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**Post Remediation Annual
Groundwater Monitoring
Event - July 2023**

Arsenic Remediation
Program, Orica Kooragang
Island

wsp

September 2023

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Post Remediation Annual Groundwater Monitoring Event - July 2023 Arsenic Remediation Program, Orica Kooragang Island

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WSP acknowledges that every project we work on takes place on First Peoples lands.

We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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1 Introduction

WSP Australia Pty Ltd (WSP) was commissioned by Orica Australia Pty Ltd (Orica) to undertake an annual (July 2023) groundwater monitoring event (GME) at Orica's facility at Greenleaf Road, Kooragang Island, New South Wales (NSW) (the 'site') (**Figure 1**) in line with an Arsenic Groundwater Monitoring Program (GMP) as defined in the Long Term Environment Management Plan (LTEMP) (WSP, 2023 Rev2). This report details the results of the July 2023 annual GME and is the fourth annual monitoring report prepared under the LTEMP post completion of the remediation.

1.1 Background

1.1.1 Arsenic Remediation Program

Orica has completed a remediation program at the former arsenic sludge disposal pit in the north western portion of the site, **Figure 1**.

The remediation was undertaken between February and September 2019. The remediation program involved the construction of a containment system comprising of a soil/bentonite cut-off wall with an integrated capping system which was designed to hydraulically isolate the identified arsenic contamination in accordance with the Remediation Action Plan (RAP) (Golder, 2016a). The cut-off wall component of the integrated system is approximately 12 m in depth and covers an area of approximately 4,200 m². A full description of the remediation and validation program is provided in the Remediation Validation Report (Golder, 2019b).

A requirement of Section 15 of the RAP, Action 2 (d and e) of the Management Order (MO) (Order No. 20181401) and Condition B9 and B10 of the Development Consent was the preparation and implementation of a LTEMP for the operational phase of the remediation system. The LTEMP was to incorporate any long-term requirements for the post remediation monitoring, maintenance and restrictions on site activities permitted to be undertaken in the vicinity of the containment system. The LTEMP is to be periodically revised based on monitoring results. The current revision of the LTEMP is Revision 2 updated in May 2023 (WSP, 2023).

1.1.2 Groundwater Monitoring Plan

The key purpose of the monitoring requirements of the GMP as defined in the LTEMP (Section 8) is to demonstrate that the containment cell is performing as per the design and achieving the Remediation Objective of segregating the residual source of arsenic from the surrounding groundwater system by significantly reducing the flux of groundwater through the hydraulically isolated arsenic contamination. Reducing the groundwater flux through the source area is intended to reduce the contaminant mass flux of arsenic migrating off site. By achieving this Remediation Objective, the MO requirement of preventing further offsite migration of arsenic in groundwater will be considered to have been met.

Section 4.3 of the LTEMP provides the rationale for the 'weight of evidence' approach for the assessment of the hydraulic effects for assessing the ongoing performance of the containment cell. It is noted in the GMP that the chemical monitoring of arsenic is being undertaken as a 'secondary line of evidence' to provide long-term understanding of the redistribution of the arsenic contamination over time.

Based on the first three years of monitoring undertaken as part of the LTEMP, the monitoring requirements were revised, with the change being the reduction of groundwater data logger down-loads from quarterly to six-monthly (bi-annual). The revised monitoring requirements were incorporated into the LTEMP - Revision 2 (WSP, 2023).

1.2 Objective

The objectives of the post remediation GMP are to:

- Assess hydraulic performance of the containment cell in accordance with the requirements of the Remediation Validation Report (RVR) (Golder, 2019b).
 - Assess long-term changes in the groundwater flow regime and arsenic distribution in groundwater down-gradient of the containment cell.
-

1.3 Monitoring Well Network

1.3.1 Containment Cell Wells

The groundwater network associated with the containment cell is a series of nested well suites at strategic locations on either side of the completed cut-off wall, such that the internal and external ‘piezometric’ water levels can be compared, enabling the hydraulic performance of the containment system to be assessed.

The containment cell monitoring well (MWCC series) network is shown in **Figure 2a** and defined in **Table A**. It comprises three sets of paired monitoring wells (a total of six nested well suites) located around the cut-off wall alignment. The selection of locations is constrained by the site characteristics and design features of the cell. The well locations to observe the effects of design implementation, are described below:

- Western boundary (MWCC02), near the north-western corner of the containment cell, down-gradient.
- Southern Boundary (MWCC03), cross-gradient.
- Eastern boundary (MWCC01), up-gradient.

At each of the well suite locations, three separate piezometers installed to target Units 1, 2 and 3. This is considered to be an appropriate level of assessment and also reflects the considerations presented in the groundwater model prepared for the design of the cell, which advocated such an approach. An additional well has been installed in the unsaturated zone to allow assessment of barometric pressure within the containment cell and allow ‘normalisation’ of the internal water level data, if required.

Data loggers were installed within the containment cell wells to continually collect groundwater elevation data demonstrating that the containment cell is performing optimally as per the design. A barometric logger was installed in the dry well in the unsaturated zone to allow assessment of barometric pressure compensating for the influence of localised atmospheric pressure variation.

1.3.2 Surrounding Groundwater Monitoring Network

There is a network of groundwater monitoring wells located in the vicinity of the containment cell, primarily down-gradient, to assess and monitoring the spatial and temporal responses in arsenic concentrations. These monitoring wells are shown on **Figure 2b** and defined in **Table A**.

2 Scope of services

The scope of works undertaken was in accordance with the requirements of the LTEMP (Rev2) (WSP, 2023), and as summarised below.

2.1 Hydraulic Monitoring

2.1.1 Groundwater Level Measurements

Standing water levels in each monitoring well listed in **Table A** were measured using an electronic water level probe. Standing water levels were measured in a single water level measuring event.

2.1.2 Data Transducer Download

Logger data was downloaded manually via the *Solinst* Optical Reader cable, utilizing the *Solinst Levellogger™* series software.

Manual measurements of groundwater levels were collected prior to the data-logger download event as described in Section 2.1.1. The manual measurements were used to check the validity of groundwater levels estimated from data of the water pressure transducers and data loggers.

Groundwater levels from the water-pressure transducers were estimated using:

- 1 the elevation of the water-pressure transducer in each well
- 2 the total pressure measured by the water-pressure transducers
- 3 corresponding measurements of barometric pressure, and
- 4 the assumption regarding the density of the groundwater (in this case assumed to be 1.0 gram per millilitre).

The nominated hydraulic monitoring locations and the sampling methodologies are presented in **Table A** and the Sampling, Analysis and Quality Plan (SAQP) (Appendix A).

2.2 Chemical Monitoring (Arsenic)

Groundwater monitoring to assess dissolved arsenic concentrations in groundwater was undertaken as a 'secondary line of evidence' to provide long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable.

Representative groundwater samples, including quality assurance and quality control (QA/QC) sampling, were collected at nominated locations in **Table A**. It should be noted that sampling at four offsite and one onsite monitoring locations could not be completed due to blockage or access restriction (See Section 6.2).

The nominated chemical monitoring locations and the sampling and analytical (including QA/QC) methodologies are presented in Appendix A. Field sheets are presented in Appendix B.

2.3 Reporting

Preparation of this annual report to include the following:

- Summary of the project background, objectives and scope of the monitoring, site environmental setting.
- Presentation and interpretation of the hydraulic monitoring data including:

- Preparation of hydrographs illustrating comparative hydraulic responses of each well pair to external influences and the effect of the containment cell.
- Preparation of Figures presenting groundwater elevations/potentiometric surface for average water levels within and surrounding the containment cell.
- Interpretation of the hydraulic responses in the ‘weight of evidence’ approach.
- Presentation and interpretation of chemical monitoring data including:
 - Tabulation of chemical data.
 - Data validation.
 - Comparison to historic monitoring data (noting that changes in arsenic concentrations is considered to be a long-term response to the construction of the containment cell).
- Recommendations, in accordance with the requirement of the LTEMP (if required).

3 Site location and identification

3.1 Location and Identification

The site's main entrance is at 75 Greenleaf Road, Kooragang Island, NSW. The site is described as Lot 2 and Lot 3 in Deposited Plan 234288. The site covers an area of approximately 22 hectares. The site is located on the south eastern peninsula of Kooragang Island at the confluence of the North and South Arms of the Hunter River (**Figure 1**).

3.2 Site Setting

A detailed description of the site land use, surrounding areas, history of use and geology and hydrogeology is provided in the Conceptual Site Model (CSM) (Golder, 2013). A brief summary is provided below, however, if further detail is required the CSM should be referred to.

Kooragang Island was originally a series of smaller islands which formed part of the Hunter River Delta. The southern portion of Kooragang Island was subsequently reclaimed² in the late 1950s and early 1960s from the original landform of a series of tidal mud flats using dredged sand from the Hunter River. Since the reclamation, the southern portion of Kooragang Island, including the area occupied by the site, has been developed for heavy industrial use, including port facilities, chemical manufacturing and storage, waste recycling and hazardous waste treatment.

3.2.1 Current Land Use

The Orica site is used for the manufacturing of ammonia and nitric acid as intermediate products in the production of ammonium nitrate for use in the mining sector. The Orica site is classified as a major hazard facility (MHF) as the site produces the scheduled materials ammonia and ammonium nitrate at rates that exceed threshold quantities specified in Schedule 15 of the *Work Health and Safety Regulation 2011*.

3.2.2 Surrounding Land Use

The southern portion of Kooragang Island, including the Orica site, is zoned 'Special Activities' under the New South Wales State Environmental Planning Policy (Major Projects) Amendment (Three Ports) 2009 under the Environmental Planning and Assessment Act 1979. The objective of this zoning is to facilitate development to maximise use of the port facility, particularly special land uses that are not allowed for in other zones as well as ensuring separation from residential areas and other sensitive land uses.

The Orica facility is surrounded (**Figure 1**):

- **To the west:** by East Coast Cement facility, immediately to the west of the remediation area, then by Heron Road where port related facilities are used for bulk goods handling at two Port of Newcastle (PoN) berths (Kooragang Berths No.2 and No.3) located adjacent to the South Arm of the Hunter River.
- **To the north:** by vacant land owned by Independent Cement and Lime, and Air Liquide who leases a fenced property on IPL owned land immediately to the north of the Ammonia Plant for purification, storage and despatch of carbon dioxide. Further north is a combination of operating facilities and vacant land owned by Incitec Pivot Limited (IPL) which operates a fertiliser storage and distribution facility.
- **To the east:** by Greenleaf Road, and on the opposite side of Greenleaf Road the Park Fuels facility which includes a number of large fuel tanks and associated bunding or grass vacant land owned by the PoN and then the North Arm of the Hunter River.
- **To the south:** by warehousing operated by logistics company Linx for the storage and distribution of bulk goods, followed by Heron Road and the Walsh Point Reserve. The Walsh Point Reserve represents both the southern extent of Kooragang Island and the point at which the North and South Arms of the Hunter River converge.

3.3 Geological Profile

A detailed summary of the inferred site hydrostratigraphy is reported in Module D of Golder (2016b). The site is underlain by appreciable thicknesses of sedimentary materials overlying bedrock at approximately 35 to 40 m below ground surface. Detailed investigations have allowed the unconsolidated materials to be divided into hydrostratigraphic ‘units’ which exhibit common hydrogeological characteristics.

- Unit 1: Fill and Reclaimed sands;
 - Unit 2: Estuarine silt and clay;
 - Unit 3: Alluvial sand;
 - Unit 4: Coarse fluvial sand;
 - Deeper sands and clays; and
 - Permian Bedrock.
-

3.4 Contaminant History

A summary of arsenic contamination associated with the former sludge disposal pit is presented in the CSM (Golder, 2013). Provided below is a summary of arsenic contamination in the area to which the MO applies. In general, this contamination is located in an approximately 4,000 m² area in the north-western portion of the Orica site, bounded to the north by the Incitec Pivot Limited site and to the west by the East Coast Cement Pty Ltd site (**Figure 1**).

3.4.1 *Former Sludge Disposal Pit*

The former sludge disposal pit (**Figure 1**) was used for the disposal of solids and liquid arsenic wastes from the Vetrocoke process used at the Ammonia Plant from late 1960s to 1994.

Although the primary source of contamination has been removed (ceased disposal), residual arsenic sorbed to soils beneath the former pit and in the surrounding subsurface represent an ongoing source of arsenic to groundwater.

3.4.2 *Soil Contamination*

Beneath the remediated extent of the former pit on site, residual arsenic soil concentrations average 170 mg/kg, 540 mg/kg and 130 mg/kg in geological units beneath the former pit (Units 1, 2 and 3), respectively. Maximum arsenic concentrations reported are of the order of 1,900 mg/kg.

The estimated mass of arsenic in soil on site is 8,200 kg (Appendix A of Orica, 2013).

Further investigations were completed as part of the remediation design in part to define the lateral and vertical extents of arsenic contamination (Golder, 2016b). The extent of identified arsenic contamination based on soil and groundwater data collected from the remediation investigation and previous investigation was defined as an area of approximately 55 m (north-south) by 75 m (east-west). The vertical extent of arsenic contamination is approximately 8 m below ground level (bgl).

3.4.3 *Groundwater Contamination*

Dissolved arsenic in groundwater is present below and down-gradient (west-northwest) of the former sludge disposal pit. Concentrations of arsenic in groundwater on site have ranged between 15 mg/L and 85 mg/L, with concentrations decreasing since the remediation of the former disposal pit in 2005.

The highest dissolved arsenic concentrations occur between 3 and 7 m bgl. At depths greater than approximately 8 m bgl, dissolved arsenic concentrations are much lower (<1 mg/L).

The predominant arsenic species in groundwater is As (III) (arsenite) with a minor portion as As(V) (arsenate), which is consistent with the original arsenic source (arsenic trioxide) and the groundwater geochemistry (mildly reducing). Both As(III) and As(V) are inferred to be present predominantly as oxyanions (including their hydrogen substituted forms) in groundwater (Golder, 2013).

A fate and transport review indicated that arsenic, either released from arsenic trioxide solution during operation of the sludge disposal pit or as a result of the subsequent leaching of arsenic from the contaminated soils below the pit, has entered into the vadose zone below the former pit and then the saturated zone (groundwater). Dissolved arsenic then migrated with the groundwater flow. Arsenic has adsorbed to aquifer materials along the flow path until the attenuation capacity of the aquifer is exceeded such that the arsenic plume has migrated more slowly than the groundwater flow. Investigations have confirmed that the predominant process attenuating arsenic in the aquifer is adsorption onto naturally-occurring iron minerals (particularly hydrous ferric (oxy) hydroxides (HFO)) (Golder, 2013).

4 Data quality objectives

The Data Quality Objectives (DQO) for the post-remediation GMP have been developed in accordance with the seven-step process described in the National Environmental Protection Measure, Schedule B2, Appendix B.

The Data Quality Indicators (DQIs) that are used to assess the reliability of field procedures and analytical results are described in Appendix A.

4.1 State the Problem

Remediation of the identified arsenic contamination was completed by the construction of a containment cell to prevent the further off-site (Orica) migration of arsenic in groundwater. Hydraulic monitoring is required to confirm the containment cell is performing as per the design. Chemical (arsenic) monitoring is required as a secondary line of evidence to confirm further off-site migration is not occurring.

The monitoring program will be more intensive in the initial years to confirm the containment cell is performing as per the design. Once this has been confirmed monitoring requirements will be reduced to provide sufficient data to confirm ongoing performance of the containment cell.

4.2 Identify the decision / goal of the study

To assess the efficacy of the hydraulic segregation of the arsenic source, a 'weight of evidence' approach considering the consistency of the observed hydraulic effects with the effects predicted by the groundwater modelling completed during the design.

Identified potential hydraulic effects included:

- The detection of responses to rainfall events that may be recorded in the external wells, but which would be expected to be less prevalent in the data collected from inside the wall.
- A flattening of the groundwater table(s) inside the cell relative to external conditions.
- An increase in the external hydraulic gradient across the cell (in the direction of groundwater flow), and/or potential increase in gradients around the perimeter of the cell.

Groundwater monitoring to assess arsenic concentrations in groundwater will be undertaken as a 'secondary line of evidence' to provide long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable.

4.3 Identify the information inputs

Hydraulic monitoring includes the long-term assessment of groundwater levels in the three hydrostratigraphic units both inside and outside of the containment cell, to allow consideration of the effectiveness of the containment cell.

Chemical monitoring to include the assessment of dissolved arsenic concentrations down-gradient of the containment cell to provide data for the long-term trends and confidence that the containment cell has prevented the further off-site migration by confirmation of a stable or decreasing trend.

4.4 Define the boundaries of the study

Monitoring is to be undertaken both within and immediately outside the containment cell within the three sets of paired monitoring wells located around the containment cell. These wells target the three hydrostratigraphic units in which the

cut-off wall has been constructed to contain the identified arsenic contamination. Further to the wells located adjacent to the containment cell, groundwater monitoring wells located within the vicinity of the containment cell, predominantly down-gradient, will also be used in the ongoing performance assessment. The monitoring network is defined in Section 1.3 and in Table A.

The duration of the monitoring program will continue to confirm the long-term performance of the containment cell.

4.5 Develop the analytical approach

Hydraulic monitoring to assess groundwater levels is to use both manual gauging and down-hole water level loggers that log hydraulic data continuously. A barometric logger was also be used to compensate for the influence of localised atmospheric pressure variation within the containment cell. Data loggers were programmed to collect water level data at 2 hourly intervals.

Chemical monitoring includes the collection of representative groundwater samples and analysis for dissolved arsenic at a commercial laboratory. QA/QC sampling and requirements are presented in Section 6.1. Validation of the data will be undertaken as described in Section 6.2.

4.6 Specify performance or acceptance criteria

There are no specific performance or acceptance criteria for assessing the performance of the containment cell. As indicated in Section 4.1 a 'weight-of-evidence' approach will be applied to assessing the hydraulic data to verify that the design outcome of hydraulic segregation has been achieved. The key indicators of the hydraulic segregation are presented in Section 4.2.

4.7 Develop the plan for obtaining the data

The GMP (as defined in Section 8 of the LTEMP) and the SAQP (Appendix A) defined the plan for obtaining the necessary hydraulic and chemical data required to assess the ongoing performance of the containment cell. The GMP and SAQP will be reviewed and updated throughout the implementation of the LTEMP, as required and as a minimum 2 yearly in accordance with the requirements of the consent/MO.

5 Hydraulic Monitoring results

5.1 Quality Assurance / Quality Control (QA/QC)

5.1.1 Groundwater Data Logger Performance

Groundwater level data loggers continually recorded groundwater pressures (i.e. levels) and temperature at two-hourly intervals throughout the monitoring period described in this report and are considered to have provided sufficient data for the assessment of groundwater levels in each of the monitored hydrostratigraphic units surrounding the containment cell. The following issues though were noted.

- MWCC03-9OUT recorded continual decreasing water pressures from April 2023.
- MWCC03-6IN recorded continual decreasing water pressures from February 2023.
- MWCC02-6IN recorded continual decreasing water pressures from November 2022.
- MWCC02-9IN was unable to be downloaded due to a faulty sensor, it was removed and replaced.
- In each instance there is little to no recognisable influence of rainfall recharge in the recorded water pressure levels or their trends.
- Manual measurements of groundwater levels during the February and July 2023 groundwater monitoring events confirmed the pressures recorded by these loggers were erroneous, these loggers will require removal from their respective wells for maintenance.

Previously faulty data loggers at locations MWCC03-3OUT, MWCC02-9OUT and MWCC01-3IN were replaced with new data loggers during the July 2023 monitoring round.

5.1.2 Data Gaps

During the post remediation GME, July 2023, the following data gaps were noted:

- Erroneous measurements of water pressure (and therefore estimates of groundwater levels) in MWCC03-9OUT, MWCC03-6IN, , and MWCC02-6IN.
- Unable to download data from MWCC02-9IN.
- No data has been collected from locations MWCC03-3OUT, MWCC02-9OUT and MWCC01-3IN as the loggers were removed in February 2023 and were replaced in the July 2023 monitoring round.
- Manual water levels were not able to be measured in five offsite and one onsite monitoring wells as follows:
 - BP7-9A on IPL was damaged/blocked
 - POMW63-6 and POMW63-9 on Port of Newcastle land could not be accessed due to construction activities (a temporary shed blocking access)
 - MW48A located up gradient of the containment cells was cover by metal sheeting and equipment at the time of sampling.

The omission of manual groundwater levels or data logger outputs at these locations are not considered to influence the long-term interpretation of the performance of the containment cell as the combined knowledge of groundwater flow direction and gradient complemented with the available data provide sufficient understanding of the groundwater responses within the vicinity of the containment cell.

5.2 Hydrographs

Hydrographs for those nested well sets located on the eastern (MWCC01), western (MWCC02) and southern (MWCC03) side of the containment cell are presented in Appendix C. Hydrographs are presented for the period 17 June 2019 to 27 July 2023.

Rainfall data shown on the hydrographs was obtained from the Bureau of Meteorology (BoM) weather station at Nobby's Head (Station No. 061055) located 3 km South-east of the site; this is the nearest BoM weather station to the site. For periods where rainfall data was not available from Nobby's Head, rainfall data from the BoM weather station at the Newcastle Airport at Williamstown (Station No. 061078), located 10 km north of the site, was used to fill such data gaps, noting that these are isolated or limited number of days when this was required.

When reviewing the hydrographs it should be noted the application of the geomembrane of the containment cell cap was completed by 27 July 2019. As such it is likely groundwater level measurements from those wells within the containment cell following this date may reflect lower infiltration rates of rainfall recharge into the containment cell.

For the period 7 July 2022 to 26 July 2023, key observations from the hydrographs are summarised below.

- Groundwater levels in Unit 1 and some Unit 2 outside the containment cell respond to rain events, whilst little or no response is observed in the corresponding wells inside the containment cell.
- Groundwater level responses to two heavy rainfall events either in aggregate and/or duration during the monitoring period (namely between 24 March to 5 April 2023 comprising 130 mm and 27 May 2023 comprising 50 mm) were observed in Unit 1 wells located on the outside of the containment cell. During these events a coincidental albeit muted change in groundwater levels was also observed in those wells installed in Unit 1 within the containment cell. Groundwater level changes in response to these rainfall events inside the containment cell were less than 0.2 m, whilst groundwater level changes in those wells outside of the containment cell ranged between 0.5 and 0.7 m.
- For these rainfall events, groundwater level changes within the cell started to
 - Increase at the same time as those on the outside of the cell, and
 - Decline either at the same time or after groundwater levels in those wells on the outside of the cell.
- Given however groundwater pressures within the cell though did not shown coincidental increases to rainfall events of lesser magnitude or duration, it is considered those increased groundwater levels observed within the cell during these 'large' rainfall events are in response to localized pressure changes and loadings in the respective hydrostratigraphic units as a result of increased groundwater levels outside of the cell (both locally and regionally), and not indicative of the infiltration of rainfall recharge through the cell capping.
- Tidal effects on groundwater levels are evident in MWCC01-6IN, MWCC01-9IN, MWCC01-9OUT, MWCC02-6OUT, MWCC02-9OUT, MWCC03-6OUT, MWCC03-9IN. It should be noted that prior to malfunction, tidal effects were also visible in MWCC02-6IN, MWCC02-9IN, MWCC03-6IN and MWCC03-9OUT.
- Groundwater levels in the paired well sets for Unit 1 (and Unit 2 at MWCC01) both inside and outside the cell appear to respond independently and differently to rainfall following the completion of the cap liner. This suggests groundwater within the cell is hydraulically separated from that groundwater outside of the cell by the cut-off wall (i.e. different head present within the same hydrostratigraphic units inside and outside of the cell).
- Groundwater levels in Unit 1 within the cell continue to decrease slowly following the completion of the cap liner. This is consistent with previous observations.
- Groundwater levels in Unit 1 wells are between about 0.6 m and 1 m higher than groundwater levels in Unit 2 and Unit 3, which:
 - Is generally consistent with groundwater level observations prior to remediation, and
 - Indicates Unit 2 (which comprises estuarine silts and clays) is continuing to act as an aquitard.

5.3 Groundwater Level Contours and Hydraulic Gradients

Groundwater contours based on the manual dip measurements of the standing water level (SWL) across the monitoring network are summarised in **Table B1** and **B2** and presented in **Figures 3a, 3b** and **3c** for Unit 1, Unit 2 and Unit 3 hydrostratigraphic units, respectively. The groundwater contours and SWLs presented on **Figures 3a, 3b** and **3c** are from measurements of SWL completed on 26 July 2023, SWLs are presented in **Table B1** and field sheets are presented in Appendix B.

In summary groundwater elevations indicate the following.

Unit 1 – Comprising MWCC01 to MWCC03 -3IN and -3OUT.

- Groundwater levels within the containment cell are lower than those observed on the outside of the cell.
- Within the containment cell, a relatively flat water table profile has developed at about 0.95 m AHD.
- Six monthly monitoring event completed in January 2023 also indicated a ‘flat’ hydraulic gradient within the cell.
- Groundwater levels in those wells installed outside the containment cell show the hydraulic gradient in this unit is to the west. This flow direction is consistent with that regional groundwater flow direction observed in this unit prior to construction of the containment cell, in this case towards the South Arm of the Hunter River.
- Mounding of groundwater is apparent up-gradient of the containment cell to the east and south as evidenced by groundwater levels in MWCC01-3OUT and MWCC03-3OUT. The mounding is less apparent compared to the July 2022 monitoring event, this could be attribute to the above average rainfall event at the time of the 2022 monitoring.

Unit 2 – Comprising MWCC01 to MWCC03 -6IN and -6OUT.

- Within the containment cell, a relatively flat hydraulic gradient has developed in this units at an elevation of about 0.47 m AHD. Groundwater levels within the containment cell appear to be approximately 0.6 m lower than the groundwater level up-gradient of the cell as evidenced in MWCC01-6OUT.
- Groundwater levels in those wells across and down-gradient of the cell (MWCC02-6OUT and MWCC03-6OUT) were about 0.1 m lower than those inside the cell.
- Outside of the containment cell groundwater in this unit flows to the west (again towards the South Arm of the Hunter River), which is consistent with the groundwater flow direction in this area prior to construction of the cell.
- Groundwater mounding appears to be occurring up-gradient and to the east of the containment cell as suggested by groundwater level measurements in MWCC01-6OUT. As discussed above, slight tidal effects are beginning to be observed in Unit 2 and could potentially influence measured water levels in this unit.

Unit 3 – Comprising MWCC01 to MWCC03 -9IN to -9OUT.

- Within the containment cell, a relatively flat gradient has developed at 0.4 m AHD.
- Groundwater levels within the containment cell are broadly consistent with those outside of the cell, with the exception of MWCC03 which is ~0.2 m lower.
- Outside the containment cell the hydraulic gradient is reasonably flat at approximately 0.3 m AHD, albeit with a slight decline to the west.

