					1.801	95% Chebyshev(Mean, Sd) UCL					1.864	
1295	97.5% Chebyshev(Mean, Sd) UCL					1.952	99% Chebyshev(Mean, Sd) UCL					2.124	
1296													

	A	B	C	D	E	F	G	H	I	J	K	L
1297	Suggested UCL to Use											
1298	95% Chebyshev (Mean, Sd) UCL					1.864						
1299												
1300	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1301	Recommendations are based upon data size, data distribution, and skewness.											
1302	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1303	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1304												
1305												
1306	Ionic Balance											
1307												
1308	General Statistics											
1309	Total Number of Observations					28	Number of Distinct Observations					28
1310							Number of Missing Observations					299
1311	Minimum					0.12	Mean					2.831
1312	Maximum					5.56	Median					2.695
1313	SD					1.555	Std. Error of Mean					0.294
1314	Coefficient of Variation					0.549	Skewness					0.0873
1315												
1316	Normal GOF Test											
1317	Shapiro Wilk Test Statistic					0.95	Shapiro Wilk GOF Test					
1318	5% Shapiro Wilk Critical Value					0.924	Data appear Normal at 5% Significance Level					
1319	Lilliefors Test Statistic					0.113	Lilliefors GOF Test					
1320	5% Lilliefors Critical Value					0.164	Data appear Normal at 5% Significance Level					
1321	Data appear Normal at 5% Significance Level											
1322												
1323	Assuming Normal Distribution											
1324	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1325	95% Student's-t UCL					3.331	95% Adjusted-CLT UCL (Chen-1995)					3.319
1326							95% Modified-t UCL (Johnson-1978)					3.332
1327												
1328	Gamma GOF Test											
1329	A-D Test Statistic					1.133	Anderson-Darling Gamma GOF Test					
1330	5% A-D Critical Value					0.758	Data Not Gamma Distributed at 5% Significance Level					
1331	K-S Test Statistic					0.185	Kolmogorov-Smirnov Gamma GOF Test					
1332	5% K-S Critical Value					0.168	Data Not Gamma Distributed at 5% Significance Level					
1333	Data Not Gamma Distributed at 5% Significance Level											
1334												
1335	Gamma Statistics											
1336	k hat (MLE)					2.053	k star (bias corrected MLE)					1.857
1337	Theta hat (MLE)					1.379	Theta star (bias corrected MLE)					1.524
1338	nu hat (MLE)					115	nu star (bias corrected)					104
1339	MLE Mean (bias corrected)					2.831	MLE Sd (bias corrected)					2.077
1340							Approximate Chi Square Value (0.05)					81.45
1341	Adjusted Level of Significance					0.0404	Adjusted Chi Square Value					80.22
1342												
1343	Assuming Gamma Distribution											
1344	95% Approximate Gamma UCL (use when n>=50))					3.614	95% Adjusted Gamma UCL (use when n<50)					3.669
1345												
1346	Lognormal GOF Test											
1347	Shapiro Wilk Test Statistic					0.804	Shapiro Wilk Lognormal GOF Test					
1348	5% Shapiro Wilk Critical Value					0.924	Data Not Lognormal at 5% Significance Level					
1349	Lilliefors Test Statistic					0.24	Lilliefors Lognormal GOF Test					
1350	5% Lilliefors Critical Value					0.164	Data Not Lognormal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L
1351	Data Not Lognormal at 5% Significance Level											
1352												
1353	Lognormal Statistics											
1354	Minimum of Logged Data				-2.12		Mean of logged Data				0.778	
1355	Maximum of Logged Data				1.716		SD of logged Data				0.918	
1356												
1357	Assuming Lognormal Distribution											
1358	95% H-UCL				5.028		90% Chebyshev (MVUE) UCL				5.151	
1359	95% Chebyshev (MVUE) UCL				6.013		97.5% Chebyshev (MVUE) UCL				7.209	
1360	99% Chebyshev (MVUE) UCL				9.559							
1361												
1362	Nonparametric Distribution Free UCL Statistics											
1363	Data appear to follow a Discernible Distribution at 5% Significance Level											
1364												
1365	Nonparametric Distribution Free UCLs											
1366	95% CLT UCL				3.314		95% Jackknife UCL				3.331	
1367	95% Standard Bootstrap UCL				3.31		95% Bootstrap-t UCL				3.308	
1368	95% Hall's Bootstrap UCL				3.327		95% Percentile Bootstrap UCL				3.292	
1369	95% BCA Bootstrap UCL				3.318							
1370	90% Chebyshev(Mean, Sd) UCL				3.712		95% Chebyshev(Mean, Sd) UCL				4.111	
1371	97.5% Chebyshev(Mean, Sd) UCL				4.666		99% Chebyshev(Mean, Sd) UCL				5.754	
1372												
1373	Suggested UCL to Use											
1374	95% Student's-t UCL				3.331							
1375												
1376	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1377	Recommendations are based upon data size, data distribution, and skewness.											
1378	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1379	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1380												
1381												
1382	Sodium Adsorption Ratio											
1383												
1384	General Statistics											
1385	Total Number of Observations				317		Number of Distinct Observations				153	
1386							Number of Missing Observations				10	
1387	Minimum				0.18		Mean				2.268	
1388	Maximum				4.88		Median				2.45	
1389	SD				0.902		Std. Error of Mean				0.0507	
1390	Coefficient of Variation				0.398		Skewness				-0.6	
1391												
1392	Normal GOF Test											
1393	Shapiro Wilk Test Statistic				0.933		Shapiro Wilk GOF Test					
1394	5% Shapiro Wilk P Value				0		Data Not Normal at 5% Significance Level					
1395	Lilliefors Test Statistic				0.103		Lilliefors GOF Test					
1396	5% Lilliefors Critical Value				0.0502		Data Not Normal at 5% Significance Level					
1397	Data Not Normal at 5% Significance Level											
1398												
1399	Assuming Normal Distribution											
1400	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1401	95% Student's-t UCL				2.351		95% Adjusted-CLT UCL (Chen-1995)				2.349	
1402							95% Modified-t UCL (Johnson-1978)				2.351	
1403												
1404	Gamma GOF Test											

	A	B	C	D	E	F	G	H	I	J	K	L	
1405	A-D Test Statistic					17.39	Anderson-Darling Gamma GOF Test						
1406	5% A-D Critical Value					0.759	Data Not Gamma Distributed at 5% Significance Level						
1407	K-S Test Statistic					0.165	Kolmogorov-Smirnov Gamma GOF Test						
1408	5% K-S Critical Value					0.0512	Data Not Gamma Distributed at 5% Significance Level						
1409	Data Not Gamma Distributed at 5% Significance Level												
1410													
1411	Gamma Statistics												
1412	k hat (MLE)					3.806	k star (bias corrected MLE)					3.772	
1413	Theta hat (MLE)					0.596	Theta star (bias corrected MLE)					0.601	
1414	nu hat (MLE)					2413	nu star (bias corrected)					2391	
1415	MLE Mean (bias corrected)					2.268	MLE Sd (bias corrected)					1.168	
1416							Approximate Chi Square Value (0.05)					2279	
1417	Adjusted Level of Significance					0.0492	Adjusted Chi Square Value					2278	
1418													
1419	Assuming Gamma Distribution												
1420	95% Approximate Gamma UCL (use when n>=50))					2.38	95% Adjusted Gamma UCL (use when n<50)					2.38	
1421													
1422	Lognormal GOF Test												
1423	Shapiro Wilk Test Statistic					0.771	Shapiro Wilk Lognormal GOF Test						
1424	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level						
1425	Lilliefors Test Statistic					0.193	Lilliefors Lognormal GOF Test						
1426	5% Lilliefors Critical Value					0.0502	Data Not Lognormal at 5% Significance Level						
1427	Data Not Lognormal at 5% Significance Level												
1428													
1429	Lognormal Statistics												
1430	Minimum of Logged Data					-1.715	Mean of logged Data					0.682	
1431	Maximum of Logged Data					1.585	SD of logged Data					0.622	
1432													
1433	Assuming Lognormal Distribution												
1434	95% H-UCL					2.559	90% Chebyshev (MVUE) UCL					2.67	
1435	95% Chebyshev (MVUE) UCL					2.794	97.5% Chebyshev (MVUE) UCL					2.966	
1436	99% Chebyshev (MVUE) UCL					3.304							
1437													
1438	Nonparametric Distribution Free UCL Statistics												
1439	Data do not follow a Discernible Distribution (0.05)												
1440													
1441	Nonparametric Distribution Free UCLs												
1442	95% CLT UCL					2.351	95% Jackknife UCL					2.351	
1443	95% Standard Bootstrap UCL					2.351	95% Bootstrap-t UCL					2.352	
1444	95% Hall's Bootstrap UCL					2.35	95% Percentile Bootstrap UCL					2.348	
1445	95% BCA Bootstrap UCL					2.343							
1446	90% Chebyshev(Mean, Sd) UCL					2.42	95% Chebyshev(Mean, Sd) UCL					2.489	
1447	97.5% Chebyshev(Mean, Sd) UCL					2.584	99% Chebyshev(Mean, Sd) UCL					2.772	
1448													
1449	Suggested UCL to Use												
1450	95% Chebyshev (Mean, Sd) UCL					2.489							
1451													
1452	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.												
1453	Recommendations are based upon data size, data distribution, and skewness.												
1454	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).												
1455	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.												
1456													
1457	Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be												
1458	reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.												

	A	B	C	D	E	F	G	H	I	J	K	L		
1459														
1460														
1461	Bicarbonate Alkalinity as CaCO3													
1462														
1463	General Statistics													
1464	Total Number of Observations					327		Number of Distinct Observations				63		
1465								Number of Missing Observations				0		
1466	Minimum					0.5		Mean				21.85		
1467	Maximum					243		Median				8		
1468	SD					41.78		Std. Error of Mean				2.31		
1469	Coefficient of Variation					1.913		Skewness				3.238		
1470														
1471	Normal GOF Test													
1472	Shapiro Wilk Test Statistic					0.481		Shapiro Wilk GOF Test						
1473	5% Shapiro Wilk P Value					0		Data Not Normal at 5% Significance Level						
1474	Lilliefors Test Statistic					0.351		Lilliefors GOF Test						
1475	5% Lilliefors Critical Value					0.0494		Data Not Normal at 5% Significance Level						
1476	Data Not Normal at 5% Significance Level													
1477														
1478	Assuming Normal Distribution													
1479	95% Normal UCL						95% UCLs (Adjusted for Skewness)							
1480	95% Student's-t UCL					25.66		95% Adjusted-CLT UCL (Chen-1995)				26.09		
1481								95% Modified-t UCL (Johnson-1978)				25.73		
1482														
1483	Gamma GOF Test													
1484	A-D Test Statistic					24.56		Anderson-Darling Gamma GOF Test						
1485	5% A-D Critical Value					0.805		Data Not Gamma Distributed at 5% Significance Level						
1486	K-S Test Statistic					0.243		Kolmogorov-Smirnov Gamma GOF Test						
1487	5% K-S Critical Value					0.0525		Data Not Gamma Distributed at 5% Significance Level						
1488	Data Not Gamma Distributed at 5% Significance Level													
1489														
1490	Gamma Statistics													
1491	k hat (MLE)					0.669		k star (bias corrected MLE)				0.665		
1492	Theta hat (MLE)					32.64		Theta star (bias corrected MLE)				32.85		
1493	nu hat (MLE)					437.7		nu star (bias corrected)				435		
1494	MLE Mean (bias corrected)					21.85		MLE Sd (bias corrected)				26.79		
1495								Approximate Chi Square Value (0.05)				387.6		
1496	Adjusted Level of Significance					0.0493		Adjusted Chi Square Value				387.4		
1497														
1498	Assuming Gamma Distribution													
1499	95% Approximate Gamma UCL (use when n>=50))					24.51		95% Adjusted Gamma UCL (use when n<50)				24.53		
1500														
1501	Lognormal GOF Test													
1502	Shapiro Wilk Test Statistic					0.92		Shapiro Wilk Lognormal GOF Test						
1503	5% Shapiro Wilk P Value					0		Data Not Lognormal at 5% Significance Level						
1504	Lilliefors Test Statistic					0.133		Lilliefors Lognormal GOF Test						
1505	5% Lilliefors Critical Value					0.0494		Data Not Lognormal at 5% Significance Level						
1506	Data Not Lognormal at 5% Significance Level													
1507														
1508	Lognormal Statistics													
1509	Minimum of Logged Data					-0.693		Mean of logged Data				2.175		
1510	Maximum of Logged Data					5.493		SD of logged Data				1.259		
1511														
1512	Assuming Lognormal Distribution													