5.4 Assessment of the Containment System – Hydraulic

As described in the RVR (Golder, 2019b), hydraulic containment within the containment cell is mainly based on groundwater level measurements in Units 1, 2 and 3 both inside and outside of the cell. Table 5.1 provides a framework to outline the hydraulic verification outcome matrix and allows effect to be tracked during the remainder of the hydraulic

verification process. The assessment of hydraulic responses has considered data available since the completion of remediation in September 2019.

Table 5.1: Verification Outcomes Matrix

Identified Potential Effect	Emerging Patterns? (Y/N)	Evidence / Comments
Groundwater level changes in response to rainfall events that may be observed in the external wells, but which would be expected to be less prevalent in magnitude and frequency within the cell.	Yes	Evidence of the effect of rainfall is presented in the hydrographs. Large rain events have occurred post construction of the containment cell. A clear increase in groundwater levels in response to rainfall can be seen in the Unit 1 wells located outside the containment cell compared to those wells located within the containment cell. Increasing groundwater levels in response to rainfall can also be seen in some of those wells screened in Unit 2 outside of the containment cell. Given however this unit is an aquitard, the lack of any notable response in these wells is not considered to reflect either the design or performance of the containment cell. Groundwater level changes in response to heavy rainfall events can clearly be observed in Unit 1 wells located on the outside of the containment cell; for these events a ‘muted’ increase of groundwater levels was also observed in the corresponding wells inside the containment cell. These responses within the cell during these rainfall events though are considered to reflect localized pressure changes and loadings in the respective hydrostratigraphic units as a result of increased groundwater levels outside the cell (both locally and regionally), rather than being indicative of the infiltration of rainfall through the cell capping.
A flattening of the groundwater table(s) inside the cell relative to external conditions.	Yes	A flattening of the water table is evident in the Unit 1 and Unit 2 within the containment cell, whereas hydraulic gradients – with groundwater flowing to the west / north-west and ultimately discharging to discharging to the Southern Arm of the Hunter River – is still evident in all units outside of the containment cell; this is also evident during those above average high-intensity and/or long-duration rainfall events in the Newcastle area as shown in Figures 3a and 3b. In Unit 3, flattening of the groundwater table inside the containment cell appears to be occurring (Figure 3c), however, is not as pronounced as that inferred in Units 1 and 2. This is likely a combination of the fact that the Unit 3 wells (screened 8 to 10 m bgl) are closer to the base of the wall (12 m bgl) and possible tidal influence which can be observed in the hydrographs for Unit 3 wells. The more recent data, as observed in the hydrographs also shows possible tidal influence in the Unit 2 wells.
A higher external hydraulic gradient across the cell (in the direction of groundwater flow) and/or potential increase in gradients around the perimeter of the cell.	Yes	An external hydraulic gradient with flow to the west is evident – and continues to be evident – in each hydrostratigraphic unit, including during and after those above average high-intensity and/or long-duration rainfall events between March and May 2023. This is also consistent with the groundwater flow direction established prior to the construction of the containment cell.

Identified Potential Effect	Emerging Patterns? (Y/N)	Evidence / Comments
		Furthermore, in Units 1 and 2 there appears to be some mounding occurring on the eastern- up-gradient side of the containment cell (MWCC01-3OUT and -6OUT). The high SWL at containment cell wells is indicative of this mounding on the eastern- up-gradient side of the containment cell.
Water levels in Units 1 and 2 will be lower inside the cell by an order of 1 to 2 m, while water in Unit 3 will be slightly higher on the inside.	Yes	There appears to be a lowering of groundwater levels within the containment cell (relative to groundwater levels outside of the cell) in Units 1 and 2. However, it should be noted that groundwater levels outside the cell, particularly in Unit 1 will be significantly influenced by rain events. As such, those rain events discussed in Section 5.2 need to be considered when assessing the difference in water levels inside and outside of the cell. There continues to be a gradual lowering of the water levels over the monitoring period (July 2022 – July 2023) within the containment cell in Unit 1 between rain events. Water levels have continued to gradually dropped from approximately 1.7 m AHD to 0.9 m AHD, this is shown in Unit 1 of the Hydrographs (Appendix C) since the construction of the cell. For Unit 2, groundwater levels on the up-gradient side of the cell appear to be 0.6 m lower inside the cell, whereas, at the down-gradient side groundwater levels are 0.1 m higher within the cell. This is likely to be as a result of mounding occurring on the up-gradient side of the cell, particularly during and immediately following ‘large’ rain events. For Unit 3, groundwater levels on the up-gradient side of the cell appear to be slightly (0.06 m) lower inside the cell, whereas, at the down-gradient side groundwater levels slightly (0.1 m) higher within the cell.

6 Arsenic monitoring

6.1 Quality Assurance / Quality Control (QA/QC)

During the GME (25 to 27 July 2023), the QA/QC procedures detailed in Appendix A were implemented.

The specific details of the QA/QC program for the July 2023 monitoring are presented below:

- Equipment used to perform testing or data recording (i.e. the water quality meter, electronic water level probe) was calibrated to manufacturer's specifications by the supplier prior to use. Calibration recorded for July 2023 are presented in Appendix B. Groundwater purging records are also included in Appendix B.

Collection of field QC samples during the groundwater sampling events. A list of the QC samples collected is presented in Table 6.1.

Table 6.1: Field QC Samples

Primary Sample	Duplicate Sample	Triplicate Sample	Field Blank
<i>July 2023</i>			
MWCC01-6IN	D01_20230726	T01_20230726	
MW50	D01_20230727	T01_20230727	
BP7-6	D02_20230727		
			FB01

- In addition to the field QC samples, the laboratory prepared and analysed the following QC samples with each laboratory batch:
- Laboratory duplicates.
- Laboratory blanks.
- Matrix spikes.
- Laboratory control samples.

6.2 Data Gaps

During the post remediation GME, July 2023, offsite monitoring well (BP7-9A) on IPL land was not able to be sampled due to the well being damaged/blocked. Four monitoring location (POMW60-3, POMW60-6, POMW63-9 and POMW60-12) on Port of Newcastle land were unable to be sampled due to construction activities onsite with a temporary shed blocking access. Onsite location, upgradient of the containment cell (MW48A) was not able to be sampled due to the monitoring well being covered with construction material. As the purpose of the monitoring of arsenic concentrations is to assess long-term trends in arsenic concentrations this is not considered to be a significant data gap.

6.3 Data Validation

Validation of the reported analytical data was undertaken to ensure that data of known quality are reported and to assess whether the data can be relied upon to fulfil the overall monitoring objectives.

The data validation guidelines adopted were based upon the following data validation guidance documents published by the United States Environmental Protection Agency (USEPA) and the National Environment Protection Council (NEPC):

- USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (EPA 540-R-10-011, dated January 2010).
- National Environmental Protection (Assessment of Site Contamination) Measure 1999 (April 2013).

Based on the data validation summary report presented in Appendix D, it is considered that the analytical data is suitable for environmental interpretive use.

Laboratory analytical reports are also included in Appendix D.

6.4 Groundwater Field Parameters

Groundwater field parameters collected during the July 2023 monitoring event is presented in the attached **Table B2**, the data indicated that:

- pH values at the monitoring locations ranged from approximately 5.9 to 8.3, indicating slightly acidic to alkaline groundwater conditions over the monitoring round. Wells inside the cut-off wall reported slightly higher pH levels, between 6.75 and 8.3 with an average of 7.5 (based on the hydrogen ion concentration), than that reported in the surrounding groundwater network. The pH could have been influenced by the materials used in the construction of the cut-off wall. The design specification allowed the bentonite slurry to have a pH of 7 to 11, daily records completed throughout the construction phase measured a pH of 9 on almost all occasions (LTEMP 2019, REV0);
- Groundwater was generally reducing with low redox potential (Eh, ranging from 40 to 310 milli-Volts (mV)) and low dissolved oxygen (DO) values (less than 1 milligram per litre (mg/L)) recorded at the majority of the well locations; and
- The electrical conductivity (EC) on site to Heron Road was fresh to moderately brackish (ranging from 930 to 2,170 microSiemens per centimetre (µS/cm)) and became saline with depth and proximity to the South Arm of the Hunter River (up to 10,710 µS/cm in well GWW03D). The vertical and horizontal differences in EC close to the river are influenced predominantly by saline intrusion from the Hunter River (URS, 2014).

The groundwater chemistry from the July 2023 monitoring event is consistent with the previous monitoring rounds and that presented in the CSM (Golder, 2013) with the exception of the higher pH levels recorded in the wells adjacent to the cut-off wall, however, the pH levels have decreased during monitoring events post construction.

6.5 Arsenic Groundwater Analytical Data

The analytical results are screened against Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) trigger values for the protection of 95% species in marine water in slightly to moderately disturbed ecosystems. The Australian and New Zealand Guidelines only includes low-reliability trigger values (known as indicative interim work levels – IIWLs) for As (III) and As (V) in marine waters (0.0023 mg/L and 0.0045 mg/L, respectively) and do not provide a specific guideline value for arsenic (dissolved) in marine waters. Given that previous geochemical assessment undertaken at the site has indicated that arsenic in groundwater is present predominantly in the As (III) state (a more toxic state than As (V)) and the trigger value for As (III) is lower than that for As (V), the low-reliability working level trigger value for As (III) in marine waters has been adopted for screening purpose as a conservative measure.

The arsenic groundwater analytical results from July 2023, including comparison with the As (III) trigger level (ANZG 2018), are presented in **Table B2**.

Review of the fourth round of monitoring post remediation indicated the following:

- Monitoring wells located on the inside of the Eastern Wall (MWCC01) up-hydraulic gradient of the former disposal pit and monitoring wells located on the inside of the Southern Wall (MWCC03) across-hydraulic gradient were low with a maximum concentration of dissolved arsenic less than 0.5 mg/L. These results are consistent with arsenic concentrations that would be expected in areas up-gradient of the former disposal pit source areas.
- Monitoring locations on the inside of the Western Wall (MWCC02) down-hydraulic gradient of the former disposal pit reported dissolved arsenic concentrations consistent with concentrations detected down-gradient of the former source area, with a maximum concentration of 90 mg/L. This is consistent with previous monitoring events since the completion of the remediation.

6.5.1 *Historical Arsenic Concentrations*

The following sections presents discussion on trends observed in arsenic concentrations. Arsenic groundwater analytical results are presented in **Table B2** and historical analytical results are present in **Table C**.

6.5.2 *Temporal Trends in Arsenic Concentrations*

It is noted that the purpose of the monitoring is to understand the long-term trends of arsenic concentrations post remediation. As such given that this is the fourth monitoring round post remediation and specifically only limited monitoring data post remediation for the wells located adjacent to the containment cell (i.e., IPL, PoN), discussion of temporal trends should be considered as preliminary.

The temporal trends have been presented in Table 6.2 (Trend analysis calculation sheets are presented in Appendix E) to provide a 'baseline' to assess the development of long-term arsenic trends as part of the monitoring program. The following should be noted when considering the trend in arsenic concentration at the monitoring wells located down-gradient of the containment cell:

- the trends in arsenic concentrations will be influenced by disposal practices and remediation works. Disposal practices may have resulted in pulses of arsenic moving within the aquifer whereas previously completed remediation may result in declining concentrations. Previous remediation includes:
- cessation of disposal of arsenic (primary source) to the former pit in 1994;
- removal of secondary source of contamination, with the remediation of contaminated soil beneath the former pit to the depth of the groundwater table in 2005; and
- geochemical fixation remediation trial in 2010/2011 which involved the introduction of iron compounds to assist with attenuation of arsenic.
- the installation of the cut-off wall is likely to have disturbed the aquifer and associated groundwater quality in the vicinity of the wall resulting in short-term mobilisation of arsenic.
- the distance of the well from the containment cell given the groundwater velocity (range between <1 m/year up to 100 m/year), it may take several years to decades before the effects of the containment cell are seen at wells located near Heron Road.
- the chemical monitoring program is to provide a 'secondary line of evidence' of the long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable.

Table 6.2: Trend Analysis

Well ID	Trend in Arsenic Concentration	Distance from Containment Cell	Comment
MWCC01-3IN	Stable	0 m	Wells are located within the containment cell. Using the four previous monitoring rounds 2020-2023, preliminary trend analysis for dissolved arsenic concentrations was completed for locations within the containment cell.
MWCC01-6IN	Stable	0 m	
MWCC01-9IN	Stable	0 m	
MWCC02-3IN	No Trend	0 m	
MWCC02-6IN	No Trend	0 m	
MWCC02-9IN	No Trend	0 m	
MWCC03-3IN	No Trend	0 m	
MWCC06-3IN	No Trend	0 m	
MWCC03-9IN	No Trend	0 m	
MW54	Decreasing	<10 m	Located adjacent to cell, likely to be influenced initially by construction of containment cell as well as previous remediation works.
BP7-3	No Trend	50 m	Subject to season variability due to groundwater level response to rain events.
BP7-6	Decreasing	50 m	Located within 50 m of cell, may be influenced initially by construction of containment cell and likely to be influenced by previous remediation works.
BP7-9	Decreasing	50 m	Well blocked and no monitoring completed since construction of the containment cell. Trend is based on monitoring prior to construction of the containment cell.

Well ID	Trend in Arsenic Concentration	Distance from Containment Cell	Comment
BP5-3	No Trend	120 m	Historical fluctuations at these wells, likely to be influenced by previous disposal practices as well as previous remediation. Unlikely to be influenced by containment cell construction at present
BP5-6	Increasing	120 m	
BP5-9	Increasing	120 m	
MW21A	Decreasing	140 m	Located within 130/140 m of cell and unlikely to be influenced by the containment cell construction at present. Long-term decreasing trend likely to be reflective of previous remediation works.
MW50	Decreasing	130 m	
GW02S	No Trend	120 m	Less long-term monitoring data at these locations (2014). Located within 120 m of cell and unlikely to be influenced by the containment cell construction at present. Likely to be influenced by previous disposal practices as well as previous remediation.
GW02I	Stable	120 m	
GW02D	Increasing	120 m	
GW03S	No Trend	120 m	
GW03I	Increasing	120 m	
GW03D	Prob. Increasing	120 m	Located within 200-250 m of cell and unlikely to be influenced by the containment cell construction at present. Likely to be influenced by previous disposal practices as well as previous remediation. Arsenic concentrations are lower at these locations west of Heron Road.
POMW7	Decreasing	200 m	
POMW60-3	No Trend	200 m	
POMW60-6	Decreasing	200 m	
POMW60-9	No Trend	200 m	
POMW60-12	No Trend	200 m	
POMW62-6	Decreasing	250 m	

Well ID	Trend in Arsenic Concentration	Distance from Containment Cell	Comment
POMW63-3	Prob. Decreasing	220 m	
POMW63-6	No Trend	220 m	
POMW63-9	No Trend	220 m	
POMW63-12	Prob. Increasing	220 m	

6.5.3 Spatial Trends

The spatial distribution of arsenic in the July 2023 monitoring data is presented on Figures 4A to 4C for Units 1 to Unit 3 respectively. Consideration of the spatial distribution as well as the historical data indicated:

- Dissolved arsenic concentrations reported in Unit 2 (i.e. intermediate monitoring wells) were higher than Units 1 and 3 (i.e. shallow and deep wells), which is consistent with a shallow source within Unit 1 and downward hydraulic and diffusion gradients affecting arsenic migration towards the river;
- Dissolved arsenic concentration reported in the southern and eastern walls (MWCC01 and MWCC03) up-gradient and across-gradient of the former disposal pit were lower than that the locations on the western wall (MWCC02) down-gradient, which is consistent with the location of the source area (disposal pit) and groundwater flow conditions;
- The wells located east of Heron Road, downgradient from the former disposal pit towards the South Arm of the Hunter River reported the highest concentrations of dissolved arsenic. This is consistent with previous investigations and monitoring. The arsenic concentrations decrease when moving towards the Hunter River from Heron Road.
- Arsenic concentrations from the July 2023 monitoring indicated that the extent of the arsenic plume has remained stable.
- These conclusions are consistent with the previous monitoring completed as part of the former GMP.

6.6 Assessment of the Containment System – Arsenic Distribution

Groundwater monitoring, in accordance with the LTEMP, is undertaken to assess dissolved arsenic concentrations in groundwater as a 'secondary line of evidence' to provide long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable. Table 6.3 provides a framework to assess the distribution and trends in dissolved arsenic concentration.

Table 6.3: Arsenic Distribution Assessment

Identified Potential Effect	Emerging Patterns? (Y/N)	Evidence / Comments
Changes in arsenic concentration within the containment cell	Yes – Stable trend in arsenic concentration	The Mann-Kendall analysis was used to assess dissolved arsenic trends within the containment cell using the results from the four previous monitoring rounds (2020-2023). A stable or no trend was observed for wells targeting the three hydrostatic units, which is consistent with expectations for arsenic concentrations within the cell.
Spatial distribution of arsenic concentration outside of the containment cell	Yes – spatial distribution consistent	The spatial distribution of arsenic in areas down-gradient and within Units 1, 2 and 3, remain consistent with the distribution prior to the remediation, indicating that the construction of the containment cell has not resulted in significant changes in the migration of arsenic either laterally or between hydrogeological units.
Trends in arsenic concentration down-gradient of the containment cell	Yes – Downward trend apparent in monitoring locations within 50 m of the containment cell	This is the fourth monitoring round post remediation and as such statistical analysis of trends is considered preliminary, particularly for assessing the effect of the construction of the containment cell at locations at distances further away from the cell. Preliminary trends in dissolved arsenic concentrations have indicated a decreasing or stable trend at monitoring locations downgradient of the containment cell in the predicted post-construction zone of influence of the cell/remediation. Based on estimated groundwater flow rates (~10 m per annum, noting variability between hydrostatic Units) and the 4 years that have elapsed since completion of construction, the groundwater chemistry data suggests this zone of influence is in the order of 50 m (ie. where groundwater unaffected by the contained contamination has now displaced contaminated groundwater). Locations further down-gradient of the containment system (outside this zone of cell/remediation influence) exhibit more variable trends (increasing and decreasing) reflecting the flow of contaminated groundwater generated prior to construction of the cell through these locations.

7 Conceptual site model

The pre-remediation Conceptual Site Model (CSM) has been presented in previous reports including the Remediation Action Plan (Golder, 2016a) and holistically for the Orica site in the Conceptual Site Model report (Golder, 2013).

Provided below is a summary of the key elements of the CSM that relate to the arsenic contamination post-remediation.

Contaminants of Concern:	Arsenic
Sources:	Former Sludge Disposal Pit (on-site) - removed
Mechanism of contamination:	Prior to remediation, disposal to ground with sorption to soil and subsequent leaching into the vadose and saturated zones
Affected environmental media:	Soil and groundwater
Remediation:	Removal of contaminated soils in the vadose zone – 2005 Construction of containment cell to 12 m below ground level and capping – 2019
Exposure Pathways:	Within the Cap and Containment area – nil Remediation (Containment Cell) has: — prevented further off-site migration of contaminated groundwater — management of the cap prevents direct contact exposure and rain infiltration Off the Orica site – management controls as defined within the Off-site EMP Exposure pathways associated with the existing off-site groundwater contamination include: — Direct contact — Inhalation of dust — Ingestion of soil and groundwater — Inhalation of aerosols from groundwater spray
Human and Ecological Receptors:	Within the Cap and Containment area – nil Off the Orica site (existing off-site groundwater contamination) — Workers undertaking intrusive works — Workers exposed to extracted groundwater
Data Gaps:	Five wells were not able to be sampled during the July 2023 monitoring event (Section 6.2), and a number of data-logger malfunctions were noted. Existing data for these locations exist and arsenic concentrations are not anticipated to have changed significantly. The data gap is not considered significant as assessment of down-gradient arsenic trends is a long-term program.
Management and Monitoring:	Ongoing management and monitoring of the containment cell to be undertaken in accordance with the LTEMP – Revision 2.

8 Conclusion

The following key conclusions can be drawn from the results of the hydraulic and arsenic groundwater monitoring program.

8.1 Hydraulic Monitoring

Based on the available data, evidence of hydraulic head and redistribution as a result of construction of the containment cell is emerging. The following effects have been identified.

- Difference in response to rain events inside and outside of the containment cell.
 - Whilst there was increase in groundwater levels within the cell due to large rain events, this is considered to be in response to localized pressure changes and loadings due to the increased groundwater levels outside the cell (both locally and regionally), and not infiltration of rainfall through the cell capping.
 - A flattening of the hydraulic gradient (i.e., groundwater table) inside the containment cell in comparison with historical gradients and external conditions.
 - Possible mounding of groundwater levels on the up-hydraulic gradient side of the containment cell, it is noted that significant mounding was noted in July 2022 when significantly above average rainfall was experienced at the site.
 - Differences in groundwater level measured in the wells set on either side of the wall with lowering of groundwater levels in Unit 1 and possible Unit 2, and an apparent increase in groundwater levels in Unit 3 compared to outside the cell. However, fluctuations of water levels outside the cell in Unit 1 due to rain events are likely to influence these relative levels.
-

8.2 Arsenic Monitoring

- The annual groundwater monitoring event completed in July 2023 met the requirements of the Arsenic GMP as defined in the LTEMP – Revision 2 (WSP, 2023). However, monitoring location MW48A located upgradient of the containment cell was unable to be accessed because the location was covered by equipment and metal sheeting, BP7-9A located on adjacent Incitec Pivot site (now leased by Independent Cement) was unable to be assessed due to damage to the monitoring well, and monitoring locations POMW60-3, POMW60-6, POMW60-9 and POMW60-12 located on adjacent Port of Newcastle land were not able to be sampled due to ongoing construction activities restricting access due to a construction shed at the time of monitoring. As the purpose of the monitoring of arsenic concentrations is to assess long-term trends in arsenic concentrations this is not considered to be a significant data gap.
- Preliminary trends in dissolved arsenic concentrations at monitoring locations within the containment cell exhibited a stable trend or no trend.
- Preliminary trends in dissolved arsenic concentrations have indicated a decreasing or stable trend at monitoring locations down-gradient of the containment cell in the predicted post-construction zone of influence of the cell/remediation. Based on an estimated groundwater flow rate (~10 m per annum) and the 4 years that have elapsed since completion of remediation, the groundwater chemistry data suggests this zone of influence is in the order of 50 m (i.e., where groundwater unaffected by the contained contamination has now displaced contaminated groundwater). Locations further down-gradient of the containment system (outside this zone of cell/remediation influence) exhibit more variable trends (increasing and decreasing) reflecting the flow of contaminated groundwater, generated prior to construction of the cell, through these locations.
- The review of the arsenic monitoring data indicates that there have been no significant changes in the spatial distribution of arsenic concentrations in groundwater; and

- The chemical monitoring program will continue to be undertaken as defined within the LTEMP (WSP, 2023) as a secondary line of evidence to confirm that further migration of arsenic in groundwater has been prevented to the extent practicable by the containment cell.
-

8.3 Recommendations for Revision of Monitoring Program

Monitoring is to continue in accordance with Section 8 of the LTEMP (WSP, 2023). Prior to the next monitoring round, maintenance or replacement data-loggers is to be undertaken. It is recommended that this monitoring program be implemented for a further 2 years (2024 and 2025), which will bring the post remediation monitoring program to 6 years, where, if trends in hydraulic and chemical performance support such a change a further reduction in the monitoring program can be implemented.

9 Limitations

Your attention is drawn to the document titled - “Limitations Statement”, which is included in Appendix F of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Limitations Statement document does not alter the obligations WSP has under the contract between it and its client.

10 References

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Tables





Table A: Long-Term Environmental management Plan - Groundwater Monitoring Program (Revision 1_2020), Arsenic MO
Orica Kooragang Island

Area of Site	Well ID	Hydraulic Monitoring			Chemical Monitoring		Rationale / Comments
		SWL	Data-logger	Barometric logger	G/W Parameter (field)	Dissolved Arsenic	Rationale / Comments
Containment Cell Wells	MWCC01-3IN	Q	Q		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-6IN	Q	Q		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-9IN	Q	Q		A	A	Eastern- Upgradient side of Containment Cell - Inside the cell
	MWCC01-3OUT	Q	Q			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC01-6OUT	Q	Q			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC01-9OUT	Q	Q			(Baseline)	Eastern- Upgradient side of Containment Cell - Outside the cell
	MWCC02-3IN	Q	Q		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-6IN	Q	Q		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-9IN	Q	Q		A	A	Western - Down-gradient side of Containment Cell - Inside the cell
	MWCC02-3OUT	Q	Q			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC02-6OUT	Q	Q			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC02-9OUT	Q	Q			(Baseline)	Western - Down-gradient side of Containment Cell - Outside the cell
	MWCC03-3IN	Q	Q		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
	MWCC03-6IN	Q	Q		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
	MWCC03-9IN	Q	Q		A	A	Southern - Cross Gradient side of Containment Cell - Inside the cell
	MWCC03-3OUT	Q	Q			(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
	MWCC03-6OUT	Q	Q			(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
	MWCC03-9OUT	Q	Q			(Baseline)	Southern - Cross Gradient side of Containment Cell - Outside the cell
	MWCC03-Baro			Q			Southern - Inside Cell - Unsaturated
On-site	MW48A-4	Q			A	A	upgradient of the former sludge pit.
	MW48A-6	Q					upgradient of the former sludge pit.
Off-site (Inictec Pivot)	MW21A	Q			A	A	Downgradient of the former sludge pit.
	MW50	Q			A	A	Downgradient of the former sludge pit.
	MW54	Q			A	A	Downgradient of the former sludge pit.
	BP5-3	Q			A	A	Downgradient of the former sludge pit.
	BP5-6	Q			A	A	Downgradient of the former sludge pit.
	BP5-9	Q			A	A	Downgradient of the former sludge pit.
	BP7-3	Q			A	A	Downgradient of the former sludge pit.
	BP7-6	Q			A	A	Downgradient of the former sludge pit.
	BP7-9A	Q			A	A	Downgradient of the former sludge pit.
	GWW01S	Q					Downgradient of the former sludge pit (well installed in June 2013).
	GWW01I	Q					Downgradient of the former sludge pit (well installed in June 2013).
	GWW01D	Q					Downgradient of the former sludge pit (well installed in June 2013).
	GWW02S	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GWW02I	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GWW02D	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
Off-site (East Coast Cement)	GWW03S	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GWW03I	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
	GWW03D	Q			A	A	Downgradient of the former sludge pit (well installed in June 2013).
Off-site (Newcastle Port Corporation)	POMW7	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW60-3	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW60-6	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW60-9	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW60-12	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW62-6	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW63-3	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW63-6	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW63-9	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.
	POMW63-12	A			A	A	Downgradient of the former sludge pit, adjacent to the environmental receptor.

Notes:
M: Monthly
B: Bi-annual
A: Annual
SWL: Standing Water Level (manual measurement with dipper)
S: Shallow
I: Intermediate
D: Deep
G/W Parameters: Field measurement of pH, EC, Redox potential, DO and temperature

Table B1. Monitoring Well Gauging Data
Annual Arsenic Groundwater Monitoring Event - July 2023
Orica Kooragang Island

Area	Well Location	Gauging Date	Type	Depth of Well	Top of Casing (TOC)	Screened Depth From	Screened Depth To	Standing Water Level	Standing Water Level
				m bTOC	m AHD	m bgl	m bgl	m bTOC	m AHD
Containment Cell Wells	MWCC01-3IN	26/7/2022	S	6.03	5.329	2.5	4.5	4.38	0.949
	MWCC01-6IN	26/7/2022	I	8.25	5.356	5.5	7	4.88	0.476
	MWCC01-9IN	26/7/2022	D	10.35	5.358	8	10	4.99	0.368
	MWCC01-3OUT	26/7/2022	S	5.33	4.469	2.5	4.5	2.65	1.819
	MWCC01-6OUT	26/7/2022	I	7.69	4.47	5.5	7	3.4	1.07
	MWCC01-9OUT	26/7/2022	D	10.75	4.468	8	10	4.04	0.428
	MWCC02-3IN	26/7/2022	S	5.71	4.906	2.5	4.5	3.95	0.956
	MWCC02-6IN	26/7/2022	I	8.74	4.864	5.5	7	4.4	0.464
	MWCC02-9IN	26/7/2022	D	3.93	4.859	8	10	4.405	0.454
	MWCC02-3OUT	26/7/2022	S	5.12	4.072	2.5	4.5	2.55	1.522
	MWCC02-6OUT	26/7/2022	I	8	4.07	5.5	7	3.71	0.36
	MWCC02-9OUT	26/7/2022	D	10.75	4.07	8	10	3.79	0.28
	MWCC03-3IN	26/7/2022	S	6.41	5.424	2.5	4.5	4.44	0.984
	MWCC03-6IN	26/7/2022	I	8.76	5.461	5.5	7	4.98	0.481
	MWCC03-9IN	26/7/2022	D	11.92	5.461	8	10	5.045	0.416
	MWCC03-3OUT	26/7/2022	S	5.34	4.447	2.5	4.5	2.76	1.687
	MWCC03-6OUT	26/7/2022	I	7.94	4.455	5.5	7	4.06	0.395
	MWCC03-9OUT	26/7/2022	D	10.65	4.508	8	10	4.15	0.358
	MWCC03-Baro	26/7/2022		-	5.222	0.3	1.5	-	-
On-site	MW48A-4	26/7/2022	S	3.93	3.13	1.5	4	NA	-
Off-site (Inictec Pivot)	MW21A	27/7/2023	I	6.00	3.49	2.5	5.5	2.41	1.08
	MW50	27/7/2023	I	6.18	3.64	4.5	6.0	3.47	0.168
	MW54	27/7/2023	I	6.32	3.95	5.0	6.0	2.66	1.292
	BP5-3	27/7/2023	S	3.51	3.38	2.0	3.0	2.14	1.243
	BP5-6	27/7/2023	I	6.34	3.32	5.0	6.0	3.12	0.197
	BP5-9	27/7/2023	D	9.48	3.28	8.0	9.0	3.22	0.057
	BP7-3	27/7/2023	S	3.00	2.95	1.0	3.0	1.50	1.45
	BP7-6	27/7/2023	I	6.48	3.45	5.0	6.0	2.85	0.6
	BP7-9A	27/7/2023	D	3.57	3.02	-113.9	9.0	NA	-
	GWW01S	27/7/2023	S	2.33	3.38	1.5	3.0	0.81	2.568
	GWW01I	27/7/2023	I	7.54	3.35	5.5	7.0	2.20	1.148
	GWW01D	27/7/2023	D	9.43	3.36	7.5	9.0	2.99	0.374
	GWW02S	27/7/2023	S	3.55	3.45	1.5	3.0	2.25	1.204
	GWW02I	27/7/2023	I	7.54	3.42	5.5	7.0	3.32	0.104
	GWW02D	27/7/2023	D	8.85	3.42	7.0	8.5	3.27	0.149
Off-site (East Coast Cement)	GWW03S	25/7/2023	S	3.80	3.43	2.0	3.5	2.19	1.24
	GWW03I	25/7/2023	I	7.95	3.56	6.0	7.5	3.34	0.22
	GWW03D	25/7/2023	D	10.81	3.55	8.8	10.3	3.33	0.22
Off-site (Port of Newcastle)	POMW7	27/7/2023	S	2.90	2.44	1.5	5.0	1.62	0.82
	POMW60-3	27/7/2023	S	2.960	2.42	1.5	3.0	NA	-
	POMW60-6	27/7/2023	I	5.56	2.45	4.5	6.0	NA	-
	POMW60-9	27/7/2023	D	8.89	2.41	7.5	9.0	NA	-
	POMW60-12	27/7/2023	D	11.90	2.43	10.5	12.0	NA	-
	POMW62-6	27/7/2023	I	5.64	2.05	4.5	6.0	2.21	-0.16
	POMW63-3	27/7/2023	S	2.820	2.55	1.5	3.0	1.91	0.64
	POMW63-6	27/7/2023	I	4.96	2.55	4.5	6.0	1.28	1.27
	POMW63-9	27/7/2023	D	8.78	2.53	7.5	9.0	2.41	0.12
	POMW63-12	27/7/2023	D	10.79	2.54	10.5	12.0	1.62	0.92

Notes:

S: shallow monitoring well

I: intermediate monitoring well

D: deep monitoring well

m AHD: metres above Australian Height Datum

m bTOC: metres below top of casing

mbgl: metres below ground level

- data not available.

Table B2. Monitoring Well Gauging, GW Quality, TD As (mg/l) Data

Post Remediation Annual Groundwater Monitoring Event - July 2023

Orica Kooragang Island

306.1

Location				Well Gauging						Water Parameters							Analysis	
Area	Well Location	Sampling Date	Type	Depth of Well	Top of Casing (TOC)	Screened Depth From	Screened Depth To	Standing Water Level	Standing Water Level	pH	Dissolved Oxygen	Electrical Conductivity	Redox	Eh	Temperature	Description	Sample Type	^ Dissolved Arsenic
				m bTOC	m AHD	m bgl	m bgl	m bTOC	m AHD	pH units	ppm	µs/cm	mV	mV	deg c			mg/L
Containment Cell Wells	MWCC01-3IN	26/7/2023	S	5	5.329	2.5	4.5	4.39	0.939	6.86	0.27	1052	-71	134	19.6	Clear, no odour	PS	0.324
	MWCC01-6IN	26/7/2023	I	8	5.356	5.5	7	4.88	0.476	7.87	0.84	1557	-130.1	74.9	20.6	Clear, no odour	PS	0.044
	D01_20230726	26/7/2023	I	-	-	-	-	-	-	-	-	-	-	-	-	-	DS	0.043
	T01_20230726	26/7/2023	I	-	-	-	-	-	-	-	-	-	-	-	-	-	TS	0.039
	MWCC01-9IN	26/7/2023	D	11	5.358	8	10	5.01	0.348	7.86	1.59	1587	-166.1	38.9	20.2	Clear, no odour	PS	0.296
	MWCC01-30OUT	26/7/2023	S	5	4.469	2.5	4.5											
	MWCC01-60OUT	26/7/2023	I	8	4.47	5.5	7											
	MWCC01-90OUT	26/7/2023	D	11	4.468	8	10											
	MWCC02-3IN	26/7/2023	S	5	4.906	2.5	4.5	3.95	0.956	6.76	1.03	930	10.6	215.6	19.3	Clear, no odour	PS	1.86
	MWCC02-6IN	26/7/2023	I	8	4.864	5.5	7	4.41	0.454	7.5	0.1	1435	-9	196	20	Clear, no odour	PS	89.8
	MWCC02-9IN	26/7/2023	D	11	4.859	8	10	4.43	0.429	7.84	0.08	1378	-107.3	97.7	19.9	Clear, no odour	PS	36.8
	MWCC02-30OUT	26/7/2023	S	5	4.072	2.5	4.5											
	MWCC02-60OUT	26/7/2023	I	8	4.07	5.5	7											
	MWCC02-90UT	26/7/2023	D	11	4.07	8	10											
	MWCC03-3IN	26/7/2023	S	4.5	5.424	2.5	4.5	4.45	0.974	6.75	0.19	1409	51.9	256.9	19.1	Clear, no odour	PS	0.003
	MWCC03-6IN	26/7/2023	I	8	5.461	5.5	7	5.01	0.451	7.65	0.17	1232	17.7	222.7	19.9	Clear, no odour	PS	0.003
	MWCC03-9IN	26/7/2023	D	11	5.461	8	10	5.05	0.411	8.3	0.02	2169	-142.5	62.5	20.1	Clear, no odour	PS	0.003
	MWCC03-30UT	26/7/2023	S	5	4.447	2.5	4.5											
	MWCC03-60UT	26/7/2023	I	8	4.455	5.5	7											
	MWCC03-90UT	26/7/2023	D	11	4.508	8	10											
	MWCC03-Baro	26/7/2023		1.5	5.222	0.3	1.5											
On-site	MW48A-4	NA	S	3.93	3.13	1.5	4	-	-	-	-	-	-	-	-	Unable to access	PS	-
Off-site (Initect Pivot)	MW21A	27/7/2023	I	6.01	3.49	2.5	5.5	2.41	1.08	7.27	0.84	1491	-77.5	127.5	15	Clear. No odour	PS	11.6
	MW50	27/7/2023	I	6.24	3.64	4.5	6.0	3.47	0.17	7.76	0.47	2500.00	101.10	306.10	18.10	Clear. No odour	PS	61.80
	D01_20230727	27/7/2023	I	-	-	-	-	-	-	-	-	-	-	-	-	-	DS	61.30
	T01_20230727	27/7/2023	I	-	-	-	-	-	-	-	-	-	-	-	-	-	TS	65.00
	MW54	27/7/2023	I	6.32	3.95	5.0	6.0	2.66	1.29	7.48	0.15	1063.00	-127.40	77.60	19.60	Clear. No odour	PS	2.95
	BP5-3	27/7/2023	S	3.51	3.38	2.0	3.0	2.14	1.24	6.71	0.56	2867.00	-5.10	199.90	19.20	Clear. No odour	PS	4.00
	BP5-6	27/7/2023	I	6.35	3.32	5.0	6.0	3.12	0.20	7.13	1.48	2445.00	-93.20	111.80	20.30	Clear. No odour	PS	43.50
	BP5-9	27/7/2023	D	9.48	3.28	8.0	9.0	3.22	0.06	7.71	1.38	3654.00	-146.60	58.40	20.60	Clear. No odour	PS	14.50
	BP7-3	27/7/2023	S	3.01	2.95	1.0	3.0	1.50	1.45	6.91	1.58	1761.00	-58.40	146.60	19.40	Clear. No odour	PS	2.89
	BP7-6	27/7/2023	I	6.48	3.45	5.0	6.0	2.85	0.60	7.44	4.27	1842.00	-55.70	149.30	20.10	Clear. No odour	PS	7.93
	D02_20230727	27/7/2023	I	-	-	-	-	-	-	-	-	-	-	-	-	-	DS	6.98
	BP7-9A	NA	D	4.97	3.02	7.5	9.0	-	-	-	-	-	-	-	-	Well Damaged	-	-
	GWW01S	27/7/2023	S	2.30	3.38	1.5	3.0	0.81	2.57							Gauged only		
	GWW01I	27/7/2023	I	7.62	3.35	5.5	7.0	2.20	1.15							Gauged only		
	GWW01D	27/7/2023	D	9.50	3.36	7.5	9.0	2.99	0.37							Gauged only		
	GWW02S	27/7/2023	S	3.56	3.45	1.5	3.0	2.25	1.20	6.60	1.72	2754.00	-21.10	183.90	17.50	Clear. No odour	PS	2.80
GWW02I	27/7/2023	I	7.54	3.42	5.5	7.0	3.32	0.10	7.49	0.73	2414.00	-98.50	106.50	19.70	Clear. No odour	PS	44.60	
GWW02D	27/7/2023	D	8.85	3.42	7.0	8.5	3.27	0.15	7.64	0.02	2597.00	-117.80	87.20	20.00	Clear. No odour	PS	63.90	
Off-site (East Coast Cement)	GWW03S	25/7/2023	S	3.81	3.43	2.0	3.5	2.19	1.24	7.27	1.56	842	25.1	230.10	20.4	Clear, no odour	PS	1.05
	GWW03I	25/7/2023	I	7.95	3.56	6.0	7.5	3.34	0.22	7.09	0.18	2056	-16.2	188.80	20.8	Clear, no odour	PS	44.3
	GWW03D	25/7/2023	D	10.89	3.55	8.8	10.3	3.33	0.22	7.8	0.24	10707	-66.1	138.9	21.3	Clear, no odour	PS	0.012
Off-site (Port of Newcastle)	POMW7	26/7/2023	S	2.90	2.44	1.5	5.0	1.62	0.82	6.64	0.15	906	53.9	258.9	18.7	Clear, no odour	PS	2.09
	POMW60-3	26/7/2023	S	2.960	2.42	1.5	3.0									Could not access	PS	
	POMW60-6	26/7/2023	I	5.56	2.45	4.5	6.0									Could not access	PS	
	POMW60-9	26/7/2023	D	8.89	2.41	7.5	9.0									Could not access	PS	
	POMW60-12	26/7/2023	D	11.90	2.43	10.5	12.0									Could not access	PS	
	POMW62-6	26/7/2023	I	5.64	2.05	4.5	6.0	2.21	-0.16	6.89	0.21	1008	69.6	274.6	21.1	Clear, no odour	PS	2.43
	POMW63-3	26/7/2023	S	2.820	2.55	1.5	3.0	1.91	0.64	5.92	4.02	852	57.9	262.9	22	Sediment, no odour	PS	0.152
	POMW63-6	26/7/2023	I	4.96	2.55	4.5	6.0	1.28	1.27	6.27	0.12	827	24.2	229.2	21	Sediment, no odour	PS	0.008
	POMW63-9	26/7/2023	D	8.78	2.53	7.5	9.0	2.41	0.12	7.44	0.22	4177	12.7	217.7	21.7	Clear, no odour	PS	0.094
POMW63-12	26/7/2023	D	10.79	2.54	10.5	12.0	1.62	0.92	6.43	0.3	508	-77	128	21.3	Clear, no odour	PS	0.012	

Notes:

S: shallow monitoring well
I: intermediate monitoring well
D: deep monitoring well
m AHD: metres above Australian Height Datum
m bTOC: metres below top of casing
mbgl: metres below ground level
- data not available.

PS: Primary Sample
FD: Field Duplicate
FT: Field Triplicate
QC: Quality Control
mg/l: milligram per litre
NA: Not Accessible

µs/cm: microseimens per centimetre
mV: milli-Volts
ppm: parts per million
Eh: Redox Potential (converted to Eh by Eh = Er + 205 mV)
LOR: limit of reporting

Primary Sample is MCC01-6IN²
Primary Sample is MW50
Primary Sample is BP7-9³

[^] Concentration exceeds the low-reliability working level trigger value for Arsenic (III) for marine water specified in ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality.

LOR is 0.001
Trigger Value is 0.0023[^]

Table C. Historical Analytical Results
Orica Kooragang Island

Well ID	MWCC01-3IN	MWCC01-6IN	MWCC01-9IN	MWCC01-3OUT	MWCC01-6OUT	MWCC01-9OUT	MWCC02-3IN	MWCC02-6IN	MWCC02-9IN	MWCC02-3OUT	MWCC02-6OUT	MWCC02-9OUT	MWCC03-3IN	MWCC03-6IN
	MWCC Wells Installed for the Remediation System													
	On-Site Wells													
Apr-97														
Mar-98														
Sep-98														
Feb-99														
Feb-00														
Jun-00														
May-01														
Jul-01														
Sep-01														
Oct-01														
Jun-02														
Apr-04														
Oct-04														
Jan-05														
Mar-05														
Jul-05														
Jul-05 (plume)*														
Jan-06														
Mar-06														
Jul-06														
Feb-07														
Aug-07														
Jan-08														
Jul-08														
Jan-09														
Jul-09														
Feb-10														
Jul-10														
Jan-11														
Jul-11														
Dec-11														
Jun-12														
Dec-12														
Jun-13														
Feb-14														
Jul-14														
Jan-15														
Jul-15														
Jan-16														
Jun-16														
Jan-17														
Jul-17														
Jan-18														
Jul-18														
Jan-19														
Jul-19														
Mar-20	0.695	0.077	0.26	0.002	0.008	0.002	0.774	87.5	35.8	4.08	26	22.1	0.003	0.002
Oct-21	0.272	0.259	0.5	NS	NS	NS	1.55	84	31.1	NS	NS	NS	0.001	0.001
Jul-22	0.465	0.049	0.43	NS	NS	NS	3.04	84.7	33.3	NS	NS	NS	0.002	0.002
Jul-23	0.324	0.044	0.296	NS	NS	NS	1.86	89.8	36.8	NS	NS	NS	0.003	0.003

Notes:
(1) All arsenic data in mg/L
(2) Data from May-01, Jul-01, Sep-01 and Oct-01 was analysed by Incitec laboratory.
(3) Triplicate result was used for MW27A and POMW60-9 (July-2010)
(4) Duplicate result was used for MW50 (July-2010)
(5) Triplicate result was used for MW45 (July-2011)
(5) Triplicate result was used for POMW60-3 (July-2011)
(6) Triplicate result was used for BPS-6 (June 2012)
(7) Duplicate result was used for MW54 (Dec 2012)
(8) There was no access to POMW58 or POMW59 wells during the December 2012 event. Therefore, the wells were sampled on 25 January 2013.
(9) Duplicate result was used for MW48 (June 2013)
(10) Triplicate result was used for POMW61-12 (June 2013)
(11) Highest concentrations between primary sample, field duplicate and field triplicate were used for monitoring rounds completed after July 2014.
DRY - Insufficient volume of water available to sample
NS - Not Sampled
NA - Not Accessible
(Plume)* - Data collected as part of plume hydrogeochemical characterisation (not Bi-annual monitoring round)
Data prior to July 14 were collected and reported by others.
^: MW48 was destroyed and replaced in December 2014. ID for the replacement well is MW48A_4.0
^^: MW27, MW27A and MW45, as well as all other wells associated with the IGF trial were decommissioned in August 2016 in preparation for the cap and containment remediation system.

Table C. Historical Analytical Results
Orica Kooragang Island

Well ID	MWCC03-9IN	MWCC03-3OUT	MWCC03-6OUT	MWCC03-9OUT	^MW48 / MW48A_4.0	MW21A	MW50	MW54	BP5-3	BP5-6	BP5-9	BP7-3
	Off-Site Wells (IPL and Vue)											
Apr-97					-		-	-	-	-	-	-
Mar-98					-		-	-	-	-	-	-
Sep-98					-		-	-	-	-	-	-
Feb-99					-		-	-	-	-	-	-
Feb-00					-		-	-	-	-	-	-
Jun-00					-		-	-	-	-	-	-
May-01					-		-	-	-	-	-	-
Jul-01					-		-	-	-	-	-	-
Sep-01					-		-	-	-	-	-	-
Oct-01					-		-	-	-	-	-	-
Jun-02					-		-	-	7.0	26.7	0.6	-
Apr-04					-		-	-	11.2	44.4	2.7	-
Oct-04					-		-	-	11.7	55.3	1.6	-
Jan-05					0.03	92.1	-	-	11.3	45.3	3.1	-
Mar-05					-	-	23.9	63.5	-	-	-	51.9
Jul-05					0.006	79.2	-	-	3.6	29.6	24.8	-
Jul-05 (plume)*					-	71.7	125	83.6	4.7	24.0	18.3	2.1
Jan-06					-	-	-	-	-	-	-	-
Mar-06					-	-	-	-	-	-	-	-
Jul-06					0.001	125	140	38.1	8.9	41.5	1.6	23.5
Feb-07					0.02	131	125	39.6	10.9	38.7	2.5	97.6
Aug-07					0.006	87.3	111	56.8	12.7	31.3	3.3	1.1
Jan-08					0.005	73.2	149	58.8	9.8	41.1	2.9	35.6
Jul-08					0.003	59.7	158	63.8	10.8	34.7	4.3	1.7
Jan-09					0.003	81.1	133	41.5	10.9	37.3	2.3	71.3
Jul-09					0.002	57.8	99.5	53.0	5.5	37.7	3.4	1.1
Feb-10					0.004	NS	132	41.6	10.1	49.0	1.9	81.6
Jul-10					0.02	58.6	118	42.1	7.8	39.0	3.4	0.7
Jan-11					0.008	63.6	107	38.7	10.8	48.7	2.4	2.4
Jul-11					0.02	59.7	109	38.5	14.9	60.0	11.0	0.8
Dec-11					0.02	43.3	87.2	26.6	13.6	37.6	6.6	0.5
Jun-12					0.001	33.8	108	23.7	12.4	44.8	4.3	0.8
Dec-12					0.002	38.0	100	17.1	11.0	46.0	2.6	46.2
Jun-13					0.002	45.8	70.6	18.3	9.4	39.4	6.6	2.0
Feb-14					0.002	44.4	108	15.6	13.0	67.3	5.9	83.2
Jul-14					0.016	24.8	86	10.5	10.4	60.6	6.5	1.2
Jan-15					0.01	36.1	82.8	8.9	14.5	75.1	6.6	59.0
Jul-15					-	32.7	78.4	11.2	-	-	-	1.44
Jan-16					0.016	42.8	77.4	8.3	10.8	72.8	17.4	1.0
Jun-16					-	17.9	47.8	8.53	-	-	-	3.3
Jan-17					0.019	41.8	77	7.38	14.8	65.6	1.8	34.2
Jul-17					-	30.2	74.3	6.18	-	-	-	1.9
Jan-18					0.016	32.8	73.9	4.6	16.3	63.4	4.9	27.6
Jul-18					-	25.4	74.6	5.43	-	-	-	2.19
Jan-19					0.012	23.8	84.4	4.92	13.9	78.0	6.2	13.8
Jul-19					-	20.4	84.2	4.96	-	-	-	1.66
Implementation of Cap Remediation System, Post Remediation Below												
Mar-20	0.003	0.002	<0.001	<0.001	0.01	NA	NA	NA	NA	NA	NA	NA
Oct-21	0.001	NS	NS	NS	0.00	11.1	70.3	2.62	8.86	49.1	14.3	0.685
Jul-22	<0.001	NS	NS	NS	0.00	14.8	65.2	2.75	2.23	54.5	19.6	0.344
Jul-23	0.003	NS	NS	NS	NS	11.6	61.8	2.95	4	43.5	14.5	2.89

Table C. Historical Analytical Results
Orica Kooragang Island

Well ID	BP7-6	BP7-9A	GWW01S	GWW01I	GWW01D	GWW02S	GWW02I	GWW02D	GWW03S	GWW03I	GWW03D	POMW7	POMW60-3
	-	-			-	-	-	-	-	-	-	DMMW7	-
			Transect Well (Along Heron Road)						East Coast Cement			Off-Site Wells (PoN)	
Apr-97	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar-98	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-98	-	-	-	-	-	-	-	-	-	-	-	6.6	-
Feb-99	-	-	-	-	-	-	-	-	-	-	-	-	-
Feb-00	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun-00	-	-	-	-	-	-	-	-	-	-	-	-	-
May-01	-	-	-	-	-	-	-	-	-	-	-	-	-
Jul-01	-	-	-	-	-	-	-	-	-	-	-	-	-
Sep-01	-	-	-	-	-	-	-	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun-02	-	-	-	-	-	-	-	-	-	-	-	26.6	-
Apr-04	-	-	-	-	-	-	-	-	-	-	-	21.5	-
Oct-04	-	-	-	-	-	-	-	-	-	-	-	22.8	-
Jan-05	-	-	-	-	-	-	-	-	-	-	-	20.4	-
Mar-05	33.4	-	-	-	-	-	-	-	-	-	-	-	-
Jul-05	-	-	-	-	-	-	-	-	-	-	-	15.4	-
Jul-05 (plume)*	31.7	-	-	-	-	-	-	-	-	-	-	22.0	-
Jan-06	-	-	-	-	-	-	-	-	-	-	-	-	-
Mar-06	-	-	-	-	-	-	-	-	-	-	-	-	4.6
Jul-06	126.0	-	-	-	-	-	-	-	-	-	-	22.6	3.1
Feb-07	119.0	8.7	-	-	-	-	-	-	-	-	-	15.8	3.7
Aug-07	116.0	28.9	-	-	-	-	-	-	-	-	-	19.9	0.9
Jan-08	128.0	37.1	-	-	-	-	-	-	-	-	-	18.6	0.9
Jul-08	113.0	36.1	-	-	-	-	-	-	-	-	-	17.7	0.9
Jan-09	105.0	37.6	-	-	-	-	-	-	-	-	-	22.7	4.8
Jul-09	61.8	32.7	-	-	-	-	-	-	-	-	-	29.5	1.4
Feb-10	99.0	37.8	-	-	-	-	-	-	-	-	-	3.6	4.1
Jul-10	62.0	42.7	-	-	-	-	-	-	-	-	-	4.4	0.6
Jan-11	75.7	-	-	-	-	-	-	-	-	-	-	-	1.8
Jul-11	79.6	-	-	-	-	-	-	-	-	-	-	8.6	0.9
Dec-11	48.3	-	-	-	-	-	-	-	-	-	-	8.0	0.3
Jun-12	67.7	-	-	-	-	-	-	-	-	-	-	12.1	2.4
Dec-12	48.2	-	-	-	-	-	-	-	-	-	-	11.2	4.3
Jun-13	39.0	-	-	-	-	-	-	-	-	-	-	11.4	1.3
Feb-14	115.0	21.00	10.8	9.2	0.004	2.8	81.9	6.9	0.4	7.5	0.01	14.1	3.2
Jul-14	91.3	10.90	9.7	10.0	0.05	2.0	63.2	9.0	0.4	6.5	0.1	9.3	0.7
Jan-15	83.7	16.70	8.3	8.3	0.01	1.1	60.4	10.8	0.6	6.4	0.004	5.8	2.3
Jul-15	70.2	10.20	-	-	-	-	-	-	-	-	-	5.9	-
Jan-16	87.0	4.70	4	0.01	6.1	1.1	74.6	29.4	0.1	6.6	0.1	5.2	0.4
Jun-16	37.6	10.20	-	-	-	-	-	-	-	-	-	8.7	-
Jan-17	47.9	13.00	2.6	0.02	3.4	2.8	85.5	13.2	1.8	12.0	0.008	8.9	2.8
Jul-17	39.9	10.50	-	-	-	-	-	-	-	-	-	NA	-
Jan-18	28.1	6.87	1.3	0.03	2.1	4.8	85.0	20.5	0.8	12.2	0.010	8.46	1.9
Jul-18	22.9	6.22	-	-	-	-	-	-	-	-	-	9.35	-
Jan-19	21.9	8.30	1.1	1.96	0.006	3.6	89.3	98.6	1.34	21.2	0.110	8.69	9.71
Jul-19	24.2	7.54	-	-	-	-	-	-	-	-	-	9.34	-
Mar-20	NA	NA	NA	NA	NA	NA	NA	NA	0.2	14.9	0.430	8.5	0.6
Oct-21	9.9	NA	NS	NS	NS	1.4	53.0	73.0	0.3	47.2	0.101	3.3	1.6
Jul-22	8.78	NA	NS	NS	NS	0.7	49.3	66.6	0.6	54.4	0.148	2.8	0.9
Jul-23	7.93	NA	NS	NS	NS	2.8	44.6	63.9	1.1	44.3	0.012	2.1	NS