	A	B	C	D	E	F	G	H	I	J	K	L
1513					95% H-UCL	22.89					90% Chebyshev (MVUE) UCL	24.71
1514					95% Chebyshev (MVUE) UCL	27.13					97.5% Chebyshev (MVUE) UCL	30.5
1515					99% Chebyshev (MVUE) UCL	37.1						
1516												
1517	Nonparametric Distribution Free UCL Statistics											
1518	Data do not follow a Discernible Distribution (0.05)											
1519												
1520	Nonparametric Distribution Free UCLs											
1521					95% CLT UCL	25.65					95% Jackknife UCL	25.66
1522					95% Standard Bootstrap UCL	25.64					95% Bootstrap-t UCL	26.12
1523					95% Hall's Bootstrap UCL	26.19					95% Percentile Bootstrap UCL	25.79
1524					95% BCA Bootstrap UCL	26.09						
1525					90% Chebyshev(Mean, Sd) UCL	28.78					95% Chebyshev(Mean, Sd) UCL	31.92
1526					97.5% Chebyshev(Mean, Sd) UCL	36.27					99% Chebyshev(Mean, Sd) UCL	44.83
1527												
1528	Suggested UCL to Use											
1529					95% Chebyshev (Mean, Sd) UCL	31.92						
1530												
1531	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1532	Recommendations are based upon data size, data distribution, and skewness.											
1533	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1534	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1535												
1536												
1537	Carbonate Alkalinity as CaCO3											
1538												
1539	General Statistics											
1540					Total Number of Observations	327					Number of Distinct Observations	1
1541											Number of Missing Observations	0
1542					Minimum	0.5					Mean	0.5
1543					Maximum	0.5					Median	0.5
1544												
1545	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
1546	ProUCL (or any other software) should not be used on such a data set!											
1547	The data set for variable Carbonate Alkalinity as CaCO3 was not processed!											
1548												
1549	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											
1550	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
1551												
1552												
1553												
1554	Hydroxide Alkalinity as CaCO3											
1555												
1556	General Statistics											
1557					Total Number of Observations	327					Number of Distinct Observations	1
1558											Number of Missing Observations	0
1559					Minimum	0.5					Mean	0.5
1560					Maximum	0.5					Median	0.5
1561												
1562	Warning: There is only one distinct observation value in this data set - resulting in '0' variance!											
1563	ProUCL (or any other software) should not be used on such a data set!											
1564	The data set for variable Hydroxide Alkalinity as CaCO3 was not processed!											
1565												
1566	If possible, compute and collect Data Quality Objectives (DQOs) based sample size and analytical results.											

	A	B	C	D	E	F	G	H	I	J	K	L
1567	The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).											
1568												
1569												
1570												
1571	Total Alkalinity as CaCO3											
1572												
1573	General Statistics											
1574	Total Number of Observations				327		Number of Distinct Observations				63	
1575							Number of Missing Observations				0	
1576	Minimum				0.5		Mean				21.85	
1577	Maximum				243		Median				8	
1578	SD				41.78		Std. Error of Mean				2.31	
1579	Coefficient of Variation				1.913		Skewness				3.238	
1580												
1581	Normal GOF Test											
1582	Shapiro Wilk Test Statistic				0.481		Shapiro Wilk GOF Test					
1583	5% Shapiro Wilk P Value				0		Data Not Normal at 5% Significance Level					
1584	Lilliefors Test Statistic				0.351		Lilliefors GOF Test					
1585	5% Lilliefors Critical Value				0.0494		Data Not Normal at 5% Significance Level					
1586	Data Not Normal at 5% Significance Level											
1587												
1588	Assuming Normal Distribution											
1589	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1590	95% Student's-t UCL				25.66		95% Adjusted-CLT UCL (Chen-1995)				26.09	
1591							95% Modified-t UCL (Johnson-1978)				25.73	
1592												
1593	Gamma GOF Test											
1594	A-D Test Statistic				24.56		Anderson-Darling Gamma GOF Test					
1595	5% A-D Critical Value				0.805		Data Not Gamma Distributed at 5% Significance Level					
1596	K-S Test Statistic				0.243		Kolmogorov-Smirnov Gamma GOF Test					
1597	5% K-S Critical Value				0.0525		Data Not Gamma Distributed at 5% Significance Level					
1598	Data Not Gamma Distributed at 5% Significance Level											
1599												
1600	Gamma Statistics											
1601	k hat (MLE)				0.669		k star (bias corrected MLE)				0.665	
1602	Theta hat (MLE)				32.64		Theta star (bias corrected MLE)				32.85	
1603	nu hat (MLE)				437.7		nu star (bias corrected)				435	
1604	MLE Mean (bias corrected)				21.85		MLE Sd (bias corrected)				26.79	
1605							Approximate Chi Square Value (0.05)				387.6	
1606	Adjusted Level of Significance				0.0493		Adjusted Chi Square Value				387.4	
1607												
1608	Assuming Gamma Distribution											
1609	95% Approximate Gamma UCL (use when n>=50))				24.51		95% Adjusted Gamma UCL (use when n<50)				24.53	
1610												
1611	Lognormal GOF Test											
1612	Shapiro Wilk Test Statistic				0.92		Shapiro Wilk Lognormal GOF Test					
1613	5% Shapiro Wilk P Value				0		Data Not Lognormal at 5% Significance Level					
1614	Lilliefors Test Statistic				0.133		Lilliefors Lognormal GOF Test					
1615	5% Lilliefors Critical Value				0.0494		Data Not Lognormal at 5% Significance Level					
1616	Data Not Lognormal at 5% Significance Level											
1617												
1618	Lognormal Statistics											
1619	Minimum of Logged Data				-0.693		Mean of logged Data				2.175	
1620	Maximum of Logged Data				5.493		SD of logged Data				1.259	

	A	B	C	D	E	F	G	H	I	J	K	L
1621												
1622	Assuming Lognormal Distribution											
1623	95% H-UCL					22.89	90% Chebyshev (MVUE) UCL					24.71
1624	95% Chebyshev (MVUE) UCL					27.13	97.5% Chebyshev (MVUE) UCL					30.5
1625	99% Chebyshev (MVUE) UCL					37.1						
1626												
1627	Nonparametric Distribution Free UCL Statistics											
1628	Data do not follow a Discernible Distribution (0.05)											
1629												
1630	Nonparametric Distribution Free UCLs											
1631	95% CLT UCL					25.65	95% Jackknife UCL					25.66
1632	95% Standard Bootstrap UCL					25.66	95% Bootstrap-t UCL					26.6
1633	95% Hall's Bootstrap UCL					26.1	95% Percentile Bootstrap UCL					25.7
1634	95% BCA Bootstrap UCL					26.05						
1635	90% Chebyshev(Mean, Sd) UCL					28.78	95% Chebyshev(Mean, Sd) UCL					31.92
1636	97.5% Chebyshev(Mean, Sd) UCL					36.27	99% Chebyshev(Mean, Sd) UCL					44.83
1637												
1638	Suggested UCL to Use											
1639	95% Chebyshev (Mean, Sd) UCL					31.92						
1640												
1641	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1642	Recommendations are based upon data size, data distribution, and skewness.											
1643	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1644	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1645												
1646												
1647	Total Hardness as CaCO3											
1648												
1649	General Statistics											
1650	Total Number of Observations					317	Number of Distinct Observations					59
1651							Number of Missing Observations					10
1652	Minimum					0.5	Mean					31.48
1653	Maximum					278	Median					20
1654	SD					42.7	Std. Error of Mean					2.398
1655	Coefficient of Variation					1.356	Skewness					3.141
1656												
1657	Normal GOF Test											
1658	Shapiro Wilk Test Statistic					0.555	Shapiro Wilk GOF Test					
1659	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
1660	Lilliefors Test Statistic					0.325	Lilliefors GOF Test					
1661	5% Lilliefors Critical Value					0.0502	Data Not Normal at 5% Significance Level					
1662	Data Not Normal at 5% Significance Level											
1663												
1664	Assuming Normal Distribution											
1665	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1666	95% Student's-t UCL					35.44	95% Adjusted-CLT UCL (Chen-1995)					35.88
1667							95% Modified-t UCL (Johnson-1978)					35.51
1668												
1669	Gamma GOF Test											
1670	A-D Test Statistic					18.47	Anderson-Darling Gamma GOF Test					
1671	5% A-D Critical Value					0.782	Data Not Gamma Distributed at 5% Significance Level					
1672	K-S Test Statistic					0.204	Kolmogorov-Smirnov Gamma GOF Test					
1673	5% K-S Critical Value					0.0524	Data Not Gamma Distributed at 5% Significance Level					
1674	Data Not Gamma Distributed at 5% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
1675												
1676	Gamma Statistics											
1677	k hat (MLE)					1.09	k star (bias corrected MLE)					1.081
1678	Theta hat (MLE)					28.89	Theta star (bias corrected MLE)					29.11
1679	nu hat (MLE)					690.8	nu star (bias corrected)					685.6
1680	MLE Mean (bias corrected)					31.48	MLE Sd (bias corrected)					30.27
1681							Approximate Chi Square Value (0.05)					625.8
1682	Adjusted Level of Significance					0.0492	Adjusted Chi Square Value					625.6
1683												
1684	Assuming Gamma Distribution											
1685	95% Approximate Gamma UCL (use when n>=50))					34.49	95% Adjusted Gamma UCL (use when n<50)					34.5
1686												
1687	Lognormal GOF Test											
1688	Shapiro Wilk Test Statistic					0.882	Shapiro Wilk Lognormal GOF Test					
1689	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
1690	Lilliefors Test Statistic					0.163	Lilliefors Lognormal GOF Test					
1691	5% Lilliefors Critical Value					0.0502	Data Not Lognormal at 5% Significance Level					
1692	Data Not Lognormal at 5% Significance Level											
1693												
1694	Lognormal Statistics											
1695	Minimum of Logged Data					-0.693	Mean of logged Data					2.925
1696	Maximum of Logged Data					5.628	SD of logged Data					1.047
1697												
1698	Assuming Lognormal Distribution											
1699	95% H-UCL					36.61	90% Chebyshev (MVUE) UCL					39.16
1700	95% Chebyshev (MVUE) UCL					42.33	97.5% Chebyshev (MVUE) UCL					46.74
1701	99% Chebyshev (MVUE) UCL					55.39						
1702												
1703	Nonparametric Distribution Free UCL Statistics											
1704	Data do not follow a Discernible Distribution (0.05)											
1705												
1706	Nonparametric Distribution Free UCLs											
1707	95% CLT UCL					35.43	95% Jackknife UCL					35.44
1708	95% Standard Bootstrap UCL					35.42	95% Bootstrap-t UCL					36.22
1709	95% Hall's Bootstrap UCL					35.87	95% Percentile Bootstrap UCL					35.32
1710	95% BCA Bootstrap UCL					35.87						
1711	90% Chebyshev(Mean, Sd) UCL					38.68	95% Chebyshev(Mean, Sd) UCL					41.93
1712	97.5% Chebyshev(Mean, Sd) UCL					46.46	99% Chebyshev(Mean, Sd) UCL					55.34
1713												
1714	Suggested UCL to Use											
1715	95% Chebyshev (Mean, Sd) UCL					41.93						
1716												
1717	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1718	Recommendations are based upon data size, data distribution, and skewness.											
1719	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1720	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1721												
1722												
1723	Electrical Conductivity @ 25°C											
1724												
1725	General Statistics											
1726	Total Number of Observations					327	Number of Distinct Observations					181
1727							Number of Missing Observations					0
1728	Minimum					55	Mean					193.3

	A	B	C	D	E	F	G	H	I	J	K	L
1729	Maximum					512	Median					191
1730	SD					80.8	Std. Error of Mean					4.468
1731	Coefficient of Variation					0.418	Skewness					0.744
1732												
1733	Normal GOF Test											
1734	Shapiro Wilk Test Statistic					0.944	Shapiro Wilk GOF Test					
1735	5% Shapiro Wilk P Value					1.110E-15	Data Not Normal at 5% Significance Level					
1736	Lilliefors Test Statistic					0.0676	Lilliefors GOF Test					
1737	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
1738	Data Not Normal at 5% Significance Level											
1739												
1740	Assuming Normal Distribution											
1741	95% Normal UCL					95% UCLs (Adjusted for Skewness)						
1742	95% Student's-t UCL					200.7	95% Adjusted-CLT UCL (Chen-1995)					200.9
1743							95% Modified-t UCL (Johnson-1978)					200.7
1744												
1745	Gamma GOF Test											
1746	A-D Test Statistic					3.597	Anderson-Darling Gamma GOF Test					
1747	5% A-D Critical Value					0.757	Data Not Gamma Distributed at 5% Significance Level					
1748	K-S Test Statistic					0.0962	Kolmogorov-Smirnov Gamma GOF Test					
1749	5% K-S Critical Value					0.0504	Data Not Gamma Distributed at 5% Significance Level					
1750	Data Not Gamma Distributed at 5% Significance Level											
1751												
1752	Gamma Statistics											
1753	k hat (MLE)					5.368	k star (bias corrected MLE)					5.321
1754	Theta hat (MLE)					36.01	Theta star (bias corrected MLE)					36.33
1755	nu hat (MLE)					3511	nu star (bias corrected)					3480
1756	MLE Mean (bias corrected)					193.3	MLE Sd (bias corrected)					83.81
1757							Approximate Chi Square Value (0.05)					3344
1758	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					3343
1759												
1760	Assuming Gamma Distribution											
1761	95% Approximate Gamma UCL (use when n>=50))					201.2	95% Adjusted Gamma UCL (use when n<50)					201.2
1762												
1763	Lognormal GOF Test											
1764	Shapiro Wilk Test Statistic					0.929	Shapiro Wilk Lognormal GOF Test					
1765	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
1766	Lilliefors Test Statistic					0.126	Lilliefors Lognormal GOF Test					
1767	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
1768	Data Not Lognormal at 5% Significance Level											
1769												
1770	Lognormal Statistics											
1771	Minimum of Logged Data					4.007	Mean of logged Data					5.168
1772	Maximum of Logged Data					6.238	SD of logged Data					0.461
1773												
1774	Assuming Lognormal Distribution											
1775	95% H-UCL					204.4	90% Chebyshev (MVUE) UCL					211
1776	95% Chebyshev (MVUE) UCL					218.1	97.5% Chebyshev (MVUE) UCL					228
1777	99% Chebyshev (MVUE) UCL					247.4						
1778												
1779	Nonparametric Distribution Free UCL Statistics											
1780	Data do not follow a Discernible Distribution (0.05)											
1781												
1782	Nonparametric Distribution Free UCLs											