Table C. Historical Analytical Results
Orica Kooragang Island

Well ID	POMW60-6	POMW60-9	POMW60-12	POMW62-6	POMW63-3	POMW63-6	POMW63-9	POMW63-12
	-	-	-	-	-	-	-	-
	Off-Site Wells (PoN)							
Apr-97	-	-	-	-	-	-	-	-
Mar-98	-	-	-	-	-	-	-	-
Sep-98	-	-	-	-	-	-	-	-
Feb-99	-	-	-	-	-	-	-	-
Feb-00	-	-	-	-	-	-	-	-
Jun-00	-	-	-	-	-	-	-	-
May-01	-	-	-	-	-	-	-	-
Jul-01	-	-	-	-	-	-	-	-
Sep-01	-	-	-	-	-	-	-	-
Oct-01	-	-	-	-	-	-	-	-
Jun-02	-	-	-	-	-	-	-	-
Apr-04	-	-	-	-	-	-	-	-
Oct-04	-	-	-	-	-	-	-	-
Jan-05	-	-	-	-	-	-	-	-
Mar-05	-	-	-	-	-	-	-	-
Jul-05	-	-	-	-	-	-	-	-
Jul-05 (plume)*	-	-	-	-	-	-	-	-
Jan-06	-	-	-	-	-	-	-	-
Mar-06	0.02	0.005	0.001	2.6	20.7	13.9	0.1	0.02
Jul-06	2.1	<0.001	<0.001	8.1	13.6	14.5	0.3	<0.001
Feb-07	3.9	<0.001	<0.001	20.6	18.5	21.4	0.4	<0.001
Aug-07	4.8	0.002	0.003	20.2	4.3	18.0	0.3	0.05
Jan-08	5.8	<0.001	0.001	23.3	2.0	6.7	0.5	<0.001
Jul-08	5.3	0.001	0.002	19.7	2.0	16.0	0.2	0.001
Jan-09	4.8	<0.001	<0.001	23.6	10.1	13.7	0.2	<0.001
Jul-09	4.9	<0.001	0.001	17.8	1.6	8.9	0.2	0.002
Feb-10	5.1	<0.001	0.01	21.1	17.4	10.6	0.2	<0.02
Jul-10	5.7	0.003	0.006	10.8	5.0	6.4	0.1	0.005
Jan-11	-	-	0.009	11.8	-	-	-	-
Jul-11	5.5	<0.001	0.002	10.9	0.3	0.1	0.04	<0.001
Dec-11	3.8	0.005	0.001	7.8	0.5	0.1	0.02	0.006
Jun-12	6.5	0.018	0.4	7.1	NA	NA	NA	0.007
Dec-12	6.4	0.001	<0.001	9.0	4.5	NA	0.2	0.001
Jun-13	4.2	0.003	<0.010	8.1	0.4	NS	0.01	< 0.001
Feb-14	8.2	<0.001	<0.01	10.3	11.8	NS	0.006	<0.001
Jul-14	5.4	<0.01	<0.01	9.7	7.5	0.5	0.005	0.001
Jan-15	6.7	<0.001	<0.01	9.4	11.8	2.9	0.002	0.01
Jul-15	-	-	-	4.9	-	-	-	-
Jan-16	6.6	0.001	0.004	5.1	0.1	0.01	0.04	0.002
Jun-16	-	-	-	3.8	-	-	-	-
Jan-17	4.3	0.008	0.01	5.3	14.8	5.62	0.13	0.001
Jul-17	-	-	-	3.2	-	-	-	-
Jan-18	4.3	0.012	0.01	3.3	12.0	0.02	0.004	<0.001
Jul-18	-	-	-	1.61	-	-	-	-
Jan-19	5.91	<0.001	0.004	2.44	1.92	7.00	0.111	0.004
Jul-19	-	-	-	1.46	-	-	-	-
Mar-20	5.0	<0.001	<0.001	3.0	8.9	0.00	0.09	0.001
Oct-21	4.2	0.507	0.108	2.3	2.3	NA	NA	0.094
Jul-22	0.2	0.016	<0.010	2.0	0.0	NA	NA	0.037
Jul-23	NS	NS	NS	2.4	0.2	0.01	0.09	0.012

Figures





- LEGEND**
- Orica Kooragang Island Facility
 - Incitec Pivot Property Boundary
 - Port of Newcastle
 - East Coast Cement
 - Arsenic Remediation Area



NOTE(S)

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)

1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.

2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

CLIENT

ORICA KOORAGANG ISLAND

PROJECT

POST REMEDIATION ANNUAL GROUNDWATER MONITORING EVENT - JULY 2023

TITLE

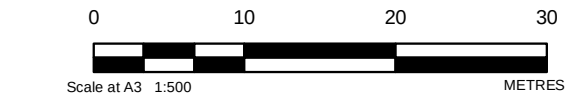
SITE LOCATION

	CONSULTANT	YYYY-MM-DD	9/21/2023
	DESIGNED	-	
	PREPARED	SDH	
	REVIEWED	AH	
	APPROVED	AH	

PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002-R	A	F001



- LEGEND
- Monitoring Well
 - Cut-off Wall Alignment
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GRONUDWATER MONITORING
EVENT - JULY 2023

TITLE
CONTAINMENT CELL WELL LOCATION PLAN

CONSULTANT



YYYY-MM-DD 2023-09-15

DESIGNED

PREPARED SDH

REVIEWED AH

APPROVED AH

PROJECT NO.
19135645

CONTROL
002

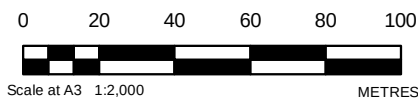
REV.
A

FIGURE
2A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A3 297mm



- LEGEND**
- Monitoring Well
 - Monitoring Well (Incitec Pivot)
 - Cut-off Wall Alignment
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

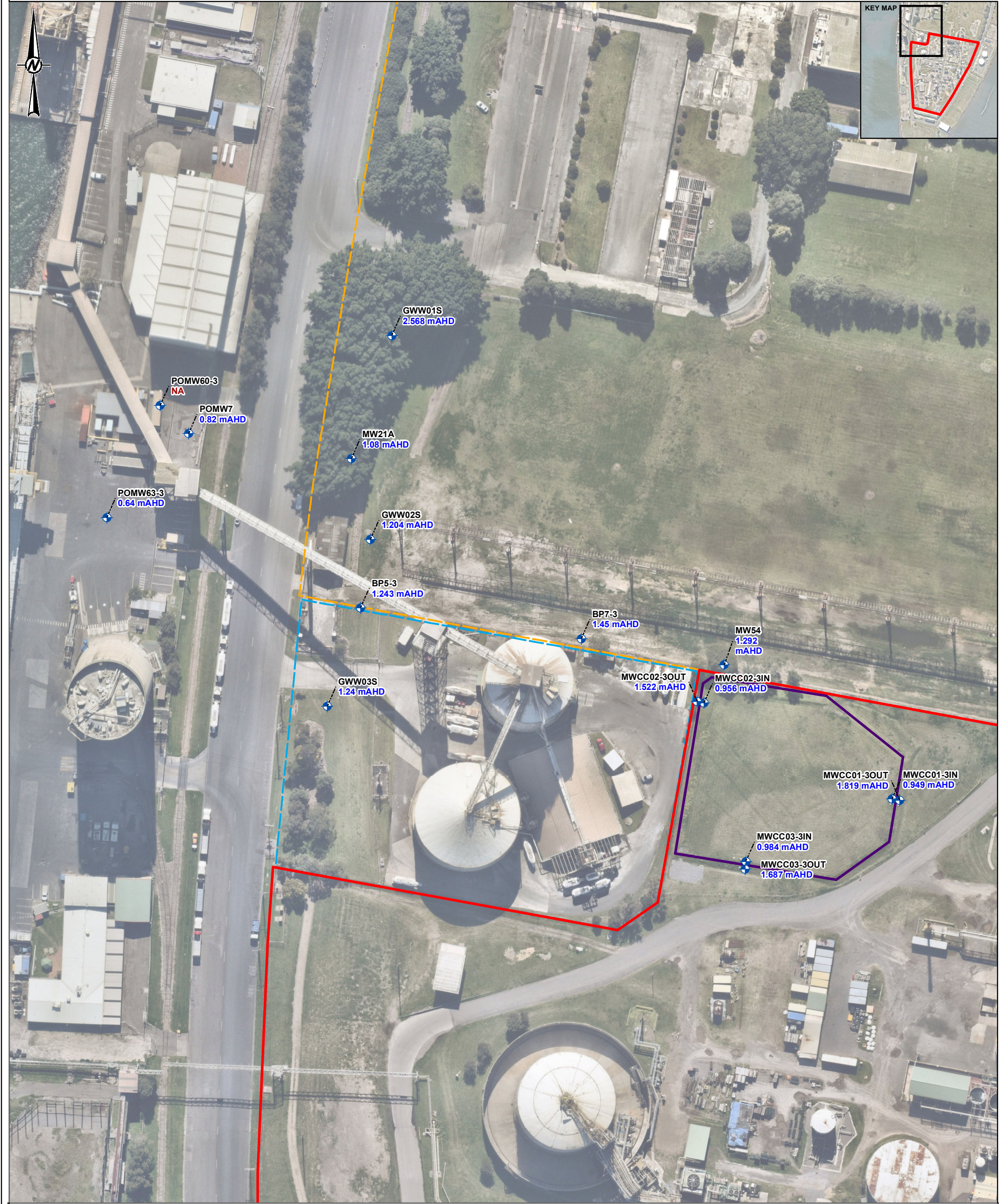
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JULY 2023

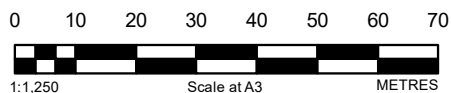
TITLE
MONITORING WELL NETWORK

CONSULTANT	YYYY-MM-DD	2022-09-15
DESIGNED		
PREPARED	SDH	
REVIEWED	AH	
APPROVED	AH	

PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002	A	2B



- LEGEND**
- Monitoring Well
 - Cut-off Wall Alignment
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary
- 1.22** Standing Water Level (mAHd)
NA - Water level not available



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

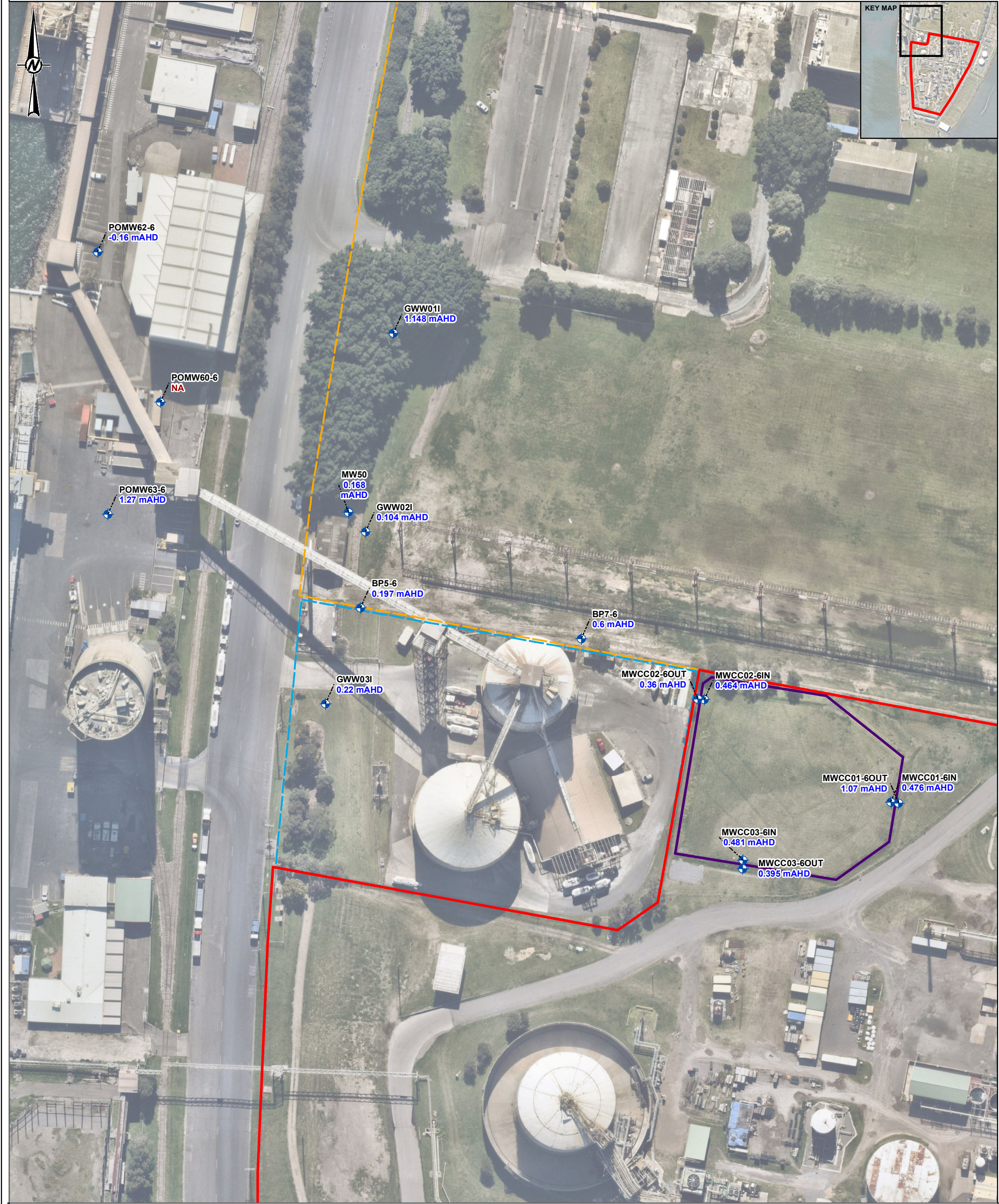
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JULY 2023

TITLE
UNIT 1 STANDING WATER LEVELS

CONSULTANT	YYYY-MM-DD	2023-09-21
DESIGNED		
PREPARED	SDH	
REVIEWED	AH	
APPROVED	AH	

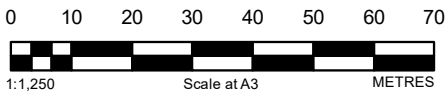
PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002-R	A	3A



LEGEND

- Monitoring Well
- Cut-off Wall Alignment
- Orica Property Boundary
- Incitec Pivot Property Boundary
- East Coast Cement Property Boundary

1.22 Standing Water Level (mAHD)
NA - Water level not available



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

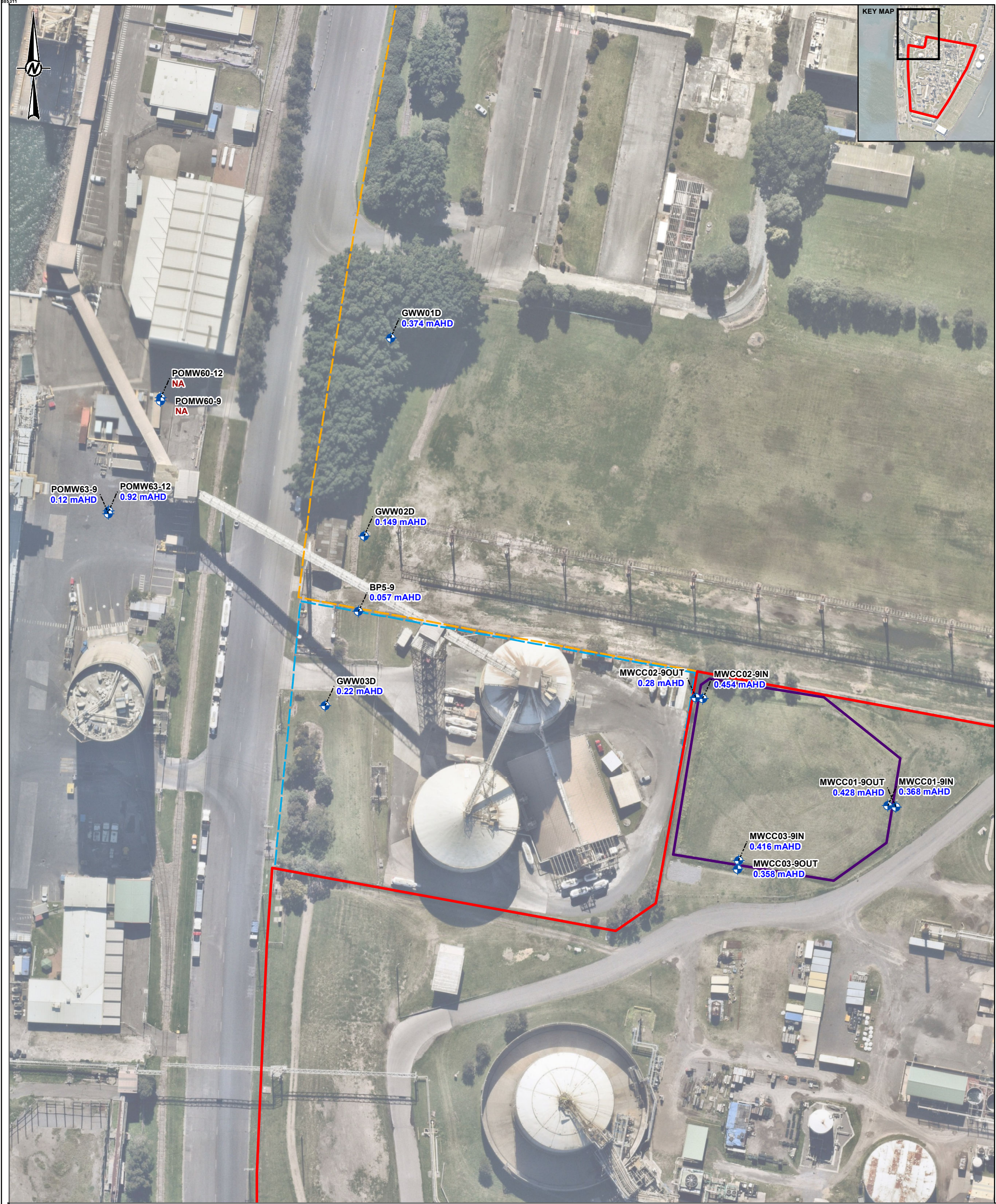
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JULY 2023

TITLE
UNIT 2 STANDING WATER LEVELS

	CONSULTANT	YYYY-MM-DD	2023-09-21
	DESIGNED		
	PREPARED	SDH	
	REVIEWED	AH	
	APPROVED	AH	

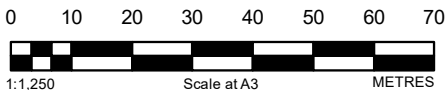
PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002-R	A	3B



LEGEND

- Monitoring Well
- Cut-off Wall Alignment
- Orica Property Boundary
- Incitec Pivot Property Boundary
- East Coast Cement Property Boundary

1.22 Standing Water Level (mAHd)
NA - Water level not available



NOTE(S)
1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)
1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.
2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

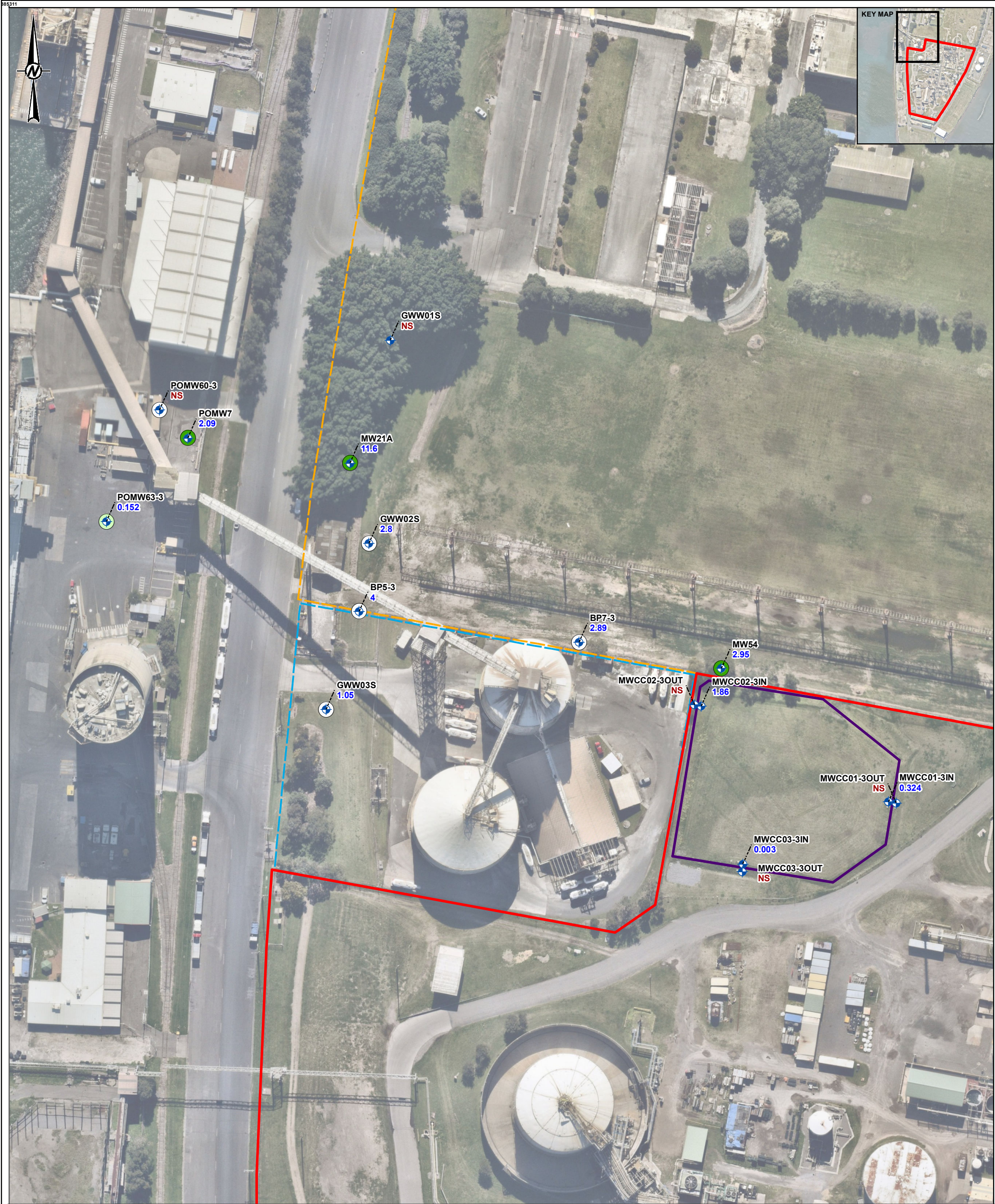
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JULY 2023

TITLE
UNIT 3 STANDING WATER LEVELS

CONSULTANT	YYYY-MM-DD	2023-09-21
DESIGNED		
PREPARED	SDH	
REVIEWED	AH	
APPROVED	AH	

PROJECT NO. 19135645	CONTROL 002-R	REV. A	FIGURE 3C
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LEGEND

- Monitoring Well
- Cut-off Wall
- Island_Outline
- Orica Property Boundary
- Incitec Pivot Property Boundary
- East Coast Cement Property Boundary

Trend in Arsenic Concentration

- Decreasing
- Prob Decreasing
- No Trend / Stable
- Prob Increasing
- Increasing
- NS Not Sampled

0 10 20 30 40 50 60 70

1:1,250 Scale at A3 METRES

NOTE(S)

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)

1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.

2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

CLIENT

ORICA, KOORAGANG ISLAND

PROJECT

POST REMEDIATION ANNUAL GROUNDWATER MONITORING EVENT - JULY 2023

TITLE

UNIT 1 DISSOLVED ARSENIC CONCENTRATIONS (MG/L)

CONSULTANT

YYYY-MM-DD 2023-09-28

DESIGNED

PREPARED SDH

REVIEWED AH

APPROVED AH

PROJECT NO.

19135645

CONTROL

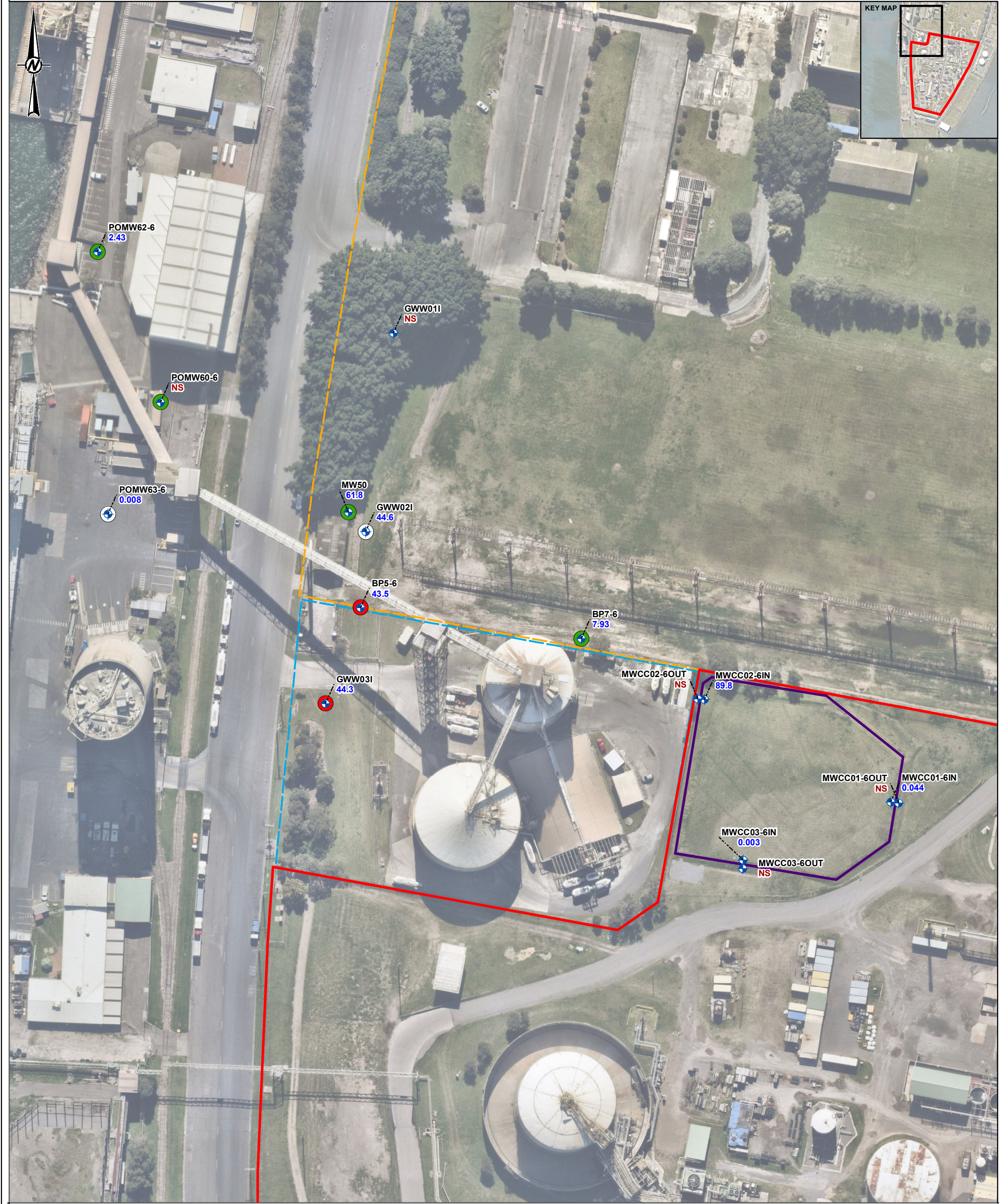
002-R

REV.

A

FIGURE

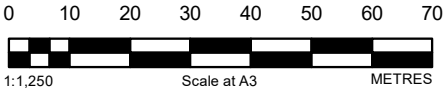
4A



- LEGEND**
- Monitoring Well
 - Cut-off Wall
 - Island_Outline
 - Orica Property Boundary
 - Incitec Pivot Property Boundary
 - East Coast Cement Property Boundary

Trend in Arsenic Concentration

- Decreasing
- Prob Decreasing
- No Trend / Stable
- Prob Increasing
- Increasing
- NS** Not Sampled



NOTE(S)

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)

1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.

2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

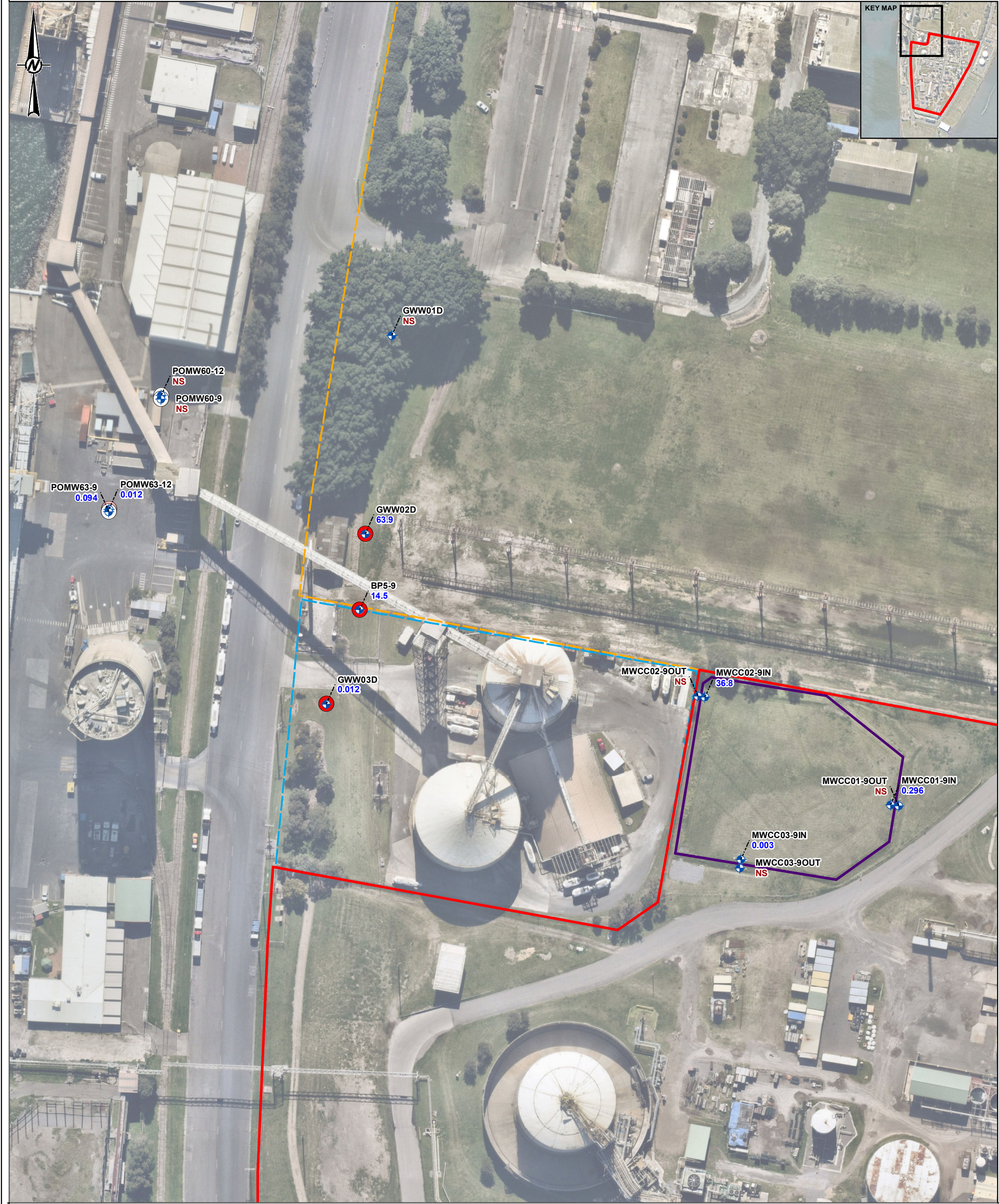
CLIENT
ORICA, KOORAGANG ISLAND

PROJECT
POST REMEDIATION ANNUAL GROUNDWATER MONITORING
EVENT - JULY 2023

TITLE
UNIT 2 DISSOLVED ARSENIC CONCENTRATIONS (MG/L)

CONSULTANT	YYYY-MM-DD	2023-09-28
DESIGNED		
PREPARED	SDH	
REVIEWED	AH	
APPROVED	AH	

PROJECT NO.	CONTROL	REV.	FIGURE
19135645	002-R	A	4B



LEGEND

- Monitoring Well
- Cut-off Wall Alignment
- Island_Outline
- Orica Property Boundary
- Incitec Pivot Property Boundary
- East Coast Cement Property Boundary

Trend in Arsenic Concentration

- Decreasing
- Prob Decreasing
- No Trend / Stable
- Prob Increasing
- Increasing
- NS Not Sampled

0 10 20 30 40 50 60 70

1:1,250 Scale at A3 METRES

NOTE(S)

1. COORDINATE SYSTEM: GDA 1994 MGA ZONE 56

REFERENCE(S)

1. AERIAL PHOTOGRAPHY (C) NEARMAP PTY LTD. THE LATEST IMAGE ON THIS SERVICE AS PER THE FIGURE DATE.

2. BASE MAP DATA (C) MAPINFO AUSTRALIA PTY LTD

CLIENT

ORICA, KOORAGANG ISLAND

PROJECT

POST REMEDIATION ANNUAL GROUNDWATER MONITORING EVENT - JULY 2023

TITLE

UNIT 3 DISSOLVED ARSENIC CONCENTRATIONS (MG/L)

CONSULTANT

YYYY-MM-DD 2023-09-28

DESIGNED

PREPARED SDH

REVIEWED AH

APPROVED AH

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19135645

CONTROL

002-R

REV.

A

FIGURE

4C

Appendix A

Sampling Analysis and Quality Plan



Document Revision

The following table outlines the revisions made to the SAQP.

Date	Revision	Nature of Revision	Editor
May 2019	Rev0	Original SAQP, prepared 2 months prior to completion of construction of the containment cell	Golder Associates
May 2020	Rev1	SAQP Revision 1, prepared post completion of remediation and first 6 months of monitoring	Golder Associates
January 2023	Rev2	SAQP Revision 2, prepared completion of 3 years post remediation monitoring	WSP

D.1 SAMPLING, ANALYSIS AND QUALITY PLAN

This is Revision 2 of the Sampling, Analysis and Quality Plan (SAQP) for the Post Remediation Groundwater Monitoring Plan (GMP) for the Containment Cell at Orica's Kooragang Island Site. This SAQP should be read in conjunction with the Long-Term Environmental Management Plan (LTEMP) prepared for the Containment Cell.

D.1.1 Background

The LTEMP provides details on:

- Site Location and Identification, including current use of the site.
- A summary of the remediation works completed at the site including the construction of the Containment Cell.
- A summary of the Surrounding Land use is presented within the Remediation Validation Report (Golder, 2019b).

The LTEMP (in Section 8) provides the GMP including the objectives and scope of works. Section 4.3 of the LTEMP provides the rationale for the 'weight of evidence' approach for the assessment of the hydraulic effects for assessing the ongoing performance of the containment cell. It is also noted in the GMP that the chemical monitoring of arsenic is being undertaken as a 'secondary line of evidence' to provide long-term understanding of the redistribution of the arsenic contamination over time. As such, there is no applicable criteria for arsenic concentrations in groundwater.

D.1.2 Conceptual Site Model

The pre-remediation Conceptual Site Model (CSM) has been presented in previous reports including the Remediation Action Plan (Golder, 2016a) and holistically for the Orica site in the Conceptual Site Model report (Golder, 2013).

Provided below is a summary of the key elements of the CSM that relate to the arsenic contamination post-remediation, which has been continually reviewed as part of each annual monitoring round.

Contaminants of Concern:	Arsenic
Sources:	Former Sludge Disposal Pit (on-site) – removed
Mechanism of contamination	Prior to remediation, disposal to ground with sorption to soil and subsequent leaching into the vadose and saturated zones
Remediation:	Removal of contaminated soils in the vadose zone – 2005 Construction of containment cell to 12 m below ground level and capping – 2019
Exposure Pathways:	Within the Cap and Containment area – nil Remediation (Containment Cell) has: — prevented further off-site migration of contaminated groundwater — management of the cap prevents direct contact exposure and rain infiltration Off the Orica site – management controls as defined within the Off-site EMP Exposure pathways associated with the existing off-site groundwater contamination include: — Direct contact — Inhalation of dust — Ingestion of soil and groundwater — Inhalation of aerosols from groundwater spray
Human and Ecological Receptors:	Within the Cap and Containment area – nil Off the Orica site (existing off-site groundwater contamination) — Workers undertaking intrusive works — Workers exposed to extracted groundwater
Data Gaps:	None identified, however, occasional wells were not available for sampling during the monitoring program, or data logger errors. Repair to wells and data loggers are regularly undertaken. Associated data gaps are considered minor due to long-term monitoring data set, extensive monitoring network confirms no significant changes, wells / data loggers are regularly repaired so data gaps for limited monitoring rounds.
Management and Monitoring:	Ongoing management and monitoring of the containment cell to be undertaken in accordance with the LTEMP.

D.2 DATA QUALITY OBJECTIVES

The Data Quality Objectives (DQO) for the post-remediation Groundwater Monitoring Program have been developed in accordance with the seven-step process described in the National Environmental Protection Measure, Schedule B2, Appendix B.

D.2.1 State the Problem

Remediation of the identified arsenic contamination has been completed by the construction of a containment cell to prevent the further off-site (Orica) migration of arsenic in groundwater. Hydraulic monitoring is required to confirm the containment cell in performing as per the design. Chemical (arsenic) monitoring is required as a secondary line of evidence to confirm further off-site migration is not occurring.

It is expected that the monitoring program will be more intensive in the initial years to confirm the containment cell is performing as per the design. Once this has been achieved the monitoring requirements will be reduced to a program that provides sufficient

data to confirm the ongoing performance of the containment cell. Revision 2 of the LTEMP and this SAQP is part of this revision process.

D.2.2 Identify the decision / goal of the study

To assess the efficacy of the hydraulic segregation of the arsenic source, a ‘weight of evidence’ approach considering the holistic assessment of observed hydraulic effects in consideration of the anticipated effects predicted by the groundwater modelling completed during the design.

Identified potential hydraulic effects included:

- The detection of responses to rainfall events that may be recorded in the external wells, but which would be expected to be less prevalent in the data collected from inside the wall.
- A flattening of the groundwater table(s) inside the cell relative to external conditions.
- An increase in the external hydraulic gradient across the cell (in the direction of groundwater flow), and/or potential increase in gradients around the perimeter of the cell.
- Groundwater monitoring to assess arsenic concentrations in groundwater will be undertaken as a ‘secondary line of evidence’ to provide long-term understanding that the further offsite migration of arsenic in groundwater has been prevented to the extent practicable.

D.2.3 Identify the information inputs

Hydraulic monitoring to include the long-term assessment of groundwater levels in the three hydrostratigraphic units both inside and outside of the containment cell, to allow consideration of the effectiveness of the containment cell.

Chemical monitoring to include the assessment of dissolved arsenic concentrations down-gradient of the containment cell to provide data for the long-term trends and confidence that the containment cell has prevented the further off-site migration by confirmation of a stable or decreasing trend.

D.2.4 Define the boundaries of the study

Monitoring is to be undertaken both within and immediately outside the containment cell within the three sets of paired monitoring wells located around the containment cell. These wells target the three hydrostratigraphic units in which the cut-off wall has been constructed to contain the identified arsenic contamination. Further to the well located adjacent to the containment cell, groundwater monitoring wells located within the vicinity of the containment cell, predominantly down-gradient, will also be used in the ongoing performance assessment. The monitoring network is defined in Table A.

The duration of the monitoring program will need to be ongoing to confirm the long-term performance of the containment cell.

D.2.5 Develop the analytical approach

Hydraulic monitoring to assess groundwater levels is to use both manual gauging and down-hole water level loggers that log hydraulic data continuously using. A barometric logger will also be used to compensate for the influence of localised atmospheric pressure variation within the containment cell. Data loggers are programmed to collect water level data at 2 hourly intervals.

Chemical monitoring includes the collection of representative groundwater samples and analysis for dissolved arsenic at a commercial laboratory. Quality assurance and quality control sampling and requirements are presented in Section C.8. The performance criteria for the Chemical monitoring are presented in the Data Quality Indicators in Section C.7.1. Validation of the data will be undertaken as described in Section C.9.

D.2.6 Specify performance or acceptance criteria

There are no specific performance or acceptance criteria for assessing the performance of the containment cell. As indicated in Section C2.1 a weight-of-evidence approach will be applied in assessing the hydraulic data to verify that the containment cell has achieved the design outcomes of preventing the further off-site migration of arsenic in groundwater by the hydraulic segregation caused by the containment cell. The key indicators of the hydraulic segregation are presented in Section C2.2.

D.2.7 Develop the plan for obtaining the data

The Groundwater Monitoring Program (as defined in Section 8 of the LTEMP) and this SAQP defined the plan for obtaining the necessary hydraulic and chemical data required to assess the ongoing performance of the containment cell. The GMP and SAQP will be reviewed and updated throughout the implementation of the LTEMP, as required.

This is Revision 2 of the LTEMP and GMP (dated 2023).

D.3 GROUNDWATER MONITORING NETWORK

The groundwater network associated with the containment cell consists of a series of nested wells at strategic locations on either side of the completed cut-off wall, to allow internal and external ‘piezometric’ water levels to be compared. This monitoring system allows collection of groundwater data to demonstrate that the containment cell is performing as per the design

The groundwater monitoring network will be used to confirm the ongoing performance of the containment cell.

D.3.1 Containment Cell Well Installation

Construction and installation of the monitoring network was completed in May of 2019 by Golder and subcontractor Star Drilling Pty Ltd. Borehole advancement was carried out with a “Sonic LX 600” truck mounted drill rig. The monitoring well network is shown in **Figure 3** of the LTEMP. It comprises three groups of nested monitoring wells (each group containing a total of six wells), located around the cut-off wall alignment. Each group included three pairs of piezometers installed to target the 3 separate and distinct groundwater units (Units 1, 2 and 3). Each pair included a well inside and outside of the cut-off wall. The locations selected were as follows:

- Western boundary, near the north-western corner of the containment cell, down-gradient.
- Southern Boundary, cross-gradient.
- Eastern boundary, up-gradient.

The construction details of these monitoring wells are shown in Table 1 below. An additional well was installed in the unsaturated zone on the southern boundary to allow assessment of barometric pressure within the containment cell and allow ‘normalisation’ of the internal water level data.

Wells were constructed using 50 mm, Class 18 unplasticised Poly Vinyl Chloride (uPVC) threaded screens and casings. Well caps and plugs were fitted to the top and bottom of the well, respectively. Screened sections as shown in Table 1, were backfilled with gravel and sealed with bentonite (above top of screen) of at least 0.5 metre (m) thickness. The remaining volume of the well annulus was backfilled using cement bentonite grout. Wells were finished with monuments. Borelogs / well construction logs are presented in the Remediation Validation Report (Golder, 2019). It is noted that depths shown on borelogs were relative to the original surface levels prior to construction of the cap. At the completion of the well installation the wells were finished with stick-ups to allow for the completion of the capping system which was higher than original surface levels. Well stick-ups were protected using barricades. Upon completion of the capping system the wells were finished with monuments and survey of the final top of casing.

Table 1: Containment Cell Well construction details.

Well Name	Total Depth of borehole* (mbgl)	Screen Interval Depth* (m bgl)	Target Unit	Survey Height** (m AHD)
MWCC01-3IN	5	2.5-4.5	1	5.329
MWCC01-3OUT	5	2.5-4.5	1	4.469
MWCC01-6IN	8	5.5-7.0	2	5.356
MWCC01-6OUT	8	5.5-7.0	2	4.470
MWCC01-9IN	11	8.0-10.0	3	5.358

Well Name	Total Depth of borehole* (mbgl)	Screen Interval Depth* (m bgl)	Target Unit	Survey Height** (m AHD)
MWCC01-9OUT	11	8.0-10.0	3	4.468
MWCC02-3IN	5	2.5-4.5	1	4.906
MWCC02-3OUT	5	2.5-4.5	1	4.072
MWCC02-6IN	8	5.5-7.0	2	4.864
MWCC02-6OUT	8	5.5-7.0	2	4.070
MWCC02-9IN	11	8.0-10.0	3	4.859
MWCC02-9OUT	11	8.0-10.0	3	4.070
MWCC03-3IN	4.5	2.5-4.5	1	5.424
MWCC03-3OUT	5	2.5-4.5	1	4.447
MWCC03-6IN	8	5.5-7.0	2	5.461
MWCC03-6OUT	8	5.5-7.0	2	4.455
MWCC03-9IN	11	8.0-10.0	3	5.461
MWCC03-9OUT	11	8.0-10.0	3	4.508
MWCC03-Baro	1.5	0.3-1.5	Unsaturated Zone	5.222

* depth is relative to the original ground surface level. Wells have been extended above original ground level to allow for cap construction.

** Survey height is post construction of capping system (final height)

D.3.2 Well Development

Post construction, wells across the groundwater monitoring network were developed to remove silt, clay, or other fine material introduced during drilling and for alignment of the gravel pack surrounding the well screens. Well development was carried out using Waterra tubing, in conjunction with a Powerpack (small petrol-powered engine) and manual surge blocking to agitate and remove water and fines from the well. The groundwater well development records are included in Remediation Validation Report (Golder, 2019). It is noted that sediment and some bentonite slurry were found in the majority of the wells. This is likely to be associated with the bentonite/clay that was used to construct the containment wall. At the completion of the well development small-scale falling head tests were completed (October 2019 - using the 30 minute data logging) which confirmed that the wells are functional and are in good hydraulic connection with the aquifer.

At the completion of well development, the wells were suitable for use of the monitoring program. It is noted that given the proximity of the wells to the cut off wall, that periodic redevelopment of the wells may be required to remove fines.

D.3.3 Surrounding Groundwater Monitoring Network

There is an existing network of groundwater monitoring wells located in the vicinity of the containment cell, primarily down-gradient, to assess and monitor the nature and extent of arsenic contamination. These monitoring wells are shown on **Figure 3** and **Figure 4**.

D.4 HYDRAULIC MONITORING

D.4.1 Groundwater Level Measurement

Standing water levels in each monitoring well are to be measured using an electronic water level probe. If practicable, all standing water levels should be measured in a single water level measuring event to allow interpretation of groundwater flow direction and

gradient. Water levels are to be measured to a marked point (or the highest point) on the top of the well uPVC casing to enable repeatability of measurements. Water levels should be re-measured prior to purging.

D.4.2 Data Transducer Deployment

Data loggers are installed in each well to record the depth of groundwater in each well over time. Solinst Levellogger Edge M5 & M10 data loggers were installed at a depth of 0.5 m above the base of each well. These loggers were attached to the top cap of each well via stainless steel wire and set to record the water depth every 2 hours. A barometric logger (Solinst Levellogger Barologger) was also installed in MWCC03-Baro to measure barometric pressure at 2 hourly intervals.

D.4.3 Data Transducer Download

Logger data is downloaded manually via the *Solinst* Optical Reader cable, utilizing the *Solinst Levellogger™* series software available from the *Solinst* website (www.solinst.com/downloads).

Manual measurements of groundwater levels are collected prior to data-logger download events as described in Section C.4.1. The manual measurements are used to check the validity of groundwater levels estimated from data of the water pressure transducers and data loggers.

Groundwater levels from the water-pressure transducers were estimated using:

1. the elevation of the water-pressure transducer in each well
2. the total pressure measured by the water-pressure transducers
3. corresponding measurements of barometric pressure, and
4. the assumption regarding the density of the groundwater (in this case assumed to be 1.0 gram per millilitre).

D.5 GROUNDWATER SAMPLING METHOD – ARSENIC

Based on the historical groundwater monitoring experience at the site, a low-flow groundwater sampling method is proposed. The preferred method uses a surface mounted peristaltic pump with dedicated Low-Density Polyethylene (LDPE) tubing and silicon tubing. The end of the LDPE tubing will correspond with the screened section of the well. Submersible sampling bladder pumps may also be used as an alternative, as long as bladders are replaced and equipment is decontaminated between each location.

Groundwater monitoring wells should be purged prior to collection of groundwater samples. The following data will be collected during the purging process:

- A physical description of the sample will be recorded on the field data sheets including:
 - Colour;
 - Turbidity;
 - Odour; and
 - Films/sheens.
- Groundwater parameters will be tested in the field at the time samples are collected using a calibrated meter/probe, for the following field parameters:
 - pH;
 - Electrical conductivity (EC);
 - Temperature;
 - Dissolved oxygen (DO); and
 - Redox potential.

Groundwater parameters are to be measured ex-situ using a flow through cell. Purging is to continue until representative groundwater has entered the well. This will be determined by obtaining stable water parameters (primarily pH, EC and redox). Water parameters are considered to be stable when successive parameter measurements are +/- 10 %.

Groundwater is to be sampled directly from the LDPE tubing, field filtered (0.45 µm), and transferred into the laboratory provided and pre-preserved bottles appropriate for the analyses.

Once filled, sample containers will be immediately tightly capped and placed in a secure chilled esky. Samples must be held and transported under Chain of Custody (CoC) protocols.

D.6 GENERAL FIELD PROCEDURES

D.6.1 Sample Labelling

The sample labels will include the sample identification number, place of collection, date of collection and initials of the sampling personnel. Each sample will be labelled with a unique sample identification number that is consistent with the site's EQIS database and that will facilitate tracking and cross-referencing of sample information. Quality Assurance / Quality Control (QA/QC) samples will also be numbered with a unique sample number.

D.6.2 Field Logs

A summary of activities performed at the site will be recorded in a field logbook. Entries for each day will commence on a new page, which will be dated. Corrections will be made by drawing a single line through the error, initialling this action and writing the correction.

The following types of information will be recorded for each groundwater sample collected:

- Unique sample identification number;
- Date and time of sample collection;
- Initials of the sampling personnel;
- Designation as to the means of collection;
- Analyses to be performed on sample; and
- Any other relevant comments (odour, colour, sheen, filtering, preservation, etc).

D.6.3 Equipment Decontamination

All non-dedicated sampling and measurement equipment is to be decontaminated before and after each use and then rinsed with deionised or distilled water following decontamination (where appropriate).

Dedicated or single use disposable equipment such as LDPE tubing and nitrile gloves will not be decontaminated and will be disposed of appropriately following use.

D.6.4 Sample Storage and Transportation

Groundwater samples are to be kept secure and cool in eskies during the field program. Eskies are to contain ice during the field program and subsequent transportation to the laboratory. Storage of the samples is to be under the custody of the field personnel during the field program.

If samples are not sent to the laboratory on the day of collection, the method of storage such as in refrigerator or in esky on ice (with ice regularly changed to maintain cool temperature) must be noted in the field log books and on the CoC form.

Samples are to be transported to the laboratories, in cooled eskies, under CoC documentation (below).

D.6.5 Chain of Custody Documentation

A CoC record must be utilised by field personnel to document possession of all samples collected for laboratory analysis. The CoC record is to include, but is not limited to, the following information:

- Project name and number;
- Name(s) of sampler(s);
- Sample type, identification number and location;
- Date of collection;
- Number, type and size of containers;
- Required analyses;
- Preservatives;
- Signatures documenting change of sample custody; and
- Turnaround time required for analytical results.

The esky containing the samples should be sealed with tape and secured with a custody seal. The custody seal will provide an indication of whether the cooler was opened by unauthorised personnel.

During sampling events partially filled and unfilled coolers are to be kept under the custody of the sample custodian. The sample custodian is to be a designated member of the sampling team.

The original CoC record must accompany the samples to the analytical laboratory, with a copy returned to the field engineer/scientist within 24 hours of sample receipt. The original, or a copy of the original, CoC record is to be placed in the appropriate project file. Samples are to be delivered to the laboratory promptly.

D.6.6 Equipment Calibration

Equipment used to perform testing or data recording (i.e. the water quality meter) will be calibrated to manufacturer's specifications by the supplier prior to use. The calibration records will be retained by the field engineer/scientist. Calibration checks and adjustments will be performed as required (i.e. generally on at least a daily basis for water quality meter) during field operations. The identification of the specific device or equipment calibrated, date, reference standard, results or adjustments made and the signature of the person performing the calibration will be documented on field data sheets or in the field log book.

D.7 ANALYTICAL PLAN - ARSENIC

The primary laboratory selected for the chemical analysis of groundwater samples is Australian Laboratory Services (ALS). The laboratory selected as the check laboratory for the inter-laboratory duplicate (i.e. triplicate) samples is Envirolab Services Pty Ltd (ELS). Both laboratories are accredited by National Association of Testing Authorities (NATA) for the required analyses.

The analytical plan for groundwater samples is detailed in **Table A** (attached), with analytical methods, limits of reporting and holding time for the analyte outlined in Table 2 below.