	A	B	C	D	E	F	G	H	I	J	K	L
1783	95% CLT UCL					200.7	95% Jackknife UCL					200.7
1784	95% Standard Bootstrap UCL					200.5	95% Bootstrap-t UCL					200.9
1785	95% Hall's Bootstrap UCL					200.7	95% Percentile Bootstrap UCL					200.4
1786	95% BCA Bootstrap UCL					200.7						
1787	90% Chebyshev(Mean, Sd) UCL					206.7	95% Chebyshev(Mean, Sd) UCL					212.8
1788	97.5% Chebyshev(Mean, Sd) UCL					221.2	99% Chebyshev(Mean, Sd) UCL					237.8
1789												
1790	Suggested UCL to Use											
1791	95% Student's-t UCL					200.7	or 95% Modified-t UCL					200.7
1792												
1793	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1794	Recommendations are based upon data size, data distribution, and skewness.											
1795	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1796	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1797												
1798												
1799	Total Dissolved Solids											
1800												
1801	General Statistics											
1802	Total Number of Observations					308	Number of Distinct Observations					138
1803							Number of Missing Observations					19
1804	Minimum					36	Mean					124.7
1805	Maximum					333	Median					123
1806	SD					52.61	Std. Error of Mean					2.998
1807	Coefficient of Variation					0.422	Skewness					0.781
1808												
1809	Normal GOF Test											
1810	Shapiro Wilk Test Statistic					0.942	Shapiro Wilk GOF Test					
1811	5% Shapiro Wilk P Value					2.220E-15	Data Not Normal at 5% Significance Level					
1812	Lilliefors Test Statistic					0.0628	Lilliefors GOF Test					
1813	5% Lilliefors Critical Value					0.0509	Data Not Normal at 5% Significance Level					
1814	Data Not Normal at 5% Significance Level											
1815												
1816	Assuming Normal Distribution											
1817	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1818	95% Student's-t UCL					129.6	95% Adjusted-CLT UCL (Chen-1995)					129.8
1819							95% Modified-t UCL (Johnson-1978)					129.7
1820												
1821	Gamma GOF Test											
1822	A-D Test Statistic					3.045	Anderson-Darling Gamma GOF Test					
1823	5% A-D Critical Value					0.757	Data Not Gamma Distributed at 5% Significance Level					
1824	K-S Test Statistic					0.094	Kolmogorov-Smirnov Gamma GOF Test					
1825	5% K-S Critical Value					0.0517	Data Not Gamma Distributed at 5% Significance Level					
1826	Data Not Gamma Distributed at 5% Significance Level											
1827												
1828	Gamma Statistics											
1829	k hat (MLE)					5.313	k star (bias corrected MLE)					5.263
1830	Theta hat (MLE)					23.47	Theta star (bias corrected MLE)					23.69
1831	nu hat (MLE)					3273	nu star (bias corrected)					3242
1832	MLE Mean (bias corrected)					124.7	MLE Sd (bias corrected)					54.35
1833							Approximate Chi Square Value (0.05)					3111
1834	Adjusted Level of Significance					0.0492	Adjusted Chi Square Value					3110
1835												
1836	Assuming Gamma Distribution											

	A	B	C	D	E	F	G	H	I	J	K	L
1837	95% Approximate Gamma UCL (use when n>=50))					130	95% Adjusted Gamma UCL (use when n<50)					130
1838												
1839	Lognormal GOF Test											
1840	Shapiro Wilk Test Statistic					0.932	Shapiro Wilk Lognormal GOF Test					
1841	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
1842	Lilliefors Test Statistic					0.124	Lilliefors Lognormal GOF Test					
1843	5% Lilliefors Critical Value					0.0509	Data Not Lognormal at 5% Significance Level					
1844	Data Not Lognormal at 5% Significance Level											
1845												
1846	Lognormal Statistics											
1847	Minimum of Logged Data					3.584	Mean of logged Data					4.729
1848	Maximum of Logged Data					5.808	SD of logged Data					0.463
1849												
1850	Assuming Lognormal Distribution											
1851	95% H-UCL					132	90% Chebyshev (MVUE) UCL					136.4
1852	95% Chebyshev (MVUE) UCL					141.1	97.5% Chebyshev (MVUE) UCL					147.7
1853	99% Chebyshev (MVUE) UCL					160.7						
1854												
1855	Nonparametric Distribution Free UCL Statistics											
1856	Data do not follow a Discernible Distribution (0.05)											
1857												
1858	Nonparametric Distribution Free UCLs											
1859	95% CLT UCL					129.6	95% Jackknife UCL					129.6
1860	95% Standard Bootstrap UCL					129.6	95% Bootstrap-t UCL					129.9
1861	95% Hall's Bootstrap UCL					129.8	95% Percentile Bootstrap UCL					129.8
1862	95% BCA Bootstrap UCL					129.6						
1863	90% Chebyshev(Mean, Sd) UCL					133.7	95% Chebyshev(Mean, Sd) UCL					137.8
1864	97.5% Chebyshev(Mean, Sd) UCL					143.4	99% Chebyshev(Mean, Sd) UCL					154.5
1865												
1866	Suggested UCL to Use											
1867	95% Student's-t UCL					129.6	or 95% Modified-t UCL					129.7
1868												
1869	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1870	Recommendations are based upon data size, data distribution, and skewness.											
1871	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1872	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1873												
1874												
1875	pH											
1876												
1877	General Statistics											
1878	Total Number of Observations					327	Number of Distinct Observations					161
1879							Number of Missing Observations					0
1880	Minimum					3.11	Mean					5.639
1881	Maximum					7.83	Median					5.57
1882	SD					0.632	Std. Error of Mean					0.0349
1883	Coefficient of Variation					0.112	Skewness					0.151
1884												
1885	Normal GOF Test											
1886	Shapiro Wilk Test Statistic					0.94	Shapiro Wilk GOF Test					
1887	5% Shapiro Wilk P Value					0	Data Not Normal at 5% Significance Level					
1888	Lilliefors Test Statistic					0.108	Lilliefors GOF Test					
1889	5% Lilliefors Critical Value					0.0494	Data Not Normal at 5% Significance Level					
1890	Data Not Normal at 5% Significance Level											

	A	B	C	D	E	F	G	H	I	J	K	L
1891												
1892	Assuming Normal Distribution											
1893	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
1894	95% Student's-t UCL					5.697	95% Adjusted-CLT UCL (Chen-1995)					5.697
1895							95% Modified-t UCL (Johnson-1978)					5.697
1896												
1897	Gamma GOF Test											
1898	A-D Test Statistic					6.966	Anderson-Darling Gamma GOF Test					
1899	5% A-D Critical Value					0.752	Data Not Gamma Distributed at 5% Significance Level					
1900	K-S Test Statistic					0.103	Kolmogorov-Smirnov Gamma GOF Test					
1901	5% K-S Critical Value					0.0501	Data Not Gamma Distributed at 5% Significance Level					
1902	Data Not Gamma Distributed at 5% Significance Level											
1903												
1904	Gamma Statistics											
1905	k hat (MLE)					78.06	k star (bias corrected MLE)					77.35
1906	Theta hat (MLE)					0.0722	Theta star (bias corrected MLE)					0.0729
1907	nu hat (MLE)					51052	nu star (bias corrected)					50585
1908	MLE Mean (bias corrected)					5.639	MLE Sd (bias corrected)					0.641
1909							Approximate Chi Square Value (0.05)					50063
1910	Adjusted Level of Significance					0.0493	Adjusted Chi Square Value					50061
1911												
1912	Assuming Gamma Distribution											
1913	95% Approximate Gamma UCL (use when n>=50))					5.698	95% Adjusted Gamma UCL (use when n<50)					5.698
1914												
1915	Lognormal GOF Test											
1916	Shapiro Wilk Test Statistic					0.925	Shapiro Wilk Lognormal GOF Test					
1917	5% Shapiro Wilk P Value					0	Data Not Lognormal at 5% Significance Level					
1918	Lilliefors Test Statistic					0.11	Lilliefors Lognormal GOF Test					
1919	5% Lilliefors Critical Value					0.0494	Data Not Lognormal at 5% Significance Level					
1920	Data Not Lognormal at 5% Significance Level											
1921												
1922	Lognormal Statistics											
1923	Minimum of Logged Data					1.135	Mean of logged Data					1.723
1924	Maximum of Logged Data					2.058	SD of logged Data					0.115
1925												
1926	Assuming Lognormal Distribution											
1927	95% H-UCL					5.7	90% Chebyshev (MVUE) UCL					5.748
1928	95% Chebyshev (MVUE) UCL					5.797	97.5% Chebyshev (MVUE) UCL					5.865
1929	99% Chebyshev (MVUE) UCL					5.998						
1930												
1931	Nonparametric Distribution Free UCL Statistics											
1932	Data do not follow a Discernible Distribution (0.05)											
1933												
1934	Nonparametric Distribution Free UCLs											
1935	95% CLT UCL					5.697	95% Jackknife UCL					5.697
1936	95% Standard Bootstrap UCL					5.697	95% Bootstrap-t UCL					5.695
1937	95% Hall's Bootstrap UCL					5.697	95% Percentile Bootstrap UCL					5.697
1938	95% BCA Bootstrap UCL					5.696						
1939	90% Chebyshev(Mean, Sd) UCL					5.744	95% Chebyshev(Mean, Sd) UCL					5.792
1940	97.5% Chebyshev(Mean, Sd) UCL					5.858	99% Chebyshev(Mean, Sd) UCL					5.987
1941												
1942	Suggested UCL to Use											
1943	95% Student's-t UCL					5.697	or 95% Modified-t UCL					5.697
1944												

	A	B	C	D	E	F	G	H	I	J	K	L
1945	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
1946	Recommendations are based upon data size, data distribution, and skewness.											
1947	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
1948	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
1949												

APPENDIX D

Settling Pond Calculations & Design Drawings

Storage Period	Days	Accumulated Solids/Sediment Storage Volume (m ³)	Calculated Free Water/Settling Volume (Minimum) (m ³)	Settling Volume ¹ (m ³)	Usable Pond Depth (m)	Total Pond Volume ² (m ³)	Required Surface Area (m ²)	Pond Width (m)	Pond Length ³ (m)
6 months	180	2894	1800	4342	2.2	7236	3289	33	99
12 months	365	5869	1800	8804	2.2	14673	6670	47	141
18 months	547	8796	1800	13194	2.2	21989	9995	58	173
24 months	730	11738	1800	17608	2.2	29346	13339	67	200

Reference:

Metcalf & Eddy, 2014. Waste Water Engineering: Treatment and Resource Recovery, 5th Edition. McGraw-Hill Education

IECA 2018 Best Practice Erosion and Sediment Control - for building and construction sites Appendix B

Notes:

¹Settling Volume derived from IECA (2018) Table B32 - Sediment Storage Volumes where by settling volume is a minimum of 150% of sediment storage zone

²Total Pond Volume equal to Accumulated Solids/Sediment Storage Volume plus Settling Volume (IECA)

³Pond Length to Width Ratio: 3:1 (IECA 2018 Appendix B)

Assumptions:

Solids Input:	0.67 m ³ /hr (or 2t/hr) based of SG of 3
Slurry Flow Rate (Q):	600 m ³ /hr
Slurry Flow Rate (Q):	0.17 m ³ /s
Residence Time (HRT)	3 Hrs
Pond Depth	2.5 m
Freeboard	0.3 m
Usable Depth	2.2 m

Table B32 – Sediment storage volume

Basin type	Minimum sediment storage volume
Type A and Type B	30% of settling volume (V _s)
Type C	50% of settling volume
Type D	50% of settling volume

Reference: IECA (2018) Best Practice Erosion and Sediment Control

Accumulated Solids Volume Calculation (U.S. Environmental Protection Agency (EPA). (2003). EPA Process Design Manual: Sludge Treatment and Disposal. EPA/625/R-03/003. Washington, D.C.: Office of Research & Development)

Solids Volume = $C_s \times 24 \times D$

Where:

- C_s = solids inflow rate (m³/hr)
- D = number of days
- 24 = hours per day

Typical Settling Velocities and Residence Times by Grain Size

Grain Size	Diameter (mm)	Settling Velocity (m/s)	Time to Settle 1 m (s)	Settlement Time (hh:mm:ss) (Rounded)
Clay	<0.002	0.00001-0.0001	10000-100000	3 hrs - 30 hrs
Silt	0.002-0.063	0.0001-0.001	1000-10000	17 mins - 3 hrs
Fine Sand	0.063-0.25	0.001-0.01	100-1000	2 mins - 17 mins
Medium Sand	0.25-0.5	0.01-0.03	33-100	33 secs - 1:30 mins
Coarse Sand	0.5-1.0	0.03-0.1	10-33	10secs - 33secs
Gravel	>2.0	>0.1	<10	<10 seconds

Reference: Chin, D. A. (2006) Water Resources Engineering, 2nd ed.