Table 2: Arsenic Analytical Methods

Analyte	LOR (mg/L)	Recommended Holding Time	Analytical Method	Container Type	Preservation
Arsenic (Dissolved)	0.001	Six months	USEPA 6020 ICP/MS	60ml plastic	Nitric acid to pH<2, chill

LOR – Limit of Reporting

mg/L – milligram per litre

ml - millilitre

LOR may vary depending the presence and concentration of other constituents

D.7.1 Data Quality Indicators

Data Quality Indicators (DQIs) are used to assess the reliability of field procedures and analytical results. They are described as follows:

- **Precision:** A quantitative measure of the variability (or reproducibility) of data;
- **Accuracy:** A quantitative measure of the closeness of reported data to the “true” value;
- **Representativeness:** The confidence (expressed qualitatively) that data are representative of each media present on site;
- **Completeness:** A measure of the amount of useable data from a data collection activity; and
- **Comparability:** The confidence (expressed qualitatively) that data may be considered to be equivalent for each sampling and analytical event.

The quantitative and qualitative measures/criteria employed to enable application of these parameters are described in the following sections. Descriptions of the various QA/QC samples are provided in **Section A.5**.

Precision

Suitable criteria and/or performance indicators for assessment of precision include:

- Performance of intra-laboratory duplicate sample sets through calculation of relative percentage differences (RPD);
- Performance of blind field duplicate sample sets, through calculation of RPD; and
- The RPDs will be assessed as acceptable if less than 30%. RPDs that exceed this range may be considered acceptable where:
- Results are less than 10 times the limits of reporting (LOR); or
- Results are less than 20 times the LOR and the RPD is less than 50%.

Accuracy

The closeness of the reported data to the “true” value is assessed through review of performance of:

- Performance of blind field triplicates (or inter-laboratory duplicate) sample sets, through calculation of RPD;
- Field blanks to assess bias introduced by chemicals during handling or transport or from laboratory supplied water, containers or preservatives (water only);
- Rinsate blanks to assess bias introduced from contaminated field equipment (if using non-dedicated equipment only); and
- Method blanks (MB), Matrix spikes (MS) and Laboratory control samples (LCS) which are analysed to assess for bias introduced from contaminated reagents (MB), and bias in percent recovery from expected values (MS and LCS), during laboratory analysis or preparation.

Representativeness

To ensure the data produced by the laboratory is representative of conditions encountered in the field, the following steps are taken by the laboratory and subsequently reviewed:

- Laboratory method blank samples will be run in parallel with field samples to confirm there are no unacceptable instances of laboratory artefacts;
- Review of RPD values for field and laboratory duplicates to provide an indication that the samples are generally homogeneous, with no unacceptable instances of significant sample matrix heterogeneities; and
- The appropriateness of collection methodologies, handling, storage and preservation techniques will be assessed to ensure/confirm there was minimal opportunity for sample interference or degradation (i.e. volatile loss during transport due to incorrect preservation / transport methods).

Completeness

In validating the degree of completeness of the analytical data sets acquired during the program the following is considered:

- Whether standard operating procedures (SOPs) for sampling protocols have been adhered to;
- Copies of all CoC documentation are reviewed and presented; and
- Whether appropriate laboratory methods and LORs were used and sample holding times were complied with.

It can therefore be considered whether the proportion of “useable data” generated in the data collection activities is sufficient for the purposes of the validation.

Comparability

Given the reported data set is likely to be comprised of several data sets from separate sampling episodes, issues of comparability between data sets are reduced through adherence to the same SOPs on each data gathering activity, the use of the same sample preparation and analytical methods as well as documenting the seepage sample locations and returning to the same nominated location (or documenting any changes in location due to the dynamic environment from which the seepage samples will be collected).

D.8 GENERAL QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Standard QA/QC procedures will be adopted during the assessment process including those for sample collection, management and handling. Specific requirements will include the use of laboratory prepared containers, use of dedicated sampling equipment where possible, decontamination of non-dedicated sampling equipment between locations, collection of an appropriate number of quality control samples, preservation of samples in ice chests and transport to laboratories under CoC documentation within holding times. Calibration of all field measurement equipment will be carried out by the supplier and the calibration certificates retained by the field engineer/scientist.

D.8.1 Field Quality Control Samples

The following field quality control (QC) samples will be collected and analysed as part of this monitoring program:

- Intra-laboratory field duplicates (blind replicates): The intra-laboratory field duplicates and corresponding primary samples will be collected from the same location, preserved, stored, transported, prepared and analysed in an identical manner by the primary laboratory, however, the duplicate sample will be blind coded. Intra-laboratory field duplicates provide an indication of the precision or reproducibility of the field sampling techniques and analytical results. Intra-laboratory field duplicates will be collected at a frequency of at least 1 in 10 (10%). Intra-laboratory field duplicate results will be assessed by calculating the RPDs;
- Inter-laboratory field duplicates (field triplicate/split sample): Individual samples will be split in the field and placed in two separate containers. One sample will be sent to the primary laboratory and the duplicate sent to an independent check

laboratory. To provide an indication of the precision or reproducibility of the analytical results. These will be analysed at a frequency of at least 1 in 20 (5%). Inter-laboratory field duplicate results will also be assessed by calculating the RPDs; and

- Field blanks: are used to provide an assessment of potential gain of constituents during sample collection, transport and storage, and/or cross contamination from storage of sampling methodology. These will be analysed at a rate of one field blank per monitoring round and assessed by comparison with percent recoveries and detection limits respectively.

D.8.2 Laboratory QA/QC

Laboratory QA/QC for the water monitoring program includes accreditation of laboratories providing analytical services, and their internal QA/QC procedures and documentation. Laboratory QA/QC will be assessed based on results of internal duplicates, blanks, controls, spikes and surrogates. The internal duplicates results will be reviewed and discussed. The results of the internal blank samples will be evaluated to demonstrate minimal interference.

The following internal laboratory QC samples will be reviewed as part of this monitoring program:

- Internal Laboratory Duplicates: are prepared by the laboratory by dividing a field sample into two or more aliquots, which are analysed separately to provide an indication of the effect of sample matrix variability on precision. These are assessed through the calculation of RPDs;
- Method Blanks: are contaminant free samples analysed by the laboratory to assess the level of contamination that exists in the laboratory analytical system. Results are evaluated by comparison to reporting limits;
- Laboratory Control Samples (LCS): are samples spiked with known concentrations of specific analytes to assess the laboratory performance on sample preparation and the analysis procedure. Results are assessed in terms of accuracy by calculating a percent recovery between the observed and spiked concentrations; and
- Matrix Spikes: are field samples spiked with known concentrations of specific analytes to assess the effects of the sample matrix on the accuracy and precision of analyses. Like laboratory control samples, matrix spike sample accuracy is evaluated in terms of a percent recovery between the observed and expected spiked compound concentrations.

D.9 DATA VALIDATION

The objective of the data validation process is to ensure that the data reported can be used to achieve the project objectives.

Accuracy and precision measurements from the appropriate QC check samples will be compared with the analytical DQIs to assess the quality of the analytical data. Should data be found to fall outside acceptable limits of precision and accuracy, appropriate corrective actions will be investigated.

The data will also be evaluated to assess the reproducibility, comparability and completeness of the data. Upon review of the DQIs an assessment as to whether the data can be relied upon for the purposes of the monitoring will be made.

Appendix B

Field Records and Calibration Certificates



Multi Parameter Water Meter

Instrument **YSI Quatro Pro Plus**
Serial No. **20M101177**



Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH	✓	
	2. mV	✓	
	3. EC	✓	
	4. D.O	✓	
	5. Temp	✓	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. pH 7.00		pH 7.00		399304	pH 6.94
2. pH 4.00		pH 4.00		399527	pH 3.97
3. mV		236.04mV		A393379/B398193	236.1mV
4. EC		2670 uS/cm		401089	2762uS/cm
4. D.O		0.0%		399958	-0.1%
6. Temp		22°C		MultiTherm	22°C

Calibrated by:

Guido Camera

Calibration date: 13/07/2023

Next calibration due: 13/08/2023

Multi Parameter Water Meter

Instrument **YSI Quatro Pro Plus**
Serial No. **18L102028**



airmet

Air-Met Scientific Pty Ltd
1300 137 067

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Fuses	✓	
	Capacity	✓	
Switch/keypad Display	Operation	✓	
	Intensity	✓	
	Operation (segments)	✓	
Grill Filter	Condition	✓	
	Seal	✓	
PCB	Condition	✓	
Connectors	Condition	✓	
Sensor	1. pH	✓	
	2. mV	✓	
	3. EC	✓	
	4. D.O	✓	
	5. Temp	✓	
Alarms	Beeper		
	Settings		
Software	Version		
Data logger	Operation		
Download	Operation		
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. pH 7.00		pH 7.00		399304	pH 7.02
2. pH 4.00		pH 4.00		399527	pH 3.99
3. ORP mV		235.16 mV		A393379/B398193	235.1 mV
4. EC uS		2760uS		401089	2762 uS
5. D.O		0.00%		399958	-0.1%
6. Temp		22.2°C		MultiTherm	22.2°C

Calibrated by: _____ Guido Camera

Calibration date: **13/07/2023**

Next calibration due: **12/08/2023**

Monitoring Summary

Project Number: _____ Date: _____ Name: _____

No.	Location ID	Date	Time	Water Level	Water Level	Casing Height	Depth	Interface Probe (IP)/Dip Meter (DM)?	Comments
				m bgl	m bto c	m	m bto c		
1	03-31N	26-7	1055		4.44		6.39	IP / DM	
2	03-61N				4.98		8.74	IP / DM	
3	03-91N				5.045		11.94	IP / DM	
4	03-30UT				2.76		5.35	IP / DM	4.53 TOC + 15cm
5	03-60UT				4.06		7.94	IP / DM	
6	03-90UT				4.15		10.64	IP / DM	
7	02-91N				4.405		11.33	IP / DM	Unable to download.
8	02-61N				4.40		8.73	IP / DM	
9	02-31N				3.95		5.81	IP / DM	
10	02-630UT				2.55		5.12	IP / DM	Bento on logger
11	02-60UT				3.71		8.03	IP / DM	
12	02-90UT				3.79		10.73	IP / DM	Replaced logger
13	01-31N				4.38		6.03	IP / DM	Replaced
14	01-61N				4.88		8.25	IP / DM	
15	01-91N				4.99		10.32	IP / DM	
16	01-30UT				2.65		5.32	IP / DM	
17	01-60UT				3.40		7.43	IP / DM	
18	01-90UT				4.04		10.74	IP / DM	
19								IP / DM	SL 10.27 MBTOC
20								IP / DM	02-9 out
21								IP / DM	
22								IP / DM	SL 5.15
23	01							IP / DM	01-31N
24	02-91N	27-7	1300		4.36			IP / DM	
25								IP / DM	
26								IP / DM	

*From bottom of well cap.

• ~~60~~ 60 + 61
POMW 4



Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS135343	Well ID:	MW001-3 IN
Client:		Sampling date:	26-7-23
Site location:		Sampler:	JF

Casing Diameter (mm):	Depth to groundwater from TOC Before Sampling (m): 4.39
Depth to LNAPL (mm):	Depth to groundwater from TOC After Sampling (m):
LNAPL thickness (mm):	Initial Pump Speed (Purging):
Method/pump type:	Initial Pump Speed (Sampling):
Start time (2400 hr): 13:19	Pump depth (from base of well):
Well depth from TOC (m): 6.01	Actual purge volume (L):
Well condition:	Did well purge 'dry'? Y / N If yes, volume (L)?
Bore volume: (1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)	

Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
13:23		4.41	6.91	19.6	1093	-23.2	0.60	Clear - 100
13:28		4.41	6.88	19.6	1073	-57.2	0.37	" "
13:33		4.41	6.86	19.6	1052	-71.0	0.27	" "
				Sample taken.				
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	

Water quality meter ID:	Calibration date:
Did field parameters stabilise? Yes / No / NA	Was the well dry purged Yes / No
Sampling details:	Analysis required:
Method/pump type:	TRH Phenols
Tubing material:	TRH silica gel Metals (see COC for list)
Sampling equipment:	BTEXN MNA
Hydrocarbon sheen observed?: Yes / No	VOC Nutrients
Primarily Sample ID:	PAH Other
Were samples filtered? Yes / No	QC samples collected? Yes / No
Preservations:	If yes – QC Sample IDs:
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):	
Field scientist:	Project manager:



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS1354345		Well ID:	MWCC02-9 IN				
Client:			Sampling date:	26.7.23				
Site location:			Sampler:	JF				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	4.43				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):	12.53		Pump depth (from base of well):					
Well depth from TOC (m):	11.29		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTWC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
12.55		4.49	7.68	19.7	1331	-57.5	0.24	Clear, NO.
13.00		4.51	7.83	19.9	1380	-100.5	0.09	" "
13.05		4.51	7.84	19.9	1378	-107.3	0.08	" "
			Sample taken.					
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	MWL02-6IN				
Client:			Sampling date:	26.7.23				
Site location:			Sampler:	JF				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	4.41				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):	12.30		Pump depth (from base of well):					
Well depth from TOC (m):	8.74		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
12.32		4.56	7.39	20.0	112	6.4	0.26	Clear, 100.
12.37		4.60	7.37	19.8	111	4.1	0.18	" "
12.42		4.62	7.37	19.9	1415	0.1	0.14	" "
12.47		4.63	7.50	20.0	1435	-9.0	0.10	" "
				Sample taken.				
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	MWU02-3IN				
Client:			Sampling date:	26.7.23				
Site location:			Sampler:	JF				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	43.95				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):	12.01		Pump depth (from base of well):					
Well depth from TOC (m):	5.72		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
12.10		3.96	7.04	19.3	961	-0.4	2.01	Clear, NO.
12.15		3.96	6.77	19.3	924	7.2	1.51	" "
12.20		3.96	6.77	19.3	931	9.4	1.17	" "
12.25		3.96	6.76	19.3	930	10.6	1.03	" "
				Sample taken.				
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343			Well ID:	MWL103-9IN			
Client:				Sampling date:	26.7.23			
Site location:				Sampler:	JF			
Casing Diameter (mm):				Depth to groundwater from TOC Before Sampling (m):	5.05			
Depth to LNAPL (mm):				Depth to groundwater from TOC After Sampling (m):				
LNAPL thickness (mm):				Initial Pump Speed (Purging):				
Method/pump type:				Initial Pump Speed (Sampling):				
Start time (2400 hr):	11.40			Pump depth (from base of well):				
Well depth from TOC (m):	11.87			Actual purge volume (L):				
Well condition:				Did well purge 'dry'? Y / N	If yes, volume (L)?			
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11.43		5.15	8.29	19.8	2126	-63.2	0.21	Clear, NO.
11.48		5.17	8.33	20.0	2142	-101.8	0.07	" "
11.53		5.17	8.32	20.1	2164	-124.8	0.04	" "
11.58		5.17	8.30	20.1	2169	-142.5	0.02	very Tea colour
				Sample taken				
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?: Yes / No				VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS135343	Well ID:	MWL03-6 IN
Client:		Sampling date:	26-7-23
Site location:		Sampler:	JF

Casing Diameter (mm):	Depth to groundwater from TOC Before Sampling (m): 5.01
Depth to LNAPL (mm):	Depth to groundwater from TOC After Sampling (m):
LNAPL thickness (mm):	Initial Pump Speed (Purging):
Method/pump type:	Initial Pump Speed (Sampling):
Start time (2400 hr): 11.25	Pump depth (from base of well):
Well depth from TOC (m): 8.74	Actual purge volume (L):
Well condition:	Did well purge 'dry'? Y / N If yes, volume (L)?
Bore volume: (1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)	

Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11.27		5.16	7.68	19.5	1257	8.3	0.45	Clear, No.
11.32		5.36	7.65	19.8	1231	13.5	0.19	" "
11.37		5.45	7.65	19.9	1232	17.7	0.17	" "
				Sample taken.				
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	

Water quality meter ID:	Calibration date:
Did field parameters stabilise? Yes / No / NA	Was the well dry purged Yes / No
Sampling details:	Analysis required:
Method/pump type:	TRH Phenols
Tubing material:	TRH silica gel Metals (see COC for list)
Sampling equipment:	BTEXN MNA
Hydrocarbon sheen observed?: Yes / No	VOC Nutrients
Primarily Sample ID:	PAH Other
Were samples filtered? Yes / No	QC samples collected? Yes / No
Preservations:	If yes – QC Sample IDs:
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):	
Field scientist:	Project manager:

GOLDER

CWNW03-I		Project Number: P5135343		Date: 25-7-23
WELL ID:		Client:		Sampled By: SF
		Site Location:		Time:

Weather Conditions (Temperature, Precipitation, Wind)

Well Maintenance Required?	YES / NO	Detail

Interface probe used?	YES / NO	Depth of pump intake (mBRP)
Initial depth to water (mBRP)	3.34	Length of hose (m)
Depth to product (mBRP)		Volume in hose (L)
Thickness of product (m)		Depth to water after placement of pump (mBRP)
Bailed product thickness (m)		Depth to water at end of purging (mBRP)
Total depth of well (mBRP)	7.97	Depth to water after collection of samples (mBRP)
Thickness of sediment on base of well (m)		Purging and Sampling Method

CPM	
Refill	
Discharge	
Throttle	

WQM Model

WQM Calibration Certificate

[illegible]

Time Sampled		Sample IDs		Sample Containers/Preservation (F=Filtered; UF=Unfiltered; P=Preserved; UP=Unpreserved)	
Colour		Primary Duplicate		Vials (P/UP)	Metals (F/UF, P/UP)
Odour		Secondary Duplicate		1L Amber	Cyanide
Turbidity	Low Medium High	Trip Blank		1L Plastic	Sulphide
Hydrocarbon Sheen ?	Yes No	Rinse		Phenols/COD/NH3 (F/UF, P/UP)	Other
Water Lab Certificate No		Field Blank		Ferrous/Ferric Iron (F/UF, P/UP)	Other



Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS135343	Well ID:	MWCC03-3 IN					
Client:		Sampling date:	26-7-23					
Site location:		Sampler:	JF					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m): 4.45						
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr): 11-07		Pump depth (from base of well):						
Well depth from TOC (m): 6.33		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N If yes, volume (L)?						
Bore volume: (1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11-00		4.45	6.87	18.6	1378	33.9	0.44	Clear, NO.
11-15		4.45	6.78	19.1	1409	45.4	0.21	" "
11-20		4.45	6.75	19.1	1409	51.9	0.19	" "
				Sample taken.				
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH			Phenols	
Tubing material:				TRH silica gel			Metals (see COC for list)	
Sampling equipment:				BTEXN			MNA	
Hydrocarbon sheen observed?: Yes / No				VOC			Nutrients	
Primarily Sample ID:				PAH			Other	
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS135343	Well ID:	PCMW63-12
Client:		Sampling date:	
Site location:		Sampler:	

Casing Diameter (mm):	Depth to groundwater from TOC Before Sampling (m): 1.62
Depth to LNAPL (mm):	Depth to groundwater from TOC After Sampling (m):
LNAPL thickness (mm):	Initial Pump Speed (Purging):
Method/pump type:	Initial Pump Speed (Sampling):
Start time (2400 hr): 11.28	Pump depth (from base of well):
Well depth from TOC (m): 10.50	Actual purge volume (L):
Well condition:	Did well purge 'dry'? Y / N If yes, volume (L)?
Bore volume: (1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)	

Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11.30		1.76	6.45	21.3	501	-65.9	0.31	Some turbidity / black flow
11.35		1.89	6.44	21.3	505	-70.9	0.29	" "
11.40		2.00	6.43	21.3	508	-77.0	0.30	" "
				Sample taken.				
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	

Water quality meter ID:	Calibration date:
Did field parameters stabilise? Yes / No / NA	Was the well dry purged Yes / No
Sampling details:	Analysis required:
Method/pump type:	TRH Phenols
Tubing material:	TRH silica gel Metals (see COC for list)
Sampling equipment:	BTEXN MNA
Hydrocarbon sheen observed?: Yes / No	VOC Nutrients
Primarily Sample ID:	PAH Other
Were samples filtered? Yes / No	QC samples collected? Yes / No
Preservations:	If yes – QC Sample IDs:
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):	
Field scientist:	Project manager:



Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS135343	Well ID:	PDMW62-6					
Client:		Sampling date:	26-7-27					
Site location:	PON	Sampler:	JF					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m): 2.2						
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr): 10.55		Pump depth (from base of well):						
Well depth from TOC (m): 5.64		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N If yes, volume (L)?						
Bore volume: (1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
10.57		2.29	6.91	20.5	986	73.7	0.58	Clear, NO.
11.02		2.30	6.86	21.0	1028	73.2	0.28	" "
11.07		2.29	6.86	21.1	1008	69.6	0.21	" "
				Sample taken.				
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:					Calibration date:			
Did field parameters stabilise? Yes / No / NA					Was the well dry purged Yes / No			
Sampling details:					Analysis required:			
Method/pump type:					TRH		Phenols	
Tubing material:					TRH silica gel		Metals (see COC for list)	
Sampling equipment:					BTEXN		MNA	
Hydrocarbon sheen observed?: Yes / No					VOC		Nutrients	
Primarily Sample ID:					PAH		Other	
Were samples filtered? Yes / No					QC samples collected? Yes / No			
Preservations:					If yes – QC Sample IDs:			
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:					Project manager:			



Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS135343	Well ID:	POMW7					
Client:		Sampling date:	26.7.23					
Site location:	PON	Sampler:	JE					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m): 1.62						
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr): 10.29		Pump depth (from base of well):						
Well depth from TOC (m): 2.88		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N If yes, volume (L)?						
Bore volume: (1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
10.30		1.73	6.86	18.5	519	88.4	0.66	Clear, NO.
10.35		1.80	6.59	18.7	674	101.9	0.35	" "
10.40		1.80	6.58	18.6	767	89.8	0.22	" "
10.45		1.79	6.64	18.7	906	53.9	0.15	" "
				Sample taken.				
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:					Calibration date:			
Did field parameters stabilise? Yes / No / NA					Was the well dry purged Yes / No			
Sampling details:					Analysis required:			
Method/pump type:					TRH		Phenols	
Tubing material:					TRH silica gel		Metals (see COC for list)	
Sampling equipment:					BTEXN		MNA	
Hydrocarbon sheen observed?: Yes / No					VOC		Nutrients	
Primarily Sample ID:					PAH		Other	
Were samples filtered? Yes / No					QC samples collected? Yes / No			
Preservations:					If yes – QC Sample IDs:			
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:					Project manager:			



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PSIBS 343		Well ID:	POMW 63-3				
Client:			Sampling date:	26.7.23				
Site location:	PON		Sampler:	JP				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	1.91				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):	12.19		Pump depth (from base of well):					
Well depth from TOC (m):	2.80		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
12.22		2.04	6.18	20.5	838	49.3	0.75	Some black flx / sed.
12.27		2.11	5.90	21.0	816	50.4	1.65	" "
12.32		2.11	5.91	21.6	841	51.6	2.69	" "
12.37		2.11	5.92	22.0	852	57.9	4.02	" "
				Sample taken				
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged			Yes / No	
Sampling details:				Analysis required:				
Method/pump type:				TRH			Phenols	
Tubing material:				TRH silica gel			Metals (see COC for list)	
Sampling equipment:				BTEXN			MNA	
Hydrocarbon sheen observed?:	Yes / No			VOC			Nutrients	
Primarily Sample ID:				PAH			Other	
Were samples filtered?	Yes / No			QC samples collected?			Yes / No	
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135 343		Well ID:	POMW 63-9				
Client:			Sampling date:	26-7-23				
Site location:	PON		Sampler:	JF				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	2.46				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):	12.03		Pump depth (from base of well):					
Well depth from TOC (m):	8.78		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
12.05		2.57	7.26	21.6	3743	32.5	0.66	Some black/floc/sediment
12.10		2.61	7.44	21.8	3839	17.9	0.23	'''
12.15		2.59	7.44	21.7	4177	12.7	0.22	'''
				Sample taken.				
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	P51353213			Well ID:	POMW63-6			
Client:				Sampling date:				
Site location:				Sampler:				
Casing Diameter (mm):				Depth to groundwater from TOC Before Sampling (m):	1.28			
Depth to LNAPL (mm):				Depth to groundwater from TOC After Sampling (m):				
LNAPL thickness (mm):				Initial Pump Speed (Purging):				
Method/pump type:				Initial Pump Speed (Sampling):				
Start time (2400 hr):	11.48			Pump depth (from base of well):				
Well depth from TOC (m):	4.53			Actual purge volume (L):				
Well condition:				Did well purge 'dry'? Y / N	If yes, volume (L)?			
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11.50		1.42	6.25	20.8	821	29.8	0.35	black flou sediment
11.55		1.55	6.26	20.9	826	25.0	0.17	" "
12.00		1.72	6.27	21.0	827	24.2	0.12	" "
				Sample taken				
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management
Standard Form 3.2.2:
Groundwater Sampling Record

Job number:	PS135343	Well ID:	MWCC01-61N					
Client:	Orica	Sampling date:	26-7-23					
Site location:	K1	Sampler:	A. Lyne					
Casing Diameter (mm):	Depth to groundwater from TOC Before Sampling (m): 4.88							
Depth to LNAPL (mm):	Depth to groundwater from TOC After Sampling (m):							
LNAPL thickness (mm):	Initial Pump Speed (Purging):							
Method/pump type:	Initial Pump Speed (Sampling):							
Start time (2400 hr):	Pump depth (from base of well):							
Well depth from TOC (m):	Actual purge volume (L):							
Well condition:	Did well purge 'dry'? Y / N If yes, volume (L)?							
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
13 21:20	0.5	5.03	7.87	20.3	1551	-159.7	0.78	Clear, No
13 21:23	1.0	5.06	7.87	20.6	1556	-133.1	0.86	"
13 21:26	1.5	5.06	7.87	20.6	1557	-130.1	0.84	"
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:	Calibration date:							
Did field parameters stabilise? Yes / No / NA	Was the well dry purged Yes / No							
Sampling details:	Analysis required:							
Method/pump type:	TRH			Phenols				
Tubing material:	TRH silica gel			Metals (see COC for list)				
Sampling equipment:	BTEXN			MNA				
Hydrocarbon sheen observed?: Yes / No	VOC			Nutrients				
Primarily Sample ID:	PAH			Other				
Were samples filtered? Yes / No	QC samples collected? Yes / No							
Preservations:	If yes – QC Sample IDs: D01-20230726 T01-20230726							
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:	Project manager:							



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343			Well ID:	GW002-I			
Client:	Orica			Sampling date:	27-7-23			
Site location:	K1			Sampler:	A. Lyne			
Casing Diameter (mm):				Depth to groundwater from TOC Before Sampling (m):	3.32			
Depth to LNAPL (mm):				Depth to groundwater from TOC After Sampling (m):				
LNAPL thickness (mm):				Initial Pump Speed (Purging):				
Method/pump type:				Initial Pump Speed (Sampling):				
Start time (2400 hr):				Pump depth (from base of well):				
Well depth from TOC (m):	7.56			Actual purge volume (L):				
Well condition:				Did well purge 'dry'? Y / N	If yes, volume (L)?			
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1042	0.5	3.34	7.57	19.1	2344	-88.3	0.96	Clear, NO
1045	1.0	3.35	7.49	19.7	2407	-97.0	0.77	
1048	1.5	3.35	7.49	19.7	2414	-98.5	0.73	
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	DS135343	Well ID:	GW002-S					
Client:	Orica	Sampling date:	27-7-23					
Site location:	K1	Sampler:	A. Lyne					
Casing Diameter (mm):		Depth to groundwater from TOC Before Sampling (m): 2.25						
Depth to LNAPL (mm):		Depth to groundwater from TOC After Sampling (m):						
LNAPL thickness (mm):		Initial Pump Speed (Purging):						
Method/pump type:		Initial Pump Speed (Sampling):						
Start time (2400 hr):		Pump depth (from base of well):						
Well depth from TOC (m): 3.56		Actual purge volume (L):						
Well condition:		Did well purge 'dry'? Y / N If yes, volume (L)?						
Bore volume: (1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)								
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1052	0.5	2.26	6.59	17.7	2657	-38.0	1.63	Clear, No
1057	1.0	2.26	6.59	17.6	2757	-27.3	1.70	1
1100	1.5	2.26	6.60	17.5	2754	-21.1	1.72	
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:					Calibration date:			
Did field parameters stabilise? Yes / No / NA					Was the well dry purged Yes / No			
Sampling details:					Analysis required:			
Method/pump type:					TRH		Phenols	
Tubing material:					TRH silica gel		Metals (see COC for list)	
Sampling equipment:					BTEXN		MNA	
Hydrocarbon sheen observed?: Yes / No					VOC		Nutrients	
Primarily Sample ID:					PAH		Other	
Were samples filtered? Yes / No					QC samples collected? Yes / No			
Preservations:					If yes – QC Sample IDs:			
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:					Project manager:			



Version: A	Reviewer: M. Hannan	Date:	Approver: C. Faull	Date: 8/12/14
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Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343			Well ID:	MW50			
Client:	Orica			Sampling date:	27-7-23			
Site location:	K1			Sampler:	A. Lyne			
Casing Diameter (mm):				Depth to groundwater from TOC Before Sampling (m):	3.47			
Depth to LNAPL (mm):				Depth to groundwater from TOC After Sampling (m):				
LNAPL thickness (mm):				Initial Pump Speed (Purging):				
Method/pump type:				Initial Pump Speed (Sampling):				
Start time (2400 hr):				Pump depth (from base of well):				
Well depth from TOC (m):	6.23			Actual purge volume (L):				
Well condition:				Did well purge 'dry'? Y / N	If yes, volume (L)?			
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTWC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1021	0.5	3.58	7.76	17.9	2463	-62.7	0.49	Clear, No
1024	1.0	3.60	7.76	18.0	2474	-82.0	0.43	
1027	1.5	3.60	7.76	18.1	2486	-96.7	0.49	
1030	2.0	3.60	7.76	18.1	2500	-101.1	0.47	
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:	MW50			PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:	D01-20230727 T01-20230727			
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	15135343			Well ID:	MW21A			
Client:	Orica			Sampling date:	27-7-23			
Site location:	K1			Sampler:	A. Lyne			
Casing Diameter (mm):				Depth to groundwater from TOC Before Sampling (m): 2.41				
Depth to LNAPL (mm):				Depth to groundwater from TOC After Sampling (m):				
LNAPL thickness (mm):				Initial Pump Speed (Purging):				
Method/pump type:				Initial Pump Speed (Sampling):				
Start time (2400 hr):				Pump depth (from base of well):				
Well depth from TOC (m): 6.03				Actual purge volume (L):				
Well condition:				Did well purge 'dry'? Y / N If yes, volume (L)?				
Bore volume:				(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)				
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1000	0.5	2.44	7.35	14.8	1505	-56.8	0.85	Clear, No
1003	1.0	2.45	7.29	14.8	1502	-69.0	0.83	
1006	1.5	2.45	7.28	14.8	1493	-75	0.80	
1009	2.0	2.45	7.27	15.0	1491	-77.5	0.84	
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	BPT-3 BPS-3				
Client:	Onica		Sampling date:	27-7-23				
Site location:	KL		Sampler:	A. Lyne				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	2.135				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	352		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11:22	0.5	2.23	6.78	19.3	2795	21.5	0.66	Clear, No
11:25	1.0	2.23	6.74	19.2	2828	11.1	0.60	
11:28	1.5	2.23	6.72	19.2	2843	-1.4	0.58	
11:31	2.0	2.23	6.71	19.2	2867	-5.1	0.56	
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	BPS-6				
Client:	Orica		Sampling date:	27.7.23				
Site location:	K1		Sampler:	A. Lyne				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	3.12				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	6.39		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1133	0.5	3.31	7.2	20.3	2448	-89.8	1.43	Clear, NO
1136	1.0	3.33	7.12	20.3	2445	-91.8	1.47	
1139	1.5	3.33	7.13	20.3	2445	-93.2	1.48	
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:			Calibration date:					
Did field parameters stabilise?	Yes / No / NA		Was the well dry purged	Yes / No				
Sampling details:			Analysis required:					
Method/pump type:			TRH	Phenols				
Tubing material:			TRH silica gel	Metals (see COC for list)				
Sampling equipment:			BTEXN	MNA				
Hydrocarbon sheen observed?:	Yes / No		VOC	Nutrients				
Primarily Sample ID:			PAH	Other				
Were samples filtered?	Yes / No		QC samples collected?	Yes / No				
Preservations:			If yes – QC Sample IDs:					
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:			Project manager:					



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	BP7-3				
Client:	Orica		Sampling date:	27-7-23				
Site location:	K1		Sampler:	A. Lyne				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	1.50				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	3.00		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters: 19.6								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1211	0.5	1.53	8.08	19.4	1805	-48	1.51	
1214	1.0	1.54	6.96	19.4	1778	-56.9	1.58	
1217	1.5	1.54	6.91	19.4	1761	-58.4	1.58	
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged			Yes / No	
Sampling details:				Analysis required:				
Method/pump type:				TRH			Phenols	
Tubing material:				TRH silica gel			Metals (see COC for list)	
Sampling equipment:				BTEXN			MNA	
Hydrocarbon sheen observed?:	Yes / No			VOC			Nutrients	
Primarily Sample ID:				PAH			Other	
Were samples filtered?	Yes / No			QC samples collected?			Yes / No	
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	BP7-6				
Client:	Orica		Sampling date:	27-7-23				
Site location:	K1		Sampler:	A. Lyne				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	2.85				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	6.45		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTWC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1205	0.5	3.13	7.44	20.0	1841	-56.7	4.26	Clear, NO
1208	1.0	3.15	7.44	20.1	1832	-56	4.24	
1211	1.5	3.15	7.44	20.1	1842	-55.7	4.27	
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:	002-20230727			
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135343		Well ID:	BPS-9				
Client:	Onica		Sampling date:	27-7-23				
Site location:	K1		Sampler:	A. Lyne				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m): 3.22					
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m): 9.47			Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N If yes, volume (L)?					
Bore volume:			(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)					
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11:45	0.5	3.23	7.68	20.6	2614	-140.8	1.58	
11:48	1.0	3.23	7.69	20.6	3633	-143.7	1.44	
11:51	1.5	3.23	7.70	20.6	3650	-145.2	1.40	
11:54	2.0	3.23	7.71	20.6	3654	-146.6	1.38	
Stabilisation Range:		+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%	
Water quality meter ID:				Calibration date:				
Did field parameters stabilise? Yes / No / NA				Was the well dry purged Yes / No				
Sampling details:				Analysis required:				
Method/pump type:				TRH		Phenols		
Tubing material:				TRH silica gel		Metals (see COC for list)		
Sampling equipment:				BTEXN		MNA		
Hydrocarbon sheen observed?: Yes / No				VOC		Nutrients		
Primarily Sample ID:				PAH		Other		
Were samples filtered? Yes / No				QC samples collected? Yes / No				
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

Job number:	PS135243		Well ID:	MWS4				
Client:	Orica		Sampling date:	27-7-23				
Site location:	KL		Sampler:	Alene				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	2.66				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):	6.32		Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTOC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
1230	0.5	2.78	7.48	19.7	1097	-111.5	0.3	Clear, no
1233	1.0	2.80	7.48	19.6	1090	-117.9	0.23	
1235	1.5	2.80	7.48	19.6	1066	-123.2	0.18	
1239	2.0	2.81	7.48	19.6	1063	-127.4	0.15	
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:				TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:				PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:				Project manager:				



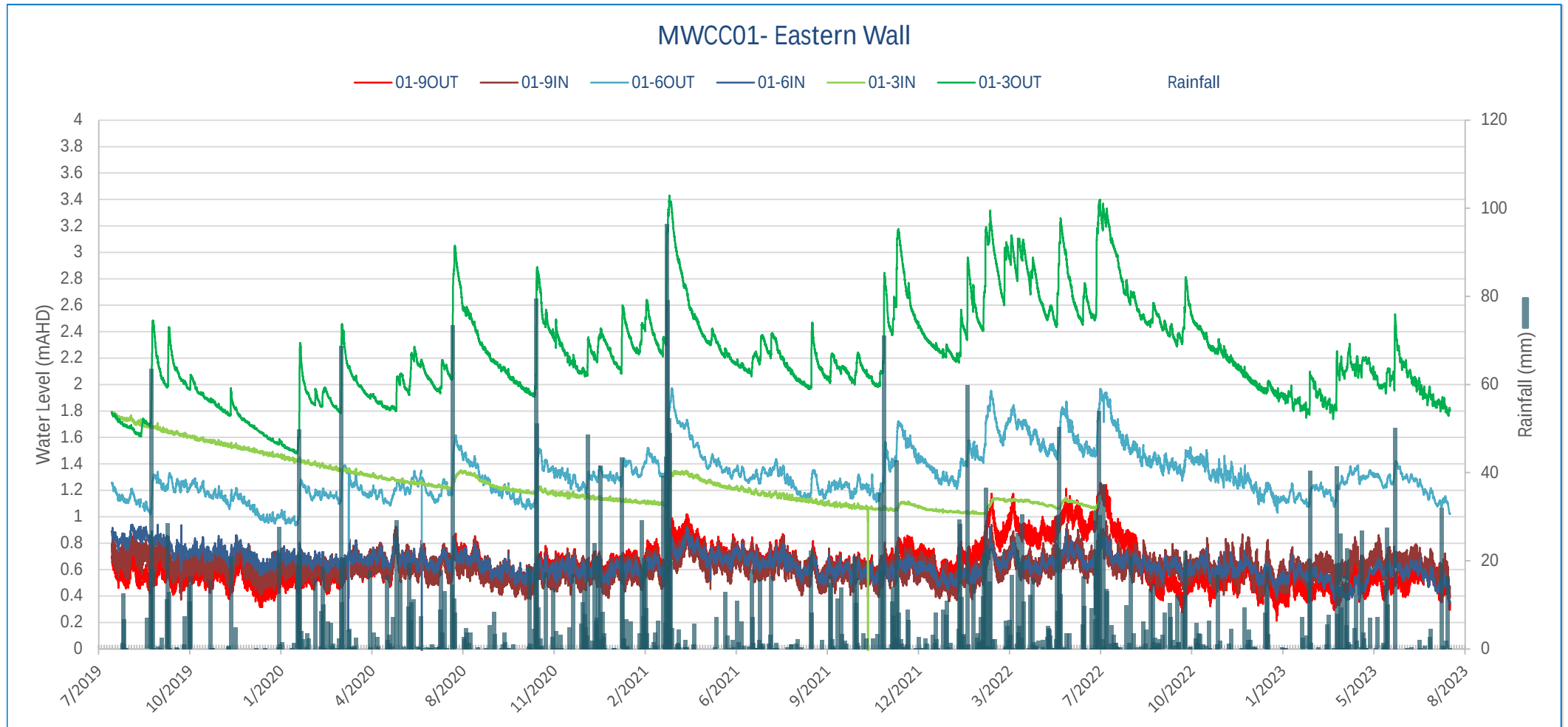
Contaminated Land Management Standard Form 3.2.2: Groundwater Sampling Record

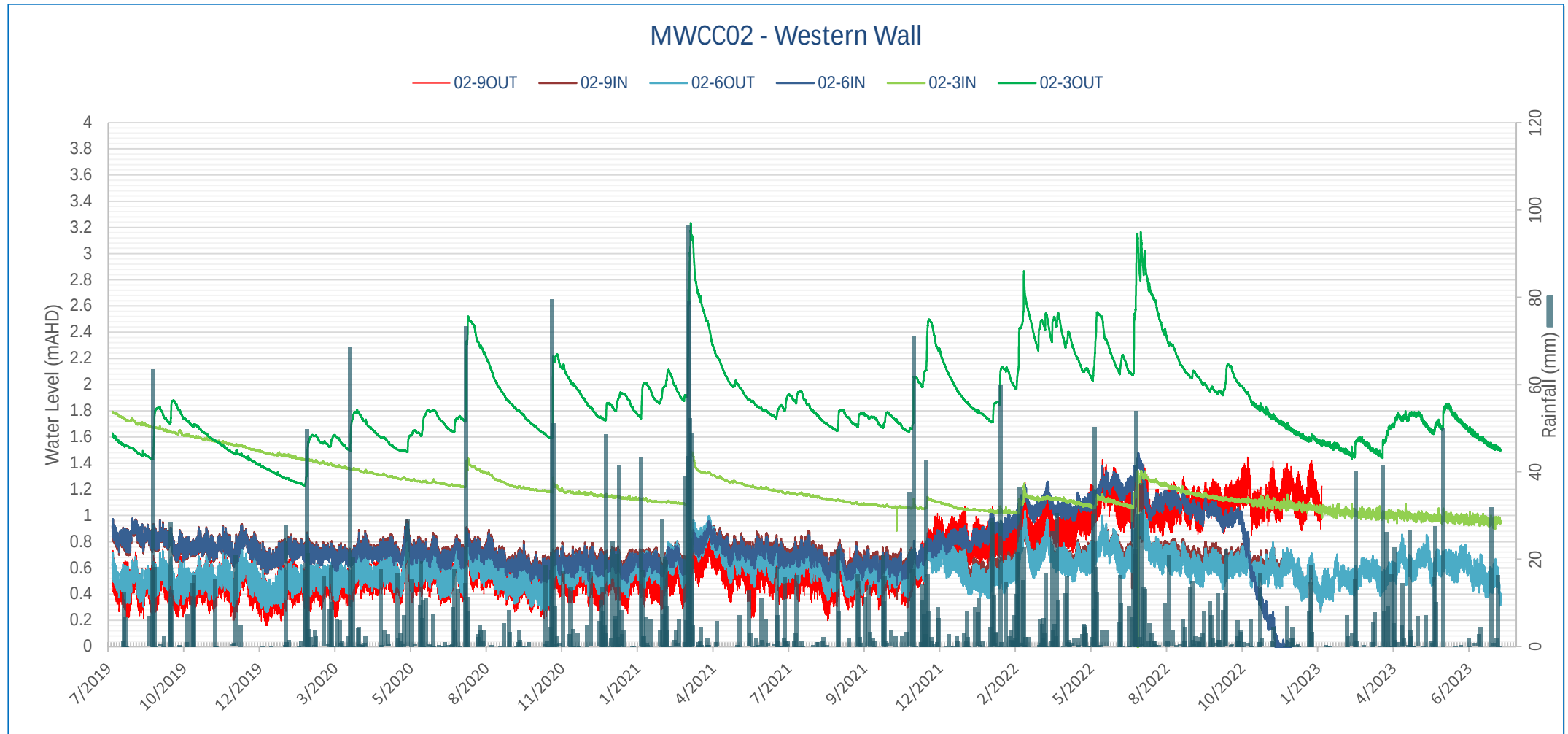
Job number:	PS135343		Well ID:	MWCC01-9 IN				
Client:	Orica		Sampling date:	26-7-23				
Site location:	K1		Sampler:	A. Lyne				
Casing Diameter (mm):			Depth to groundwater from TOC Before Sampling (m):	5.01				
Depth to LNAPL (mm):			Depth to groundwater from TOC After Sampling (m):					
LNAPL thickness (mm):			Initial Pump Speed (Purging):					
Method/pump type:			Initial Pump Speed (Sampling):					
Start time (2400 hr):			Pump depth (from base of well):					
Well depth from TOC (m):			Actual purge volume (L):					
Well condition:			Did well purge 'dry'? Y / N	If yes, volume (L)?				
Bore volume:	(1 bore volume = 2L/m for 50 mm well or 8L/m for 100 mm well)							
Purging and Water Quality Parameters:								
Time (min)	Purged Vol (L)	DTW (mBTWC)	pH (units)	Temp (°C)	EC (uS/cm)	Redox (mV)	DO (ppm)	Comments (turbidity, colour, odour, sheen, pump rate etc.).
11:00	0.5	5.05	7.89	20.0	1587	-141.1	1.64	Clear, NO
11:05	1.0	5.06	7.89	20.2	1560	-100.2	1.78	
11:08	1.5	5.07	7.88	20.2	1580	-162.7	1.64	
11:11	2.0	5.07	7.86	20.2	1587	-166.1	1.59	
Stabilisation Range:	+/-0.1 m	+/-0.1	+/-0.2°C	+/-5%	+/-10mV	+/-10%		
Water quality meter ID:				Calibration date:				
Did field parameters stabilise?	Yes / No / NA			Was the well dry purged	Yes / No			
Sampling details:				Analysis required:				
Method/pump type:	Peri			TRH	Phenols			
Tubing material:				TRH silica gel	Metals (see COC for list)			
Sampling equipment:				BTEXN	MNA			
Hydrocarbon sheen observed?:	Yes / No			VOC	Nutrients			
Primarily Sample ID:	MWCC01-9 IN			PAH	Other			
Were samples filtered?	Yes / No			QC samples collected?	Yes / No			
Preservations:				If yes – QC Sample IDs:				
Other comments and observations (i.e. photos, objects in well/blockages, variances to sampling procedure):								
Field scientist:	A. Lyne			Project manager:				

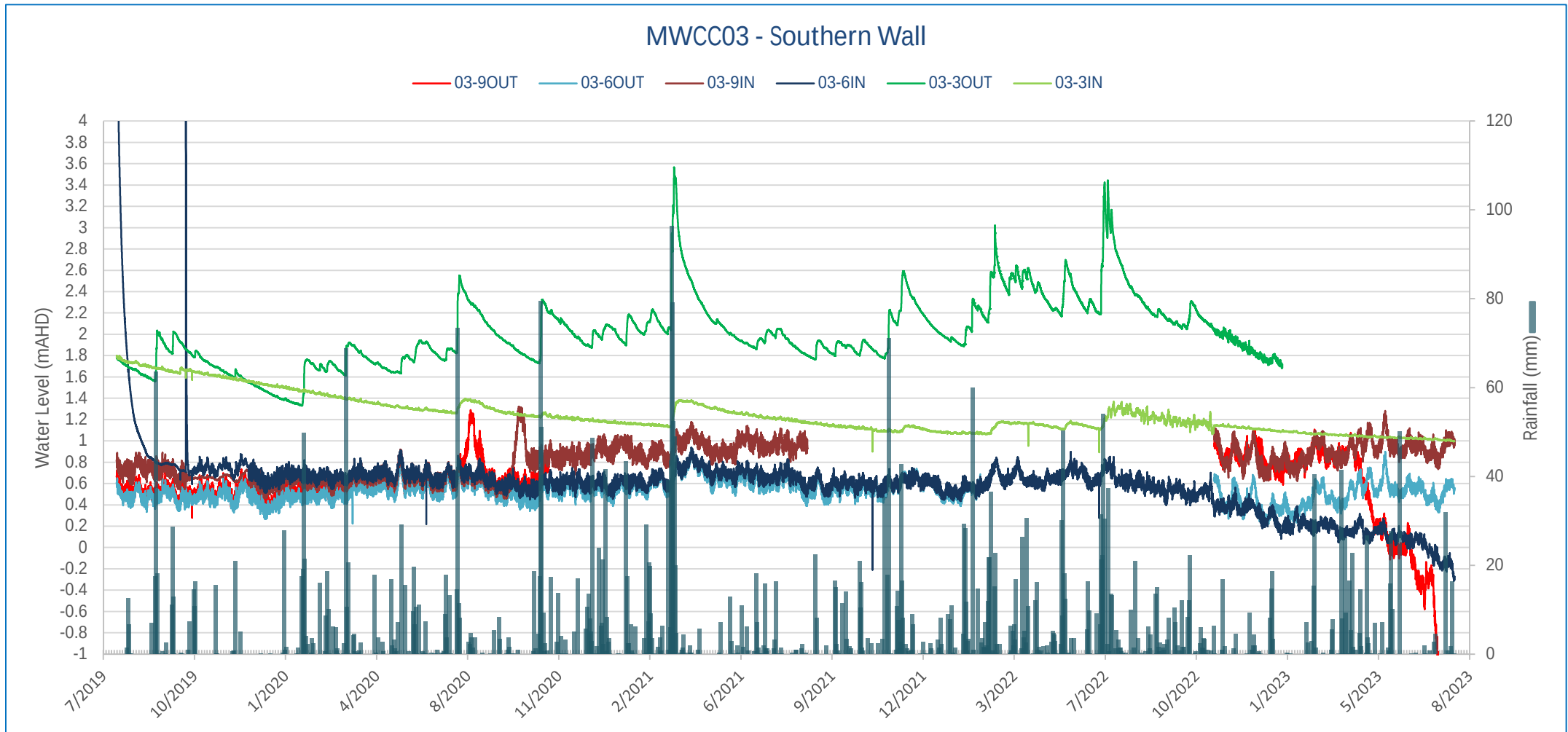
Appendix C

Hydraulic Verification









Appendix D

Data Validation and Laboratory Results



		DATA VALIDATION SUMMARY SHEET (NSW)	
Project Name:		Orica KI LTEMP GW Monitoring	Project Number: PS19135645
Primary Laboratory:		ALS Newcastle	Work Order Number: ES2325162
Secondary Laboratory:		Eurofins	Work Order Number: 1012240
Date Sampled:		26 & 27 July 2023	Sample Medium: Water
Sample Information			
Number of Primary Samples:		29	Number of Triplicate Samples: 2
Number of Duplicate Samples:		3	Number of Other QAQC Samples: 1
Documentation and Sample Handling Information			
		Y/N	Comments
COC completed properly?		Y	Signed by field staff and laboratory personnel.
All requested analysis completed?		Y	All requested analyses on the COC performed by ALS & Eurofins.
Samples received intact and chilled?		Y	ALS: 10.1°C, ice present. Samples received in good order. Note, sample delivered directly to laboratory from the site (<30 minutes) Eurofins: 4.8°C.
Samples analysed within appropriate holding times?		Y	All samples were analysed within appropriate holding times (ALS & Eurofins).
Sample volumes sufficient for QC analysis?		Y	Sufficient sample volume was provided for all laboratory tests (ALS & Eurofins).
Are there non-NATA accredited methods used?		N	ALS & Eurofins are NATA accredited for all methods used in this batch.
Chromatograms supplied as appropriate?		NA	N/A.
Laboratory reports signed by authorised personnel?		Y	All reports signed.
QAQC Sample Information (Method Blank - MB, Rinsate Blank - RB, Field Blank - FB, Trip Blank - TB)			
Type	Sample ID	Comments	
MB	Method Blank	All results were below the LOR (ALS).	
FB	FB01	All results were below the LOR (ALS).	
Trip Spike Information			
Analyte	Control Spike Concentrations	Trip Spike Concentration	% Recovery
Sample ID: NA			
Laboratory Control Spike (LCS) Analyses			
Analyte Group		Comments	
All		All LCS recoveries are within the laboratory based DQOs (ALS).	
Matrix Spike (MS) Analyses			
Analyte Group		Comments	
Arsenic		ALS: MS recoveries for ammonia (as N) are not determined (ES2325162-0). Refer to overall comments.	
-		All other MS recoveries are within the laboratory based DQOs (ALS & Eurofins).	
Laboratory Duplicates (LD) Analyses			
Analyte Group		Sample ID	Comments
-		-	All LD RPDs are within the laboratory based DQOs (ALS & Eurofins).
Field Duplicates (FD) Analyses			
Analyte Group	Primary ID	Duplicate ID	Comments
-	MWCC01-6IN	D01_2023726	All FD RPDs are within DQOs.
	BP7-6	D02_20230727	
	MW50	D01_20230727	
Field Triplicates (FT) Analyses			
Analyte Group	Primary ID	Triplicate ID	Comments
-	MWCC01-6IN	T01_20230726	All FT RPDs are within DQOs.
	MW50	T01_20230727	
Surrogate Compound Monitoring Analyses			
Analyte Group	Analyte(s)	Comments	
-	-	N/A	
Overall Comments			
ALS: MS recovery for Arsenic are not determined. As stated by ALS, "MS recoveries are not determined, background level greater than or equal to 4x spike level.			
This batch has been validated and is considered suitable for environmental interpretive use.			
Note: Data validation assesses each analyte in terms of all the data validation variables and only the exceedances and outliers are reported in this form.			
*When concentrations are less than the LOR for both primary and duplicate/triplicate results, no RPDs are calculated			
Performed By: Adam Lyne		Checked By: Andrew Holloway	
Date: 9/08/2023		Date: 14/09/2023	



CHAIN OF CUSTODY

CLIENT: Golder
PROJECT: [blank]
PROJECT MANAGER: [blank]
SUBJECT: [blank]
DATE: [blank]
PROJECT NO: [blank]
PROJECT NAME: [blank]
PROJECT LOCATION: [blank]
PROJECT STATUS: [blank]
PROJECT TYPE: [blank]
PROJECT PHASE: [blank]
PROJECT DESCRIPTION: [blank]
PROJECT OBJECTIVES: [blank]
PROJECT SCOPE: [blank]
PROJECT BUDGET: [blank]
PROJECT RISK: [blank]
PROJECT COMPLIANCE: [blank]
PROJECT DOCUMENTATION: [blank]
PROJECT COMMUNICATION: [blank]
PROJECT REPORTING: [blank]
PROJECT EVALUATION: [blank]
PROJECT CLOSURE: [blank]

d

9-8
Branston
2672 2.57

SAMPLE DETAILS			ANALYSIS INFORMATION			TESTING INFORMATION		
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PREPARATION	ANALYSIS	TESTING	RESULTS	REMARKS
1	GW001-01	20/02/20	W					
2	GW001-02	20/02/20	W					
3	GW001-03	20/02/20	W					
4	GW001-04	20/02/20	W					
5	GW001-05	20/02/20	W					
6	GW001-06	20/02/20	W					
7	GW001-07	20/02/20	W					
8	GW001-08	20/02/20	W					
9	GW001-09	20/02/20	W					
10	GW001-10	20/02/20	W					
11	GW001-11	20/02/20	W					
12	GW001-12	20/02/20	W					
13	GW001-13	20/02/20	W					
14	GW001-14	20/02/20	W					
15	GW001-15	20/02/20	W					
16	GW001-16	20/02/20	W					
17	GW001-17	20/02/20	W					
18	GW001-18	20/02/20	W					
19	GW001-19	20/02/20	W					
20	GW001-20	20/02/20	W					
21	GW001-21	20/02/20	W					
22	GW001-22	20/02/20	W					
23	GW001-23	20/02/20	W					
24	GW001-24	20/02/20	W					
25	GW001-25	20/02/20	W					
26	GW001-26	20/02/20	W					
27	GW001-27	20/02/20	W					
28	GW001-28	20/02/20	W					
29	GW001-29	20/02/20	W					
30	GW001-30	20/02/20	W					
31	GW001-31	20/02/20	W					
32	GW001-32	20/02/20	W					
33	GW001-33	20/02/20	W					

To 1- 20230727
To 1- 20230726 / Europins

Subcon / Forward Lab / Split WO
Lab / Analysts:
Organised By / Date:
Relinquished By / Date:
Connote / Courier:
WO No:
Attached By PO / Internal Sheet:

ES2325162



1012240

Tax Invoice

Golder Associates
PO Box 1302
Crows Nest
NSW 2065

Purchase Order #: Not provided
Invoice #: 793353
Date: Aug 4, 2023
Report #: 1012240
Project Name: ARSENIC LTEMP - ORICA
Project ID: PS135343
Contact: Andrew Holloway

Description	Quantity	Price	Total	Notes
Liquid Samples				
Standard Filtered Metals				
AsFilt	2	\$11.00	\$22.00	
Handling Charge	1	\$30.00	\$30.00	

	Nett Total	\$52.00
	GST	\$5.20
	Total Inc GST	\$57.20

This invoice is subject to [Eurofins General Terms of Sales](#).