Free Water Volume Calculation (Metcalf & Eddy, 2014. Waste Water Engineering: Treatment and Resource Recovery, 5th Edition. McGraw-Hill Education)

Free Water Volume (m³) = $Q \times t$

Where:

- Q = slurry flow rate (m³/hr)
- t = residence time (hr)

Surface Area Calculation (Metcalf & Eddy, 2014. Waste Water Engineering: Treatment and Resource Recovery, 5th Edition. McGraw-Hill Education)

Required Surface Area = $\frac{\text{Total Volume}}{\text{Depth}}$



Image source: Holcim: (2025)

- Site Boundary
- Stage 1 Dredging Envelop
- Stage 2 Dredging Envelop
- Stage 3 Dredging Envelop
- Stage 4 Dredging Envelop

Possible Temporary
Settlement Pond Location
(not to scale, location
subject to change)

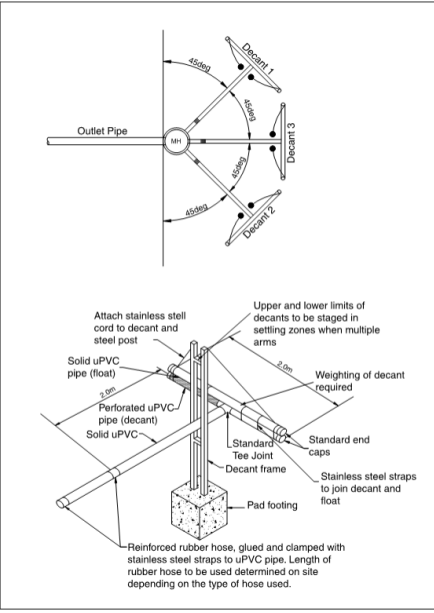
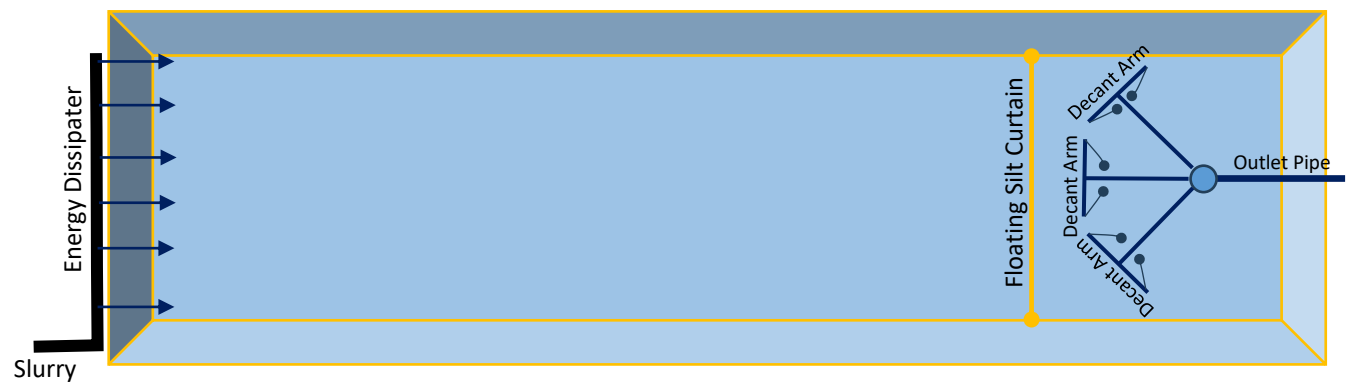
0 50 100m



Proposed Temporary Settlement Pond Location Salt Ash

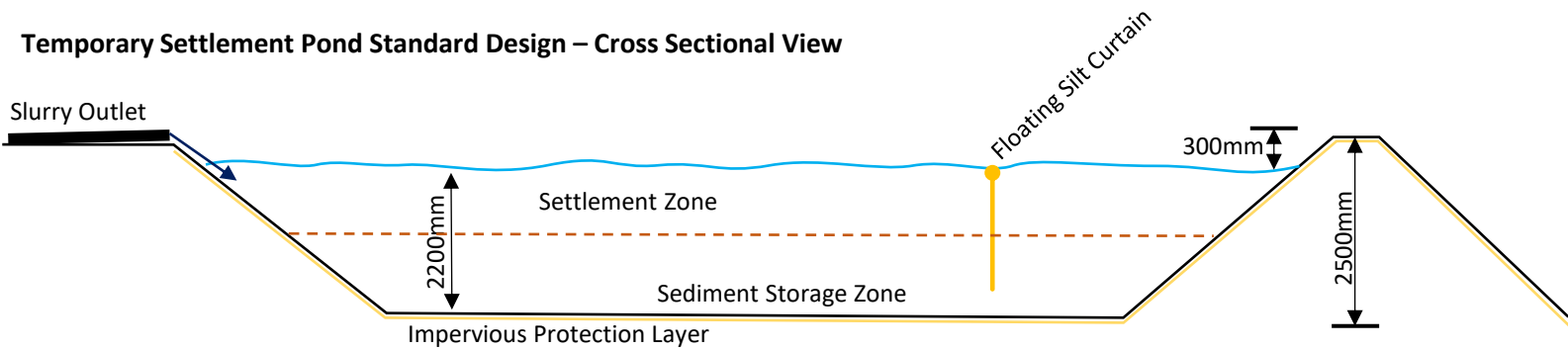
Client: Holcim (Australia) P/L
Job No: 250154

Temporary Settlement Pond Standard Design – Plan View



Decant (Skimmer) Standard Design

Temporary Settlement Pond Standard Design – Cross Sectional View



Temporary Settlement Pond Specifications Salt Ash

Client: Holcim (Australia) P/L
 Job No: 250154

APPENDIX E

Trigger Action Response Plans (TARPS)

Key Area/Indicator	Trigger Level	Risk Level	Action Required	Responsible Party
Settlement Pond				
Slurry Exposure Time to Air	< 4 hours	Low	Keep deposited slurry wet during handling.	Site Supervisor/ Dredging Operator
	4-8 hours without cover	Moderate	Re-submerge exposed material in pond with process water and record incident and investigate.	Site Supervisor
	> 8 hours	High	Apply lime or spread material through water jetting; notify Environmental Manager and record incident and investigate.	Site Supervisor/ Environmental Manager
Pond Water pH	6.5-8.5	Low	Maintain operations and monitor weekly.	Environmental Officer
	5.5-6.4	Moderate	Increase pH monitoring frequency to daily; investigate acid generating indicators within slurry output.	Environmental Officer
	< 5.5	High	Apply neutralising agent (lime); record incident and investigate.	Environmental Manager
Pond Water Iron Concentrations	<0.3 mg/L	Low	Maintain operations and monitor monthly.	Environmental Officer
	0.3-1.0 mg/L, and/or visible iron 'staining' in pond (red/orange colouration).	Moderate	Increase water quality sampling to weekly to develop short-term trend analysis.	Environmental Officer
	Weekly monitoring shows increasing iron trend over short-term (up to one month).	High	Increase aeration of process water in wash plant and continue monitoring weekly until iron concentrations are <0.3 mg/L, at which time monitoring can return to monthly and increased aeration within wash plant may cease. If this does not occur, consider lime dosing in wash plant to increase pH and encourage iron precipitation.	Environmental Manager and Officer
Pond Water Quality Degradation (Discharge)	Daily monitoring shows pH reduction >1.0 unit from previous measurement, OR 4 consecutive daily increases in acidity or metals.	High	1. Review upstream processes and lime dosing system effectiveness immediately. 2. Halt discharge of fines to the main dredge pond (if occurring). 3. Undertake environmental validation testing of accumulated fines in the settling pond (per Table 9 of the GWMP) to identify the source of degradation.	Environmental Manager
Water Cover over Sediment	> 0.5 m	Low	Maintain water level; verify pump performance.	Site Supervisor
	0.3-0.5 m	Moderate	Top up pond with process water as necessary; monitor daily. Review distribution of fines through pond.	Site Supervisor
	< 0.3 m	High	Cease discharge to pond and refill; report incident; reassess containment procedures.	Site Supervisor/ Environmental Manager

Key Area/Indicator	Trigger Level	Risk Level	Action Required	Responsible Party
Dredge Pond (Dredging & Fines Interment)				
Water Quality (pH, DO, Turbidity, Acidity, Metals)	Weekly monitoring shows: pH reduction of > 1.0 pH unit from previous measurement, OR 4 x consecutive weekly increases in DO, Turbidity, Total Acidity, or Metals.	Moderate	1. Immediately investigate the potential cause (e.g., dredge operation, lime dosing, fines discharge). 2. Increase monitoring frequency for relevant parameters for a period of up to 3 months to determine if a sustained issue is occurring.	Environmental Officer
	A sustained adverse trend is confirmed after the increased monitoring period.	High	Implement corrective actions (e.g., adjust dredge operation, optimise lime dosing, adjust fines discharge method). Record incident and investigation findings.	Environmental Officer
Water Quality (Iron)	<0.3 mg/L	Low	Maintain operations and monitor weekly.	Environmental Officer
	0.3-1.0 mg/L, and/or visible iron 'staining' in pond (red/orange colouration).	Moderate	Increase water quality sampling to daily to develop short-term trend analysis.	Environmental Officer
	Daily monitoring shows increasing iron trend over short-term (up to one week).	High	Increase aeration of process water in wash plant and continue monitoring daily until iron concentrations are <0.3 mg/L, at which time monitoring can return to weekly and increased aeration within wash plant may cease. If this does not occur, consider lime dosing in wash plant to increase pH and encourage iron precipitation.	Environmental Manager and Officer
Algal Bloom	One or more visual indicators of an algal bloom are recorded during the weekly monitoring.	Low	1. Use a commercially available field kit capable of detecting blue-green algae or its toxins. Alternatively, conduct laboratory analysis for: cyanophyta, neurotoxins and hepatotoxins which are indicators of blue green algae. 2. If blue green algae are detected in the water, consider implementing one or more of the following actions until laboratory/field kit testing or field indicators suggest the algal bloom has dissipated: a) avoiding all worker contact with surface water in the dredge pond; b) if this is not possible, use personal protective equipment (PPE) to prevent worker exposure to the surface water. 3. Investigate and mitigate the potential source(s) of nutrients in the surface water, where possible.	Environmental Manager
Wash Plant Outflow				
Outflow pH	Daily monitoring shows pH reduction of > 1.0 unit from previous measurement.	High	Immediately review and adjust the lime-dosing system. Investigate the cause (e.g., lime supply, dosing rate, system calibration) and record the incident.	Plant Operator/ Environmental Manager

Key Area/Indicator	Trigger Level	Risk Level	Action Required	Responsible Party
Drained Water from Sand Stockpiles				
Leachate Quality	Water quality is consistent with dredge pond water quality objectives.	Low	Discharge direct to dredge pond.	Site Supervisor
	Low pH only, OR elevated iron and aluminium that can be managed by the wash plant.	Moderate	Divert water through the wash plant for pH correction and metals precipitation.	Site Supervisor
	Elevated metals that cannot be managed through the wash plant process.	High	Cease discharge. Contain water and seek advice from a suitably qualified expert for appropriate treatment.	Environmental Manager
Groundwater - Performance Monitoring (Internal Wells)				
pH, Acidity & Metals	Monitoring results show a sustained adverse trend but remain below the high-risk trigger.	Moderate	Increase monitoring frequency for the specific well(s) and parameter(s) for up to 3 months to confirm the trend. Review upgradient site activities.	Environmental Officer
	Quarterly monitoring shows: pH reduction > 1.0 unit across 4 consecutive rounds, OR 4 x consecutive increases in Total Acidity or specified metals.	High	1. Increase monitoring frequency for the affected well(s) to confirm if the trend is sustained. 2. If confirmed, review all project activities that may influence the location and implement corrective actions (e.g., review pond management, enhance lime dosing). Notify Environmental Manager.	Environmental Manager

Key Area/Indicator	Trigger Level	Risk Level	Action Required	Responsible Party
Groundwater - Compliance Monitoring (Boundary Wells)				
Project Water Quality Criteria (PWQC)	A single, minor exceedance of a PWQC.	Moderate	1. Verify result (re-sample if necessary). 2. Increase monitoring frequency for the affected well/parameter for up to 3 months to assess for a sustained issue. 3. Investigate potential causes.	Environmental Officer
	A sustained or significant exceedance of PWQC that is attributable to project activities.	High	Notify Environmental Manager. Investigate the source and pathway of the impact. Review relevant site operations and management measures.	Environmental Manager
	Impacted Groundwater Migration (Worst-Case Scenario). Monitoring and investigation confirm project-related impacts are migrating, or are likely to migrate, off-site.	Critical / Contingency	Notify regulators as required under license conditions and legal obligations. A suitably qualified and experienced expert is to be engaged to consider implementation of contingency measures as detailed in Section 6.6 of the GWMP (e.g., Broadscale Lime Dosing, Permeable Reactive Barriers, or Pump and Treat). Note: Other alternateremedial options may be more suitable and the management measure should consider water chemistry and the distribution of impact.	Environmental Manager

APPENDIX F

Technical Memorandum (ENV, 2025)

TECHNICAL MEMO

REVIEW OF HANSON TWEED SAND PLANT GROUNDWATER IRON CONCENTRATIONS

For:
Holcim Australia Pty Ltd

Date:
24 July 2025

ENV Services Pty Ltd

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1 Introduction

1.1 Engagement

ENV Services Pty Ltd (ENV) was commissioned by Holcim Australia Pty Ltd (Holcim) to prepare this technical memo (literature review) to investigate whether quarrying operations at Tweed Sand Plant (TSP) (Heidelberg Materials) located in Northern New South Wales have adversely impacted groundwater chemistry, with specific focus on dissolved iron (all iron concentrations discussed herein refer to dissolved iron).

1.2 Background

During pre-lodgement meetings for Holcim's proposed sand dredging quarry in Salt Ash NSW, the Department of Planning and Water Group (DCCEEW) had verbally indicated that the Salt Ash Groundwater Management Plan should investigate water chemistry impacts and measures implemented to prevent groundwater degradation implemented at Heidelberg Materials active sand mining operations (TSP) located in the Tweed Local Government Area. ENV understands the issue of concern that the Department raised relates specifically to dissolved iron and this review has subsequently focussed on assessing risk associated with changes in iron concentrations.

1.3 Scope of Work

The objective of this review is to identify if there is any clear indication that iron has been mobilised within the localised aquifer as a direct result of the dredging and processing component of the operations, and if required, propose additions to the Trigger Action Response Plan (TARP) being developed as part of the Groundwater Management Plan (GWMP) for Holcim's proposed Salt Ash Sand Quarry.

The scope of this review has been prepared with consideration of publicly available documentation such as Heidelberg Materials TSP's Soil and Water Management Plan, Annual Return documentation, and information relating to the regional setting of the site (such as local soil landscapes).

1.4 TSP Dredging Operations

The TSP is understood to currently hold approval for extraction of 150,000 m³ of material annually.

Sand is extracted by dredging and processed through a wash plant to extract sand from the dredging slurry. Outflow from the wash plant is returned to the dredge lake (including pyritic fines, being re-interred within the lake).

Stockpiled sands are assessed for acid sulfate soils but review of select annual return documents indicates that due to natural buffering capacity, liming is typically not required.

2 Site Environmental Setting

Information within this section has been summarised from Gilbert + Sutherland (2019) SOIL AND WATER MANAGEMENT PLAN FOR TWEED SAND PLANT (PHASES 3 AND 4), CUDGEN NEW SOUTH WALES, and supplemented by available web data accessed by ENV.

2.1 Location

The TSP is located at Altona Road, Cudgen NSW (Lot Plans; 22/DP1082435, 23/DP1077509 and 494/DP720450). The site is located on the floodplain within the Tweed Valley and is bounded by a low hill formation to its south.

Figures showing the site and its water monitoring locations have been extracted from the TSP Soil and Water Management Plan (Gilbert + Sutherland, 2019) and provided as Attachment 1.

2.2 Landuse

Sand extraction operations have been conducted on the site since 1983. The site is surrounded by a variety of land uses, including:

- North: Agricultural land (sugar cane cultivation and grazing), council's wastewater treatment facility, and residential properties
- East: The Cudgen Lake Sand Quarry.
- South: Residential properties located along the Cudgen Road ridge proceeded by agricultural land
- West: Agricultural land (sugar cane cultivation and grazing).

2.3 Topography and Drainage

The site is mostly flat with an elevation consistently below 2 metres Australian Height Datum (AHD). The terrain is characterised as level to very gently inclined.

As part of the Chinderah Drainage Trust district, the site's drainage is managed through a combination of natural infiltration and constructed drainage systems. A significant portion of surface runoff permeates through the highly porous sandy soils. The remaining runoff is channelled either into the on-site extraction lake or into a network of agricultural drains. These man-made drains, running along the northern and western boundaries, direct water through flood gates into the Tweed River. No natural water courses are present in the immediate area of the extraction lake.

2.4 Geology and Soils

The site's geology is composed of Quaternary sedimentary deposits, which include river gravel, sand, clay, and alluvium. The underlying strata consist of Quaternary organic clays covered by a layer of Quaternary sands. These sands are described as poorly graded, fine to medium-grained quartzose sand.

Soils within the extraction area are classified as Oxyaquic Hydrosols. The typical soil profile consists of a topsoil of dark brown to black silty sands, which overlays fine to medium-grained sands

The NSW Department of Planning, Industry and Environment's eSPADE v2.2 webapp maps the site to be situated within the Tweed soil landscape (tw). The tw soil landscape report notes that the region is a flood plain that has been cleared and drained primarily for cultivation of sugar cane. The eSPADE soil landscape report notes that as a result of the regional agricultural drainage network *"The presence of potential and actual acid sulfate soils has led to extremely acid runoff after dry periods. This is believed to be an important factor in the fish kills that have occurred in the Tweed."* Thus, it is noted that there is a regional acid sulfate soils issue that has occurred irrespective of the TSP quarrying operations.

To the south, the site is bordered by the Cudgen (cu) soil landscape; a tertiary basalt plateau characterised by red or red-brown Krasnozems (indicating high soil iron content).

2.5 Surface Water Bodies and Flooding

The main water feature on the property is the extraction lake, which functions as a 'groundwater window'. The site is susceptible to flooding and becomes inundated during periods of extreme rainfall and major flood events.

2.6 Groundwater Resources

The site sits above an unconfined sand aquifer that has a saturated thickness of approximately 20 metres. The groundwater table is shallow, typically found at less than 2.5 metres below the ground surface, and its level can fluctuate by around 1.0 metre depending on rainfall.

3 Reported Iron Concentrations

3.1 Overview

Information on historic groundwater iron concentrations has primarily been obtained from the TSP Annual Environmental Monitoring Reports prepared by Gilbert and Sutherland between 2012 and 2024.

The TSP Soil and Water Management Plan (Gilbert + Sutherland, 2019), identifies a historic report *“IGC and Associates (1996) A regional assessment of the hydrogeology and geochemistry of shallow groundwater in the Chinderah Floodplain”*, which was prepared to support land application of biosolids from the Cudgen Sewerage Treatment Plant. While a copy of the report is not available to ENV at this time, Gilbert and Sutherland 2019 notes:

“that assessment concluded that the water table in most areas of the floodplain was shallow (<2.0 m below NSL) with high groundwater iron concentrations and low in situ acidity.”

Groundwater iron concentrations were reported in annual return documentation prepared by Gilbert and Sutherland that is publicly available for the TSP.

Pages from *Gilbert + Sutherland (2024) ANNUAL REVIEW TWEED SAND PLANT CUDGEN, NEW SOUTH WALES JULY 2023 TO JUNE 2024* showing tabulated and graphed iron concentrations are presented as Attachment 2.

3.2 Surface Water Iron Concentrations

Surface water monitoring was undertaken at three (3) locations within the lake (SW1, SW2 and SW3, as shown in Attachment 1). During the monitoring program, iron concentrations within the lake have remained below 1 mg/L. No surface water monitoring was undertaken at depth, or outside of the lake itself (i.e. from drainage channels).

3.3 Shallow Bore Iron Concentrations

Baseline data from between October 2001 and July 2003 for bores MB1b, MB2b, MB3, MB4, MB5b, MB6 and MB7 supported wide variability in iron concentrations, which ranged between 0.01 mg/L and 61.4 mg/L. During this period, iron concentrations appear to generally increase over time up until January 2003, before falling to relatively low concentrations by April 2003, spiking again for the July 2003 monitoring round, and then rapidly decreasing again across all bores.

3.3.1 Bores MB3, MB4, MB5b and MB11a and MB12a

Bores MB3, MB4, MB5b and MB11a and MB12a have supported the highest iron concentrations over the monitoring program with concentrations ranging between:

- MB3 – 0.03 mg/L to 98.3 mg/L
- MB4 – 0.01 mg/L to 61.4 mg/L
- MB5b – 0.04 mg/L to 46.8 mg/L
- MB11a – 0.026 mg/L to 35.6 mg/L

- MB12a – 110 mg/L to 136 mg/L (noting MB12a only has two (2) data entries in 2007).

Over the monitoring program, all of these wells (with exception of MB12a) have shown substantial fluctuations in iron concentrations, with high and low concentrations often reported for temporally adjacent monitoring rounds (in either order).

3.3.2 Bore MB7

Bore MB7 has generally supported iron concentrations below the threshold (20 mg/L). Three (3) exceptions are noted, sequentially within monitoring events carried out in September 2018 (32.8 mg/L), June 2019 (34.4 mg/L), and December 2019 (22 mg/L).

3.3.3 Other Bores

Bores MB1, MB2b, MB8a, MB9a, and MB10a have all supported compliant iron concentrations (<20 mg/L) over the duration of the monitoring program.

3.4 Deep Bore Iron Concentrations

Baseline data was developed between October 2001 and July 2003 for three (3) bores, MB1a, MB2a and MB5a. The baseline concentrations ranged from 0.01 mg/L to 4.03 mg/L and a relatively conservative iron target of 1.82 mg/L was adopted.

3.4.1 Bore MB10b

Groundwater monitoring completed up until the most recent available data (June 2024) indicates that bore MB10b exhibited iron concentrations often approximately an order of magnitude above the other bores. MB10b shows substantial fluctuations in iron concentrations ranging from 0.01 mg/L (April 2012) up to 39.6 mg/L (April 2013). It is noted that fluctuations occur throughout the period of MB10b being monitored. For example, the initial result in May 2007 of 20 mg/L decreases to 1.2 mg/L the following year. With exception of some minor increased iron concentrations, MB10b remains relatively stable (<3 mg/L), before spiking to 39.6 mg/L in April 2013.

The majority of results between April 2013 and June 2020 are substantially elevated however there are notable drops in iron concentrations for:

- October 2014 (0.22 mg/L)
- September 2015 (2.28 mg/L)
- December 2020 (1.49 mg/L)

From June 2020 onwards, iron concentrations are highly volatile, with results ranging from as high as 37 mg/L, to as low as 0.088 mg/L.

3.4.2 Bore MB9b

Bore MB9b was sampled five (5) times between September 2010 and September 2013. Iron concentrations were initially low (up to 0.5mg/L) until April 2013, when iron concentrations spiked to 28.7 mg/L. MB9b was only samples once more after this (September 2013, with a

concentration of 24.5 mg/L). It is understood that monitoring was suspended after the bore was damaged or destroyed. It is unclear as to why the monitoring bore was not replaced.

3.4.3 Other Bores

Bores MB5a, MB8b and MB11b all reported various exceedances of the iron target levels, however these exceedances were generally near to the target level (up to a maximum of 4.69 mg/L) and are relatively low concern, noting that MB5a supported up to 4.03 mg/L during baseline monitoring.

The remaining bores (MB1a, MB2a and MB12b) did not support iron concentrations above the target level for any samples during the monitoring program.

3.5 Gilbert + Sutherland Commentary on Groundwater Iron Concentrations

Throughout the annual reports, Gilbert and Sutherland discuss that elevated iron concentrations only occur in groundwater and have not impacted the lake. As such, it was concluded that the elevated iron concentrations were not of concern.

3.6 Groundwater Migration

The TSP Soil and Water Management Plan (Gilbert + Sutherland, 2019), identifies groundwater migration direction to vary over the seasons. Generally, groundwater migrates to the north with intermittent periods of migration towards the lake from the southwest.

Groundwater velocities were estimated to be low (up to 13 m/year) with monthly variation.

The time for groundwater migration from the lake to reach bore locations MB10 and MB11 (north of the lake) is estimated to be a minimum of 30 and 22 years respectively (with upper estimates being greater than an order of magnitude longer). Bore location MB8 is identified to be up-gradient of the lake.

4 Discussion and Conclusion

An analysis of the available data does not clearly indicate that elevated iron concentrations can be attributed to the quarrying operations of the TSP, rather that there are complex regional environmental factors including potential iron inputs from regional acid sulfate soil oxidation (and release of iron) and runoff/infiltration from the iron-rich Cudgen soil landscape, which may have led to fluctuations in iron content.

This is based on key lines of evidence in the following subsections

4.1 The Effectiveness of Onsite Water Management

The quarrying process includes mitigation measures by separating fines including pyrite with reinterment into the dredge lake. The surface water iron concentration remaining below 1 mg/L indicate that this process control is successful in preventing the oxidation of pyrite (and an associated release of iron)

4.2 Contradiction Between Observed Data and a Quarry Plume

If the dredge lake is acting as a source of iron, it would be expected to generate a plume of dissolved iron that migrates with groundwater, resulting in gradual and sustained increases in iron concentrations in downgradient monitoring bores. However, the monitoring data contradicts this expectation. The records show volatile fluctuations in both shallow and deep bores, with concentrations often varying significantly between adjacent monitoring rounds. This pattern is inconsistent with a slow-moving plume from a single source and is more indicative of intermittent, surface derived inputs.

4.3 Spatial Distribution and Slow Groundwater Migration

The spatial pattern of iron concentrations provides the strongest evidence against the quarry being the primary source. Groundwater at the site generally flows north, with very low velocity (estimated up to 13 m/year). The bore locations that would be expected to show first impact (MB1 and MB2, north of the lake) have remained compliant with iron targets throughout the monitoring program. The slow migration of groundwater makes it unlikely that a plume would have substantial impact on bores further afield from the lake (locations MB10 and MB11) without impacting MB1 and MB2. If iron was released down gradient due to changes in groundwater chemistry (for example changed to redox potential that could later mobilise iron in the down gradient aquifer), it does not explain reasoning for shallow bores MB3, MB4 and MB5b supporting elevated iron concentrations for some monitoring rounds while being directly adjacent the lake.

4.4 Decreasing Iron Concentration

Iron concentrations have been low in recent years (since 2021) with the exception of a volatile fluctuation in 2023. The general decrease in iron concentration indicates that there is not a continuous input of iron into the system from the operations.

4.5 Conclusions

On the basis of the information reviewed in this memo, it appears that iron concentrations are most likely impacted by inputs from the iron rich Cudgen soil landscape, and regional agricultural drainage. The correlation of high iron levels in shallow bores with nested bores supporting elevated but lower concentrations of iron suggests that the source is surface derived, likely from infiltration and runoff from naturally iron rich soils, and oxidised acid sulfate soils (which have been oxidised due to the agriculturally lowered watertable), which are a known regional issue. These conclusions are generally aligned with commentary by Gilbert + Sutherland through the TSP documentation, with the source of iron input deemed not to be attributable to the sand mining operations.

4.6 Recommendations

While there has not been any clear attribution of groundwater iron concentrations to the quarrying activities at the TSP, it is recommended to enhance the Trigger Action Response Plan for responding to elevated iron concentrations at Salt Ash. This can be achieved by Increasing lime dosing at the front end of the proposed wash plant (at the point of inflow), increasing aeration, and performance monitoring.

The groundwater monitoring network at the TSP has some flaws in that there are limited monitoring wells between the lake (some being directly adjacent) and the property boundary where the majority of wells are situated. If additional wells were present, it would likely be possible to better attribute the source of elevated iron concentrations (or changes in other analytes). The Salt Ash project should ensure sufficient groundwater monitoring infrastructure is present to better determine the distribution of any elevated (or decreasing) analytes.

Stratified monitoring in the dredge pond and surface water monitoring locations including surface water monitoring (e.g. in agricultural drainage channels) would further support delineation of water quality issues.

5 References

Gilbert + Sutherland (2019) SOIL AND WATER MANAGEMENT PLAN FOR TWEED SAND PLANT (PHASES 3 AND 4), CUDGEN NEW SOUTH WALES

Gilbert + Sutherland (2024) ANNUAL REVIEW TWEED SAND PLANT CUDGEN, NEW SOUTH WALES JULY 2023 TO JUNE 2024

Spatial Services, NSW Department of Customer Service (2025) eSPADE v2.2. NSW Government.

Spatial Services, NSW Department of Customer Service (2025) *SIX Maps*. NSW Government.

Document Control

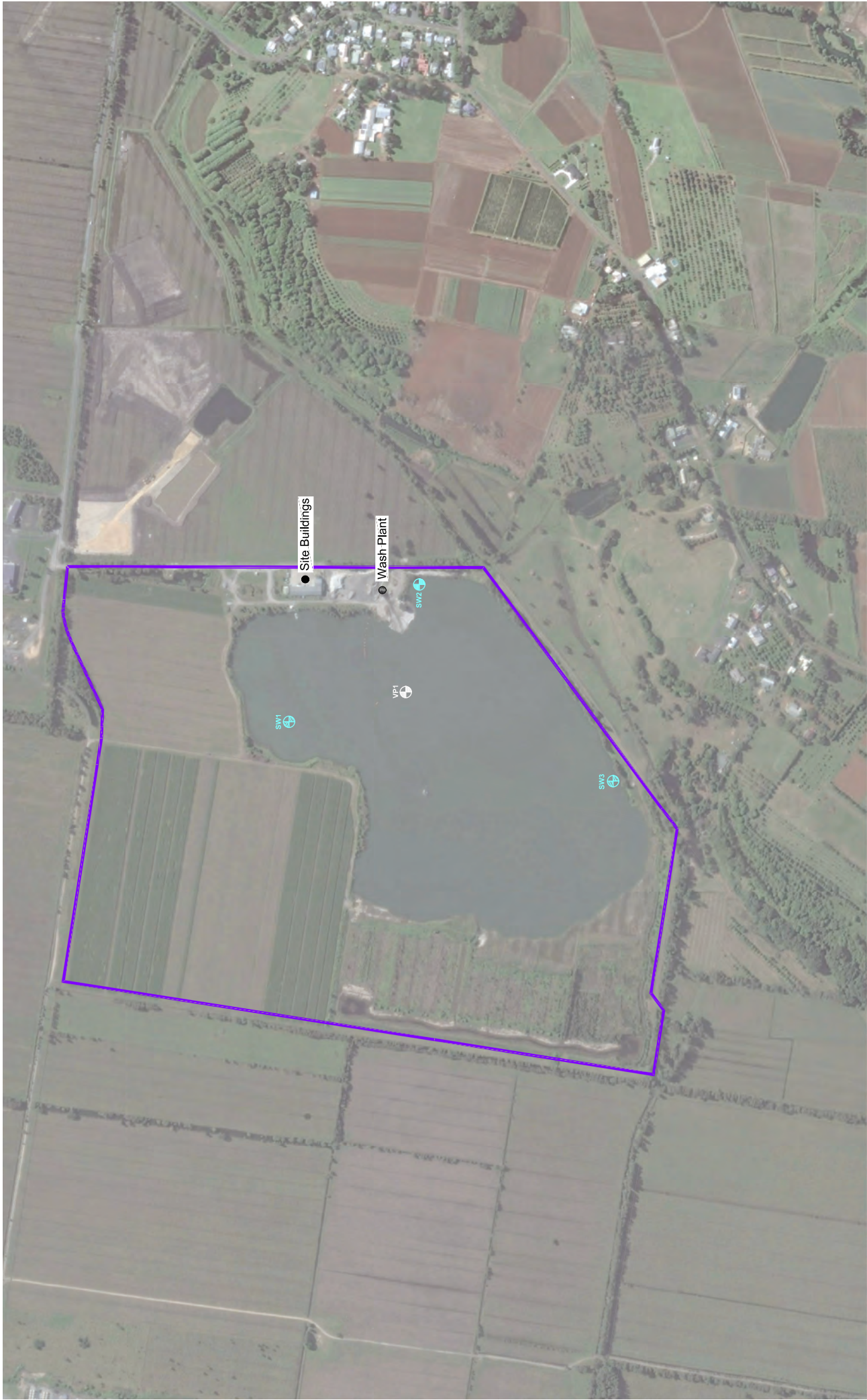
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Prepared By:	Ben Pieterse BEnvSc, CEnvP	31/07/2025	
Reviewed By:	Kingsley Baldwin BAppSc	1/08/2025	

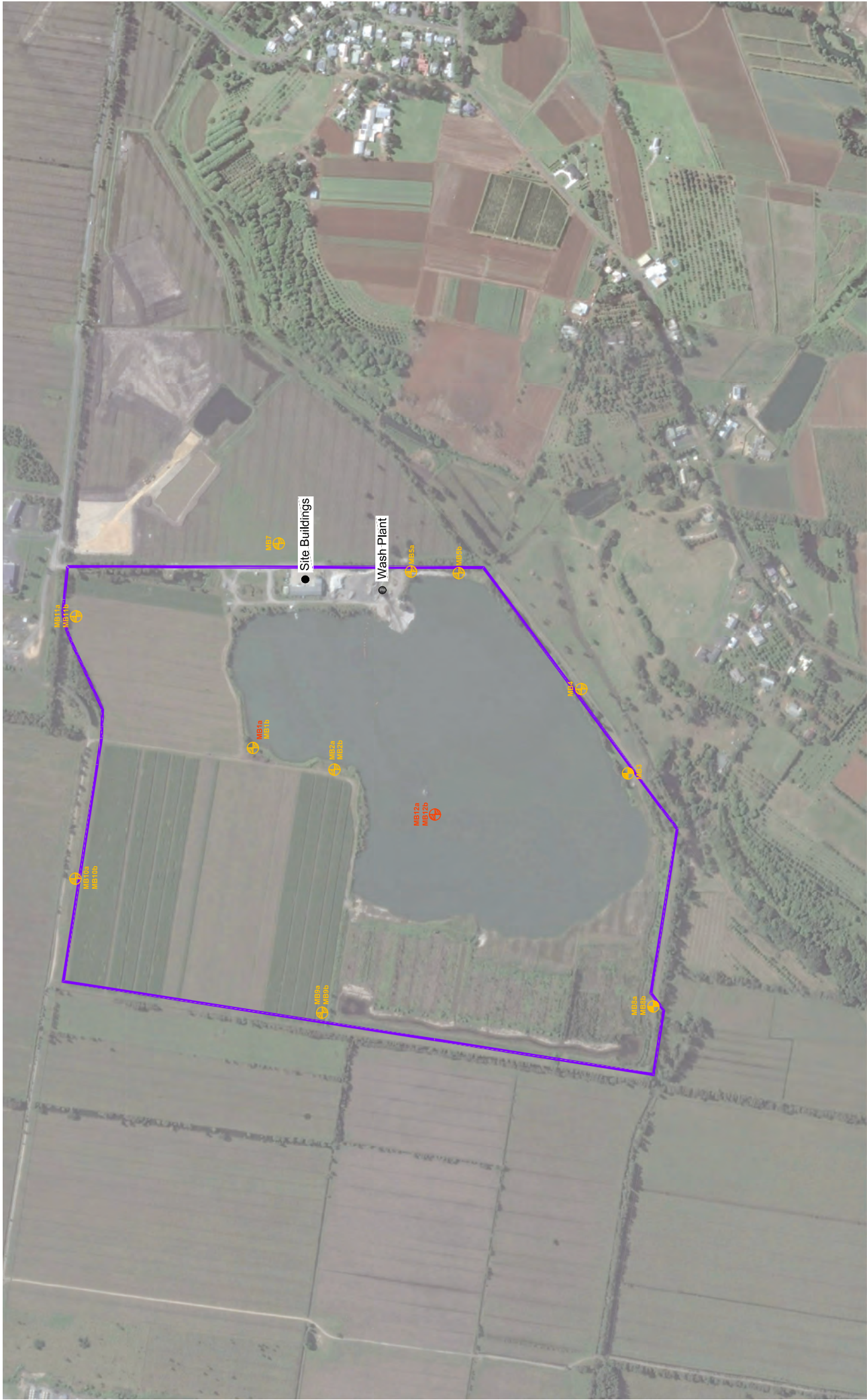
Attachments

Attachment 1 – Figures (Extracted from Gilbert + Sutherland, 2019)

Attachment 2 – Monitoring Results (Extracted from Gilbert + Sutherland, 2024)

**Attachment 1 – Monitoring Locations (Extracts from Gilbert +
Sutherland (2024) ANNUAL REVIEW TWEED SAND PLANT CUDGEN,
NEW SOUTH WALES JULY 2023 TO JUNE 2024)**





**ORIENTATION**

SCALE 1:6 250
0 50 100 150 200 250 300
metres

ROBINA
PO Box 4115 Robina QLD 4230
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LEGEND

 Site Boundary

 Existing Groundwater Bore

 Damage/Degraded Groundwater Bore

SOURCES

Image: Google Earth Pro 2016, Image date: 21.07.2017

PROJECT

TWEED SAND PLANT - AEMR

CLIENT

HANSON CONSTRUCTION MATERIALS

DRAWING

GROUNDWATER MONITORING LOCATIONS

SCALE

1:6 250@A3

DATE

28/08/2018

DRAWN

AJS/SNP

CHECKED

GRC

PROJECT

10683

DRAWING

003

REVISION



**Attachment 2 – Monitoring Results (Extracts from Gilbert +
Sutherland (2024) ANNUAL REVIEW TWEED SAND PLANT CUDGEN,
NEW SOUTH WALES JULY 2023 TO JUNE 2024)**

Table A1.12 Surface water dissolved iron (Fe) concentrations (mg/L) recorded by G&S during biannual monitoring from October 2001 to the end of the reporting period

Sampling Date	SW1	SW2	SW3
Oct-2001	0.06	0.06	
Jan-2002	0.07		
Apr-2002	0.11	0.01	
Jul-2002	0.06	0.02	
Oct-2002	0.29	0.12	
Jan-2003	0.01	0.14	
Apr-2003	0.01	0.01	
Jul-2003	0.01	0.01	
Oct-2003	0.01	0.01	
Feb-2004	0.02	0.01	
Apr-2004	0.01		
Jul-2004	0.01	0.01	
Oct-2004	0.01	0.01	
Jan-2005	0.01	0.01	
Apr-2005	0.01	0.01	
Jul-2005	0.05	0.05	
Oct-2005	0.05	0.05	
Jan-2006	0.05	0.05	
Apr-2006	0.05	0.05	
Jul-2006	0.05		
Nov-2006	0.05	0.05	
Mar-2007	0.05	0.05	
May-2007	0.01	0.01	0.01
Sep-2007	0.29	0.30	0.31
Jan-2008	0.42	0.43	0.45
Apr-2008	0.32	0.32	0.32
Jul-2008	0.52	0.54	0.53
Oct-2008	0.54	0.56	0.54
Dec-2008	0.01	0.02	0.01
Jun-2009	0.16	0.15	0.16
Sep-2009	0.15	0.17	0.14

Sampling Date	SW1	SW2	SW3
Mar-2010	0.01	0.01	0.01
Sep-2010	0.05	0.05	0.05
Mar-2011	0.05	0.05	0.05
Sep-2011	0.05	0.05	0.06
Apr-2012	0.01	0.11	0.01
Sep-2012	0.06	0.05	0.05
Apr-2013	0.32	0.32	0.31
Sep-2013	0.05	0.05	0.05
Mar-2014	0.05	0.05	0.05
Oct-2014	0.05	0.05	0.05
Mar-2015	0.05	0.05	0.05
Sep-2015	0.05	0.05	0.05
Mar-2016	0.05	0.05	0.05
Sep-2016	0.01	0.01	0.01
Apr-2017	0.07	0.076	0.074
Sep-2017	0.011	0.005	0.005
Mar-2018	0.005	0.005	0.005
Sep-2018	0.002	0.003	0.002
Jun-2019	0.002	0.002	0.002
Dec-2019	0.025	0.025	0.025
Jun-2020	0.148	0.124	0.115
Dec-2020	0.002	0.002	0.002
Jun-2021	0.001	0.001	0.001
Dec-2021	0.002	0.002	0.002
Jun-2022	0.01	0.014	0.015
Dec-2022	0.002	0.002	0.002
Jun-2023	0.001	0.001	0.001
Dec-2023	0.001	0.001	0.001
Jun-2024	0.002	0.002	0.002
Target Maximum	20	20	20
Median (historical)	0.050	0.050	0.050
Median	0.002	0.002	0.002

Notes – Bold indicates current reporting period.

Surface Water Monitoring | Dissolved Iron

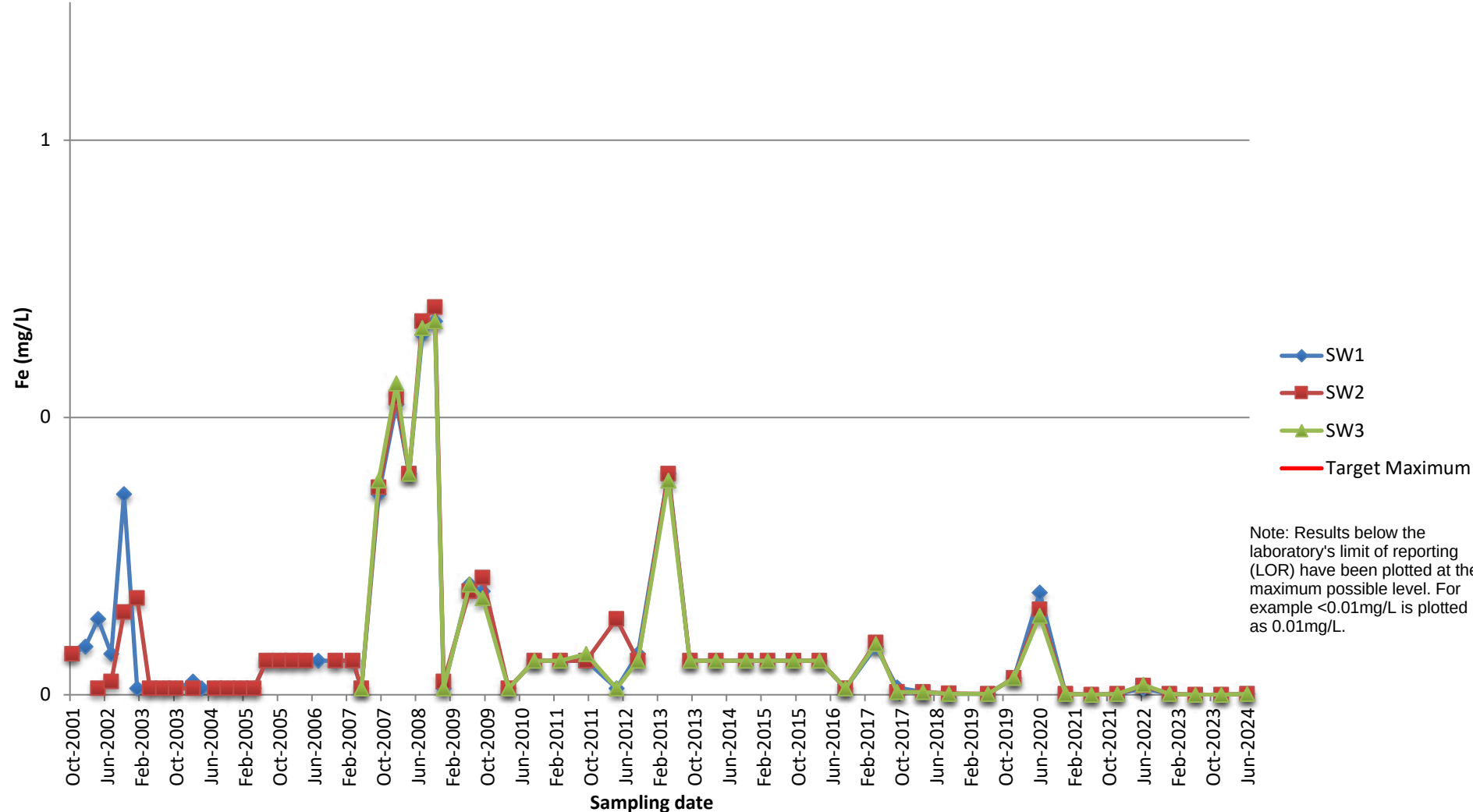


Figure A1.12 Surface water dissolved iron variations since the commencement of monitoring at the site

Table A5.11 Shallow groundwater bores dissolved iron (Fe) results (mg/L) recorded biannually by G&S from October 2001 to the end of the reporting period

Sampling Date	MB1b	MB2b	MB3	MB4	MB5b	MB6	MB7	MB8a	MB9a	MB10a	MB11a	MB12a
Oct-2001	0.01	5.11	0.08	30.60	0.05	0.12	8.34					
Jan-2002	1.37	7.10	4.62	61.40	9.08	3.49	9.84					
Apr-2002	0.01	5.61	2.12	31.80	3.04		6.52					
Jul-2002	1.45	18.80	13.40	46.80	17.80		7.50					
Oct-2002	7.39	17.80	18.70	56.20	22.10		8.05					
Jan-2003	1.59	0.44	13.60	20.10	14.50		8.95					
Apr-2003	0.02	2.36	0.03	7.70	4.30		4.41					
Jul-2003	12.20	0.43	29.30	16.20	20.50							
Oct-2003	0.02	1.92	13.60	0.02	0.03		4.06					
Feb-2004	0.01	0.11	4.10	0.01	0.04		5.50					
Apr-2004	9.07	0.38	11.30	0.08	8.78		6.59					
Jul-2004	0.01	0.12	1.87	0.01	15.50		8.98					
Oct-2004	2.44	10.50	33.10	0.01	41.00		7.10					
Jan-2005	0.03	0.38	24.00	0.13	0.04		2.41					
Apr-2005	11.50	0.42	34.10	0.75	16.20		6.14					
Jul-2005	6.77	0.11	25.80		0.09		1.07					
Oct-2005	7.51	8.19	0.05	0.09	0.44		4.39					
Jan-2006	0.05	0.23	0.05		0.06		0.72					
Apr-2006	0.05	0.22	0.18	0.19	0.05		2.1					
Jul-2006	0.38	0.17	37.90		0.09		0.53					
Nov-2006	13.40	0.07	9.84		7.92		4.03					
Mar-2007	2.07	1.52	0.16		4.55		9.85					
May-2007	0.01	5.39	2.12	0.64	0.10		8.12	2.51	0.54	0.16	0.06	136
Sep-2007	0.23	0.53			0.62			0.23	2	0.38	0.21	110
Jan-2008	0.71				1.10		5.90		0.23	0.42	0.33	
Apr-2008	1.50		0.40		0.58			3.2	0.24		0.4	
Jul-2008	0.76				0.91			0.33	0.28	0.55	0.57	
Oct-2008	0.47		3.10	0.61	0.63		2.50	0.31	1.4	0.24	0.46	
Dec-2008	5.55		30.00		1.93			0.35	1.71	6.96	0.34	
Jun-2009	1.12			0.12	0.26			0.08	0.19	0.2	0.16	
Sep-2009	2.56		0.48					0.17	0.23	0.14	0.34	

Sampling Date	MB1b	MB2b	MB3	MB4	MB5b	MB6	MB7	MB8a	MB9a	MB10a	MB11a	MB12a
Mar-2010			13.00		10		3.56	1.53	2.25		7.29	
Sep-2010	0.84	0.57	64.20	16.6			4.13	0.08	1.62		1.25	
Mar-2011	7.82	0.23	66.5	37.3	12.9			5.64	8.1	5.01	19.4	
Sep-2011	5.76	1.35	74.4	20.3	46.5			3.05	6.22	0.54	22.4	
Apr-2012	2.41	0.44	16.00	0.1	17		2.35	1.4	0.54	1.91	14	
Sep-2012	3.35	0.31	28.4	18.8	30.2		3.05	1.34	6.27	0.4	20.1	
Apr-2013	6.91	0.98	29.1	25.6	46.8		18.1	7.99	7.58	4.01	35.6	
Sep-2013	4.6	2.08	20.1	23.1	25		8.35	13	6.88	4.3	27.2	
Mar-2014	9.62	7.81	23.9	28.4	26.8		6.36	12	5.91	4.15	28.4	
Oct-2014	6.46	6.82	35.0	30.0	21.3		4.68	0.05	7.26	4.06	21.8	
Mar-2015	7.91	1.8	42.4	23.3	1.99		2.37	9.45	6.28	3.84	22.3	
Sep-2015	0.05	0.22	21.7	0.05	0.23		0.81	1.76	0.77	0.08	6.74	
Mar-2016	10.3	0.61	93	30.8	16.5		5.07	13.1	7.26	7.61	30.8	
Sep-2016	0.016	0.31	47	24	20		3.7	10	9.5	7.7	34	
Apr-2017	12	9.4	30	30	26		3.3	3.4	4.7	9.4	27	
Sep-2017	10	8.1	58	14	2.2		3.5	7.5	4.5	7.2	29	
Mar-2018	9.1	7.4	59	30	58		17	12	4.2	11	30	
Sep-2018	6.24	10.4	66	31.4	43.5		32.8	6.33	5.83	11.3	23	
Jun-2019	6.69	11.9	69.6	20.4	33		34.4	6.25	5.11	11.1	25.9	
Dec-2019	8.9	13.2	98.3	22	24.8		22	8.06	6.79	9.5	30.8	
Jun-2020	11.2	4.52	63.7	23.4	28.8		7.17	7.05	6.3	8.72		
Dec-2020	1.74	3.21	25.4	1.9	0.397		5.52	0.007	0.096	0.963	0.026	
Jun-2021	0.166	3.47	0.4	0.087	0.04		4.23	0.209	0.039	1.34	0.072	
Dec-2021		2.65	5.45	0.208	0.022		2.03	0.264	0.058	2.26	5.71	
Jun-2022		2.67	5.12	0.907	0.052		0.405	2.18	0.024	3.28	0.089	
Dec-2022		1.42	0.103	0.044	0.043		0.354	0.582	0.049	1.04	0.199	
Jun-2023		7.56	58.1	20.2	4.72		2.2	2.03	7.9	7.84	23.6	
Dec-2023		0.158	16.7	0.016	0.032		1.58	0.136	0.024	1.11	4.28	
Jun-2024		3.7	6.42	0.032	0.018		1.31	0.336	0.025	2.47	0.372	
Target Maximum	20	20	20	20	20	20	20	20	20	20	20	20
Median (historical)	2.41	1.86	19.40	16.40	4.43	1.81	4.41	2.03	2.13	3.28	7.29	123.00
Median		1.93	11.56	0.02	0.03		1.45	0.24	0.02	1.79	2.33	

Notes – Bold indicates current reporting period. Red text indicates non-compliance with the target.

Shallow Groundwater (piezometer) Monitoring | Dissolved Iron

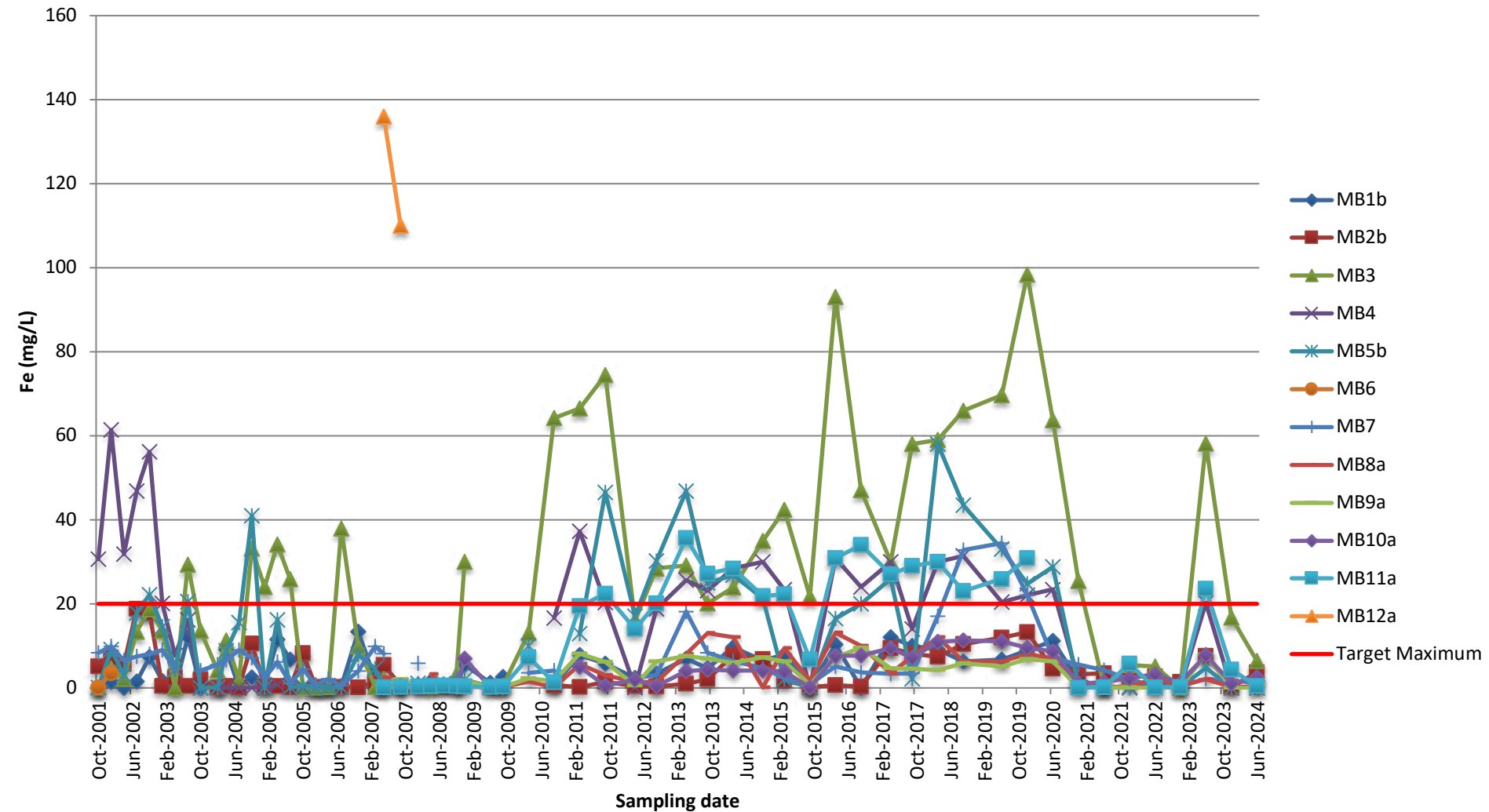


Figure A5.11 Shallow groundwater bores dissolved iron variations since the commencement of monitoring at the site

Table A7.12 Deep groundwater bores iron (Fe) results (mg/L) recorded biannually by G&S from October 2001 to the end of the reporting period

Sampling Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB12b
Oct-2001	0.02	0.19	2.26					
Jan-2002	0.46	0.67	4.03					
Apr-2002	0.18	0.57	0.04					
Jul-2002	0.04	0.06	0.41					
Oct-2002	0.06	0.10	0.35					
Jan-2003	0.01	0.18	0.03					
Apr-2003	0.01	0.01	0.01					
Jul-2003	0.04	0.06	0.01					
Oct-2003		0.05	0.02					
Feb-2004		0.02	0.01					
Apr-2004		0.07	0.01					
Jul-2004		0.01	0.01					
Oct-2004		0.02	0.01					
Jan-2005		0.03	0.03					
Apr-2005		0.04	0.02					
Jul-2005		0.08	1.06					
Oct-2005		0.05	0.64					
Jan-2006		0.05	0.05					
Apr-2006		0.05	0.05					
Jul-2006		0.05	0.06					
Nov-2006		0.05	0.05					
Mar-2007		0.02	0.04					
May-2007		0.01	0.01	0.07		20	0.01	0.2
Sep-2007		0.59	0.88	1.7		1.2	1.4	1.5
Jan-2008		1.60	1.70			2.7	3.4	
Apr-2008		0.18	0.57			1.4	1.5	
Jul-2008		0.19	0.67	3		1.1	2.3	
Oct-2008			0.78	2.9		1.4	1.8	
Dec-2008			0.08	0.14		0.05	0.02	
Jun-2009			0.24	0.69		0.22	0.57	
Sep-2009			0.45	0.9		0.42	0.97	

Sampling Date	MB1a	MB2a	MB5a	MB8b	MB9b	MB10b	MB11b	MB12b
Mar-2010			0.01	0.01			0.91	
Sep-2010			0.05	0.05	0.09	0.09	0.06	
Mar-2011		0.61	4.04	0.4		0.05	0.05	
Sep-2011		1.23	0.13	0.5	0.3	1.03	0.55	
Apr-2012		0.53	0.01	0.01	0.46	0.01	0.01	
Sep-2012		0.09	0.05	0.3	0.05	0.13	0.35	
Apr-2013		0.34	2.32	1.45	28.7	39.6	1.9	
Sep-2013		0.57	3.03	1.48	24.5	29.9	1.54	
Mar-2014		0.60	2.97	1.18		34	2.12	
Oct-2014		0.76	2.96	0.80		0.22	2.01	
Mar-2015			3.49			25.00	1.80	
Sep-2015		0.05	0.05	0.05		2.28	0.05	
Mar-2016		0.99	4.04	1.50		34.30	1.14	
Sep-2016		0.019	4.10	1.50		13.00	2.00	
Apr-2017		0.26	2.40	1		33.00	1.9	
Sep-2017		0.39	3.40	0.88		23.00	1.6	
Mar-2018		0.59	2.10	0.89		35.00	1.9	
Sep-2018		0.90	1.83	1.66		37.60	2.4	
Jun-2019		0.50	1.98	0.05		32.60	2.46	
Dec-2019		1.28	1.95	1.44		31.1	2.4	
Jun-2020		1.3	1.78	0.25		29.3		
Dec-2020		0.058	0.001	0.059		1.49	2.88	
Jun-2021		1.65	0.009	2.35		37	2.36	
Dec-2021		0.014	0.019	0.012		6.32	0.022	
Jun-2022		0.029	0.004	0.018		0.088		
Dec-2022		0.015	0.004	0.01		1.22	0.02	
Jun-2023		1.42	1.27	4.69		30.7	2.39	
Dec-2023		0.009	0.008	0.0025		0.228	0.019	
Jun-2024		0.024	0.002	0.025		0.521	0.045	
Target Maximum		1.82	1.82	1.82	1.82	1.82	1.82	
Median (historical)	0.04	0.09	0.11	0.69	0.38	2.28	1.52	0.85
Median		0.02	0.01	0.01		0.37	0.03	

Notes – Bold indicates current reporting period. Red text indicates non-compliance with the target.

Deep Groundwater (piezometer) Monitoring | Dissolved Iron

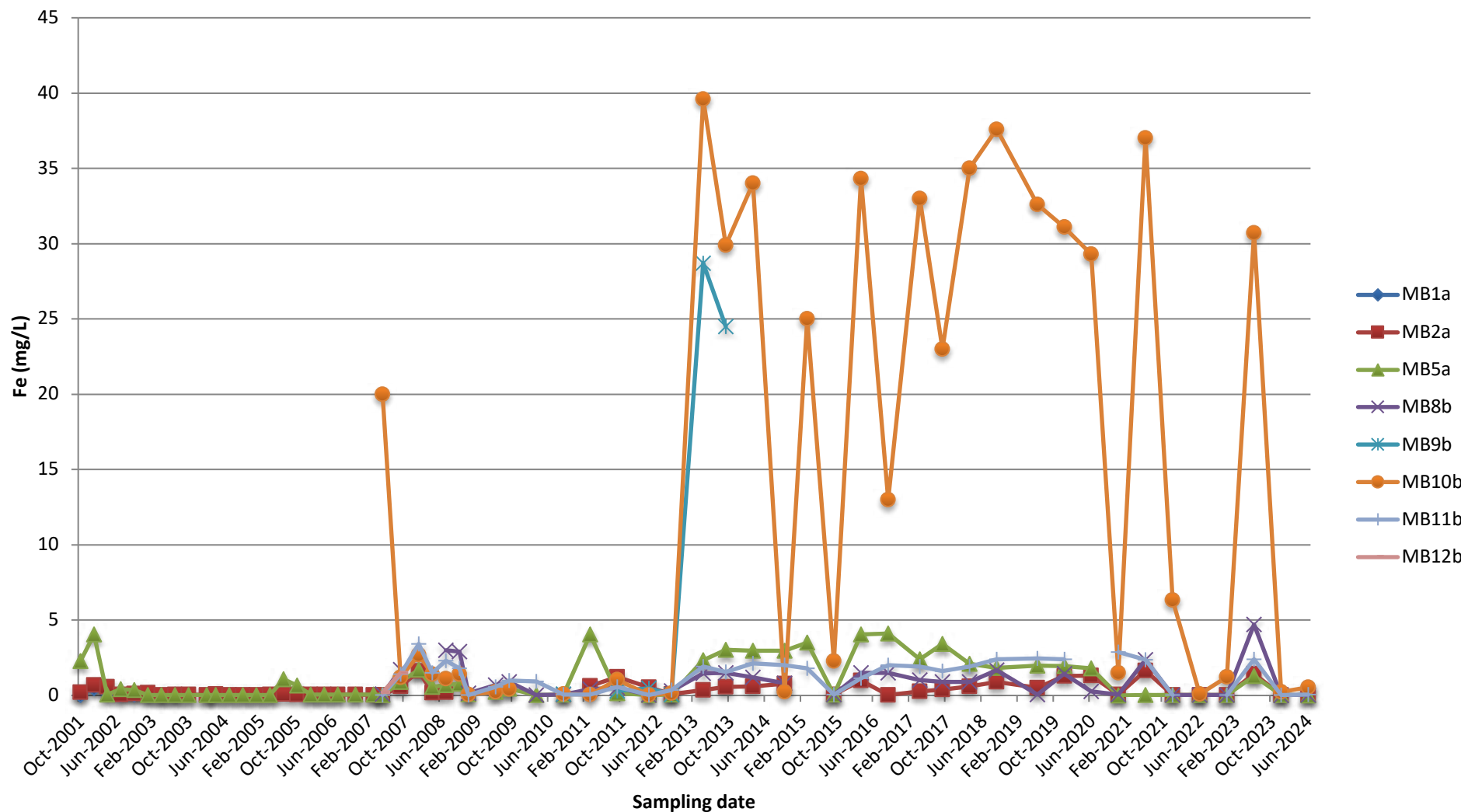


Figure A7.12 Deep groundwater bores dissolved iron variations since the commencement of monitoring at the site