Please detach and return with payment to:

Postal:
Eurofins Environment Testing
6 Monterey Road
Dandenong South
Victoria, 3175

Please EFT Payments to:
Eurofins Environment Testing
BSB 063-498
Acct No: 10057019
e.mail Remittances:
EnviroRemittances@eurofins.com

Invoice Number : 793353
Amount Inc GST : \$57.20

TERMS STRICTLY 30 DAYS

Eurofins Environment Testing Australia Pty Ltd

ABN: 50 005 085 521

Melbourne	Geelong	Sydney	Canberra	Brisbane	Newcastle
6 Monterey Road Dandenong South VIC 3175 Tel: +61 3 8564 5000 NATA# 1261 Site# 1254	19/8 Lewalan Street Grovedale VIC 3216 Tel: +61 3 8564 5000 NATA# 1261 Site# 25403	179 Magowar Road Girraween NSW 2145 Tel: +61 2 9900 8400 NATA# 1261 Site# 18217	Unit 1,2 Dacre Street Mitchell ACT 2911 Tel: +61 2 6113 8091 NATA# 1261 Site# 25466	1/21 Smallwood Place Murarrie QLD 4172 Tel: +61 7 3902 4600 NATA# 1261 Site# 20794	1/2 Frost Drive Mayfield West NSW 2304 Tel: +61 2 4968 8448 NATA# 1261 Site# 25079 & 25289

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Eurofins Environment Testing NZ Ltd

NZBN: 9429046024954

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35 O'Rourke Road Penrose, Auckland 1061 Tel: +64 9 526 4551 IANZ# 1327	43 Detroit Drive Rolleston, Christchurch 7675 Tel: +64 3 343 5201 IANZ# 1290

Sample Receipt Advice

Company name:	Golder Associates Pty Ltd (Syd)
Contact name:	Andrew Holloway
Project name:	ARSENIC LTEMP - ORICA
Project ID:	PS135343
Turnaround time:	5 Day
Date/Time received	Jul 28, 2023 2:57 PM
Eurofins reference	1012240

Sample Information

- ✓ A detailed list of analytes logged into our LIMS, is included in the attached summary table.
- ✓ Sample Temperature of chilled sample on the batch as recorded by Eurofins Sample Receipt : 4.8 degrees Celsius.
- ✓ All samples have been received as described on the above COC.
- ✓ COC has been completed correctly.
- ✓ Attempt to chill was evident.
- ✓ Appropriately preserved sample containers have been used.
- ✓ All samples were received in good condition.
- ✓ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
- ✓ Appropriate sample containers have been used.
- ✓ Sample containers for volatile analysis received with zero headspace.
- ✗ Split sample sent to requested external lab.
- ✗ Some samples have been subcontracted.
- N/A Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Bonnie Pu on phone : or by email: BonniePu@eurofins.com

Results will be delivered electronically via email to Andrew Holloway - AHolloway@golder.com.au.



web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd

ABN: 50 005 085 521

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NATA# 1261 Site# 1254

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NATA# 1261 Site# 25403

Sydney
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Girraween
NSW 2145
Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

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Mitchell
ACT 2911
Tel: +61 2 6113 8091
NATA# 1261 Site# 25466

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Murarrie
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NATA# 1261 Site# 20794

Newcastle
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Mayfield West NSW 2304
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NATA# 1261
Site# 25079 & 25289

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NATA# 2377 Site# 2370

Eurofins Environment Testing NZ Ltd

NZBN: 9429046024954

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Auckland 1061
Tel: +64 9 526 4551
IANZ# 1327

Christchurch
43 Detroit Drive
Rolleston,
Christchurch 7675
Tel: +64 3 343 5201
IANZ# 1290

Company Name: Golder Associates Pty Ltd (Syd)
Address: Level 8, 40 Mount Street
North Sydney
NSW 2060

Project Name: ARSENIC LTEMP - ORICA
Project ID: PS135343

Order No.:
Report #: 1012240
Phone: 02 9478 3900
Fax: 02 9478 3901

Received: Jul 28, 2023 2:57 PM
Due: Aug 4, 2023
Priority: 5 Day
Contact Name: Andrew Holloway

Eurofins Analytical Services Manager : Bonnie Pu

Sample Detail						Arsenic (filtered)
Sydney Laboratory - NATA # 1261 Site # 18217						X
External Laboratory						
No	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID	
1	T01_20230727	Jul 27, 2023		Water	S23-JI0067610	X
2	T01_20230726	Jul 26, 2023		Water	S23-JI0067611	X
Test Counts						2

Golder Associates
Level 8, 40 Mount Street
North Sydney
NSW 2060



NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
 NATA is a signatory to the ILAC Mutual Recognition
 Arrangement for the mutual recognition of the
 equivalence of testing, medical testing, calibration,
 inspection, proficiency testing scheme providers and
 reference materials producers reports and certificates.

Attention: **Andrew Holloway**

Report **1012240-W**
 Project name **ARSENIC LTEMP - ORICA**
 Project ID **PS135343**
 Received Date **Jul 28, 2023**

Client Sample ID			T01_20230727	T01_20230726
Sample Matrix			Water	Water
Eurofins Sample No.			S23-JI0067610	S23-JI0067611
Date Sampled			Jul 27, 2023	Jul 26, 2023
Test/Reference	LOR	Unit		
Heavy Metals				
Arsenic (filtered)	0.001	mg/L	65	0.039

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description

Heavy Metals (filtered)

Testing Site

Sydney

Extracted

Aug 01, 2023

Holding Time

180 Days

- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS

Company Name:	Golder Associates Pty Ltd (Syd)	Order No.:		Received:	Jul 28, 2023 2:57 PM
Address:	Level 8, 40 Mount Street North Sydney NSW 2060	Report #:	1012240	Due:	Aug 4, 2023
Project Name:	ARSENIC LTEMP - ORICA	Phone:	02 9478 3900	Priority:	5 Day
Project ID:	PS135343	Fax:	02 9478 3901	Contact Name:	Andrew Holloway
Eurofins Analytical Services Manager : Bonnie Pu					

Sample Detail						Arsenic (filtered)
Sydney Laboratory - NATA # 1261 Site # 18217						X
External Laboratory						
No	Sample ID	Sample Date	Sampling Time	Matrix	LAB ID	
1	T01_20230727	Jul 27, 2023		Water	S23-JI0067610	X
2	T01_20230726	Jul 26, 2023		Water	S23-JI0067611	X
Test Counts						2

Internal Quality Control Review and Glossary

General

- Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
- All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
- All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
- Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
- Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
- SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
- Samples were analysed on an 'as received' basis.
- Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
- This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram	mg/L: milligrams per litre	µg/L: micrograms per litre
ppm: parts per million	ppb: parts per billion	%: Percentage
org/100 mL: Organisms per 100 millilitres	NTU: Nephelometric Turbidity Units	MPN/100 mL: Most Probable Number of organisms per 100 millilitres
CFU: Colony forming unit		

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (<i>bis</i> -tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR: RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

- Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
- Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
- pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
- Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
- For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
- Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic (filtered)	S23-JI0061860	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Bonnie Pu	Analytical Services Manager
Fang Yee Tan	Senior Analyst-Metal



Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please [click here](#).

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CERTIFICATE OF ANALYSIS

Work Order : **ES2325162**
Client : **WSP Australia Pty Ltd**
Contact : Mr Andrew Holloway
Address : PO BOX 1162
NEWCASTLE NSW, AUSTRALIA 2300
Telephone : ----
Project : PS135343 Arsenic LTEMP - Orica
Order number : PS135343
C-O-C number : ----
Sampler : Adam Lyne
Site : ----
Quote number : EN/008/21
No. of samples received : 33
No. of samples analysed : 33

Page : 1 of 9
Laboratory : Environmental Division Sydney
Contact : Sepan Mahamad
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : +61 2 8784 8555
Date Samples Received : 27-Jul-2023 15:08
Date Analysis Commenced : 29-Jul-2023
Issue Date : 02-Aug-2023 14:50



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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories

Position

Accreditation Category

Ankit Joshi

Senior Chemist - Inorganics

Sydney Inorganics, Smithfield, NSW



General Comments

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

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

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

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

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

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

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



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MWCC01-3IN	MWCC01_6IN	MWCC01_9IN	MWCC02_3IN	MWCC02_6IN
Sampling date / time					26-Jul-2023 00:00	26-Jul-2023 00:00	26-Jul-2023 00:00	26-Jul-2023 00:00	26-Jul-2023 00:00
Compound	CAS Number	LOR	Unit		ES2325162-001	ES2325162-002	ES2325162-003	ES2325162-004	ES2325162-005
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		0.324	0.044	0.296	1.86	89.8



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MWCC02_9IN	MWCC03_3IN	MWCC03_6IN	MWCC03_9IN	MW21A
Sampling date / time					26-Jul-2023 00:00	26-Jul-2023 00:00	26-Jul-2023 00:00	26-Jul-2023 00:00	27-Jul-2023 00:00
Compound	CAS Number	LOR	Unit		ES2325162-006	ES2325162-007	ES2325162-008	ES2325162-009	ES2325162-010
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		36.8	0.003	0.003	0.003	11.6



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	MW50	MW54	BP5-3	BP5-6	BP5-9
Sampling date / time					27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00
Compound	CAS Number	LOR	Unit		ES2325162-011	ES2325162-012	ES2325162-013	ES2325162-014	ES2325162-015
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		61.8	2.95	4.00	43.5	14.5



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	BP7-3	BP7-6	GWW02S	GWW02I	GWW02D
Sampling date / time					27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00
Compound	CAS Number	LOR	Unit	ES2325162-016	ES2325162-017	ES2325162-018	ES2325162-019	ES2325162-020	
				Result	Result	Result	Result	Result	
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L	2.89	7.93	2.80	44.6	63.9	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	GWW03S	GWW03I	GWW03D	POMW7	POMW62-6
Sampling date / time					27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00
Compound	CAS Number	LOR	Unit		ES2325162-021	ES2325162-022	ES2325162-023	ES2325162-024	ES2325162-025
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		1.05	44.3	0.012	2.09	2.43



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	POMW63-3	POMW63-6	POMW63-9	POMW63-12	D01_20230726
Sampling date / time					27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	26-Jul-2023 00:00
Compound	CAS Number	LOR	Unit		ES2325162-026	ES2325162-027	ES2325162-028	ES2325162-029	ES2325162-030
					Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		0.152	0.008	0.094	0.012	0.043



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	D02_20230727	D01_20230727	FB01_20230727	----	----
Sampling date / time					27-Jul-2023 00:00	27-Jul-2023 00:00	27-Jul-2023 00:00	----	----
Compound	CAS Number	LOR	Unit		ES2325162-031	ES2325162-032	ES2325162-033	-----	-----
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		6.98	61.3	<0.001	----	----



QUALITY CONTROL REPORT

Work Order	: ES2325162	Page	: 1 of 3
Client	: WSP Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: Mr Andrew Holloway	Contact	: Sepan Mahamad
Address	: PO BOX 1162 NEWCASTLE NSW, AUSTRALIA 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: PS135343 Arsenic LTEMP - Orica	Date Samples Received	: 27-Jul-2023
Order number	: PS135343	Date Analysis Commenced	: 29-Jul-2023
C-O-C number	: ----	Issue Date	: 02-Aug-2023
Sampler	: Adam Lyne		
Site	: ----		
Quote number	: EN/008/21		
No. of samples received	: 33		
No. of samples analysed	: 33		



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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	Position	Accreditation Category
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW



General Comments

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

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

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key :
 Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
 CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
 LOR = Limit of reporting
 RPD = Relative Percentage Difference
 # = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5202947)									
ES2325162-004	MWCC02_3IN	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	1.86	1.87	0.5	0% - 20%
ES2324877-001	Anonymous	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<1 µg/L	<0.001	0.0	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 5202951)									
ES2325162-014	BP5-6	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	43.5	39.2	10.5	0% - 20%
ES2325162-024	POMW7	EG020A-F: Arsenic	7440-38-2	0.001	mg/L	2.09	2.11	0.7	0% - 20%



Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: WATER				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%) LCS	Acceptable Limits (%) Low High	
Method: Compound	CAS Number	LOR	Unit	Result				
EG020F: Dissolved Metals by ICP-MS (QCLot: 5202947)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	101	85.0	114
EG020F: Dissolved Metals by ICP-MS (QCLot: 5202951)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	107	85.0	114

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: WATER				Matrix Spike (MS) Report			
				Spike Concentration	SpikeRecovery(%) MS	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number			Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 5202947)							
ES2324877-004	Anonymous	EG020A-F: Arsenic	7440-38-2	1 mg/L	128	70.0	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 5202951)							
ES2325162-015	BP5-9	EG020A-F: Arsenic	7440-38-2	1 mg/L	# Not Determined	70.0	130



QA/QC Compliance Assessment to assist with Quality Review

Work Order	: ES2325162	Page	: 1 of 4
Client	: WSP Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: Mr Andrew Holloway	Telephone	: +61 2 8784 8555
Project	: PS135343 Arsenic LTEMP - Orica	Date Samples Received	: 27-Jul-2023
Site	: ----	Issue Date	: 02-Aug-2023
Sampler	: Adam Lyne	No. of samples received	: 33
Order number	: PS135343	No. of samples analysed	: 33

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO** Method Blank value outliers occur.
- **NO** Duplicate outliers occur.
- **NO** Laboratory Control outliers occur.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

- **NO** Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- **NO** Quality Control Sample Frequency Outliers exist.

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG020F: Dissolved Metals by ICP-MS	ES2325162--015	BP5-9	Arsenic	7440-38-2	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results. This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein. Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Method	Sample Date	Extraction / Preparation			Analysis			
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation	
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) MWCC01-3IN, MWCC01_9IN, MWCC02_6IN, MWCC03_3IN, MWCC03_9IN,	MWCC01_6IN, MWCC02_3IN, MWCC02_9IN, MWCC03_6IN, D01_20230726	26-Jul-2023	----	----	----	29-Jul-2023	22-Jan-2024	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) MW21A, MW54, BP5-6, BP7-3, GWW02S, GWW02D, GWW03I, POMW7, POMW63-3, POMW63-9, D02_20230727, FB01_20230727	MW50, BP5-3, BP5-9, BP7-6, GWW02I, GWW03S, GWW03D, POMW62-6, POMW63-6, POMW63-12, D01_20230727,	27-Jul-2023	----	----	----	29-Jul-2023	23-Jan-2024	✓



Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✔ = Quality Control frequency within specification .

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	40	10.00	10.00	✔	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	40	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	40	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	40	5.00	5.00	✔	NEPM 2013 B3 & ALS QC Standard



Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.



SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : ES2325162

Client	: WSP Australia Pty Ltd	Laboratory	: Environmental Division Sydney
Contact	: Mr Andrew Holloway	Contact	: Sepan Mahamad
Address	: PO BOX 1162 NEWCASTLE NSW, AUSTRALIA 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: andrew.holloway@wsp.com	E-mail	: Sepan.Mahamad@ALSGlobal.com
Telephone	: ----	Telephone	: +61 2 8784 8555
Facsimile	: ----	Facsimile	: +61-2-8784 8500
Project	: PS135343 Arsenic LTEMP - Orica	Page	: 1 of 3
Order number	: ----	Quote number	: ES2021PARBRINSW0018 (EN/008/21)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: Adam Lyne		

Dates

Date Samples Received	: 27-Jul-2023 15:08	Issue Date	: 27-Jul-2023
Client Requested Due Date	: 03-Aug-2023	Scheduled Reporting Date	: 03-Aug-2023

Delivery Details

Mode of Delivery	: Undefined	Security Seal	: Not Available
No. of coolers/boxes	: 1	Temperature	: 10.1°C - Ice Bricks present
Receipt Detail	:	No. of samples received / analysed	: 33 / 33

General Comments

- This report contains the following information:
 - Sample Container(s)/Preservation Non-Compliances
 - Summary of Sample(s) and Requested Analysis
 - Proactive Holding Time Report
 - Requested Deliverables
- **Sample T01_20230727 and T01_20230726 to be forwarded to Eurofins as per COC's.**
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**
- Please direct any queries you have regarding this work order to the above ALS laboratory contact.
- Analytical work for this work order will be conducted at ALS Sydney.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.



Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- No sample container / preservation non-compliance exists.

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Sampling date / time	Sample ID	WATER - EG020F Dissolved Metals by ICP/MS
ES2325162-001	26-Jul-2023 00:00	MWCC01-3IN	✓
ES2325162-002	26-Jul-2023 00:00	MWCC01_6IN	✓
ES2325162-003	26-Jul-2023 00:00	MWCC01_9IN	✓
ES2325162-004	26-Jul-2023 00:00	MWCC02_3IN	✓
ES2325162-005	26-Jul-2023 00:00	MWCC02_6IN	✓
ES2325162-006	26-Jul-2023 00:00	MWCC02_9IN	✓
ES2325162-007	26-Jul-2023 00:00	MWCC03_3IN	✓
ES2325162-008	26-Jul-2023 00:00	MWCC03_6IN	✓
ES2325162-009	26-Jul-2023 00:00	MWCC03_9IN	✓
ES2325162-010	27-Jul-2023 00:00	MW21A	✓
ES2325162-011	27-Jul-2023 00:00	MW50	✓
ES2325162-012	27-Jul-2023 00:00	MW54	✓
ES2325162-013	27-Jul-2023 00:00	BP5-3	✓
ES2325162-014	27-Jul-2023 00:00	BP5-6	✓
ES2325162-015	27-Jul-2023 00:00	BP5-9	✓
ES2325162-016	27-Jul-2023 00:00	BP7-3	✓
ES2325162-017	27-Jul-2023 00:00	BP7-6	✓
ES2325162-018	27-Jul-2023 00:00	GWW02S	✓
ES2325162-019	27-Jul-2023 00:00	GWW02I	✓
ES2325162-020	27-Jul-2023 00:00	GWW02D	✓
ES2325162-021	27-Jul-2023 00:00	GWW03S	✓
ES2325162-022	27-Jul-2023 00:00	GWW03I	✓
ES2325162-023	27-Jul-2023 00:00	GWW03D	✓
ES2325162-024	27-Jul-2023 00:00	POMW7	✓
ES2325162-025	27-Jul-2023 00:00	POMW62-6	✓
ES2325162-026	27-Jul-2023 00:00	POMW63-3	✓
ES2325162-027	27-Jul-2023 00:00	POMW63-6	✓
ES2325162-028	27-Jul-2023 00:00	POMW63-9	✓
ES2325162-029	27-Jul-2023 00:00	POMW63-12	✓
ES2325162-030	26-Jul-2023 00:00	D01_20230726	✓
ES2325162-031	27-Jul-2023 00:00	D02_20230727	✓
ES2325162-032	27-Jul-2023 00:00	D01_20230727	✓
ES2325162-033	27-Jul-2023 00:00	FB01_20230727	✓



Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ADAM LYNE

- *AU Certificate of Analysis - NATA (COA)	Email	adam.lyne@wsp.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	adam.lyne@wsp.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	adam.lyne@wsp.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	adam.lyne@wsp.com
- Chain of Custody (CoC) (COC)	Email	adam.lyne@wsp.com
- EDI Format - ENMRG (ENMRG)	Email	adam.lyne@wsp.com
- EDI Format - ESDAT (ESDAT)	Email	adam.lyne@wsp.com
- Purchase Order Request Letter (PO_Request)	Email	adam.lyne@wsp.com

Andrew Holloway

- *AU Certificate of Analysis - NATA (COA)	Email	andrew.holloway@wsp.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	andrew.holloway@wsp.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	andrew.holloway@wsp.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	andrew.holloway@wsp.com
- A4 - AU Tax Invoice (INV)	Email	andrew.holloway@wsp.com
- Chain of Custody (CoC) (COC)	Email	andrew.holloway@wsp.com
- EDI Format - ENMRG (ENMRG)	Email	andrew.holloway@wsp.com
- EDI Format - ESDAT (ESDAT)	Email	andrew.holloway@wsp.com
- Purchase Order Request Letter (PO_Request)	Email	andrew.holloway@wsp.com

ESDAT REPORTS

- EDI Format - ESDAT (ESDAT)	Email	wsp@esdat.com.au
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INVOICES

- A4 - AU Tax Invoice (INV)	Email	au.accountspayable@wsp.com
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LAB OF ORIGIN:
NEWCASTLE

 CHAIN OF CUSTODY ALS Laboratory: please tick →	ADELAIDE 21 Bruma Road Pinnaroo SA 5005 Ph: 08 8599 0900 E: adelaide@alsglobal.com DUNEDIN 2181 Stirling Street Dunedin 9016 Ph: 03 4782 7222 E: samples.dunedin@alsglobal.com JOHANNESBURG 40 Calverton Drive Midrand 2008 Ph: 011 7421 2000 E: johannesburg@alsglobal.com	MELBOURNE 18 Hargrave Road Macleod VIC 3085 Ph: 07 4044 0177 E: melb@alsglobal.com MURDOCH 120 Sydney Road Mudgee NSW 2855 Ph: 02 6572 8735 E: mudgee@alsglobal.com	NEWCASTLE 6555 Maitland Road Mayfield NSW 2304 Ph: 02 4914 2500 E: samples.newcastle@alsglobal.com SYDNEY 2-4 Westgate Road Sydney NSW 2051 Ph: 02 8545 9000 E: samples.melb@alsglobal.com PERTH 10 Hedley Way Malaga WA 6060 Ph: 08 9420 1955 E: samples.perth@alsglobal.com	JOHANNESBURG 211 Woodpark Road Sandhurst NSW 2164 Ph: 02 8758 8355 E: samples.sydney@alsglobal.com JOHANNESBURG 14-15 Denham Court Bona 4818 Ph: 07 4702 0000 E: johannesburg@alsglobal.com JOHANNESBURG 30 Kerry Street Wollongong NSW 2500 Ph: 02 4223 3105 E: wollongong@alsglobal.com
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CLIENT: Golder	TURNAROUND REQUIREMENTS: ☒ (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	FOR LABORATORY USE ONLY (Circle)
OFFICE: Newcastle	☐ Non Standard or urgent TAT (List due date):	Custody Seal intact? Yes No ☒ N/A
PROJECT: Arsenic LTEMP - Orica	PROJECT NO: PS135343	Free ice / frost / ice blocks present upon receipt? Yes No ☒ N/A
ORDER NUMBER:	PURCHASE ORDER NO.:	Random Sample Temperature on Receipt: 10.1 °C
PROJECT MANAGER: Andrew Holloway	CONTACT PH: 0439 441 468	Other comment:
SAMPLER: Adam Lyne	SAMPLER MOBILE: 0402452896	RECEIVED BY: <i>ll</i>
COC Emailed to ALS? YES	EDD FORMAT (or default): Esdat	RELINQUISHED BY: Adam Lyne
Email Reports to (will default to PM if no other addresses are listed): Andrew.Holloway@wsp.com Adam.Lyne@wsp.com	DATE/TIME: 27/7/2023	DATE/TIME: 27/7/2023
Email Invoice to (will default to PM if no other addresses are listed): andrew.holloway@wsp.com		DATE/TIME: 27/7/2023

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY		SAMPLE DETAILS MATRIX: Solid(S) Water(W)		CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB: Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (Red Filtered bottle required).										Additional Information	
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Arsenic Dissolved											Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	MWCC01-3IN	26/7/23	W		1	X											
2	MWCC01-6IN	26/7/23	W		1	X											
3	MWCC01-9IN	26/7/23	W		1	X											
4	MWCC02-3IN	26/7/23	W		1	X											
5	MWCC02-6IN	26/7/23	W		1	X											
6	MWCC02-9IN	26/7/23	W		1	X											
7	MWCC03-3IN	26/7/23	W		1	X											
8	MWCC03-6IN	26/7/23	W		1	X											
9	MWCC03-9IN	26/7/23	W		1	X											
10	MW21A	27/7/23	W		1	X											
11	MW50	27/7/23	W		1	X											
12	MW54	27/7/23	W		1	X											
13	BP5-3	27/7/23	W		1	X											
14	BP5-6	27/7/23	W		1	X											
15	BP5-9	27/7/23	W		1	X											
16	BP7-3	27/7/23	W		1	X											
17	BP7-6	27/7/23	W		1	X											
18	GWW02S	27/7/23	W		1	X											
19	GWW02I	27/7/23	W		1	X											
20	GWW02D	27/7/23	W		1	X											
21	GWW03S	7/01/2022	W		1	X											
22	GWW03I	7/01/2022	W		1	X											
23	GWW03D	7/01/2022	W		1	X											
24	POMW7	27/7/23	W		1	X											
25	POMW62-6	27/7/23	W		1	X											
26	POMW63-3	27/7/23	W		1	X											
27	POMW63-6	27/7/23	W		1	X											
28	POMW63-9	27/7/23	W		1	X											
29	POMW63-12	27/7/23	W		1	X											
30	D01_20230726	26/7/23	W		1	X											
31	D02_20230727	27/7/23	W		1	X											
	T01_20230727	27/7/23	W		1	X											Forward to Eurofins
	T01_20230726	26/7/23	W		1	X											Forward to Eurofins
32	D01_20230727	27/7/23	W		1	X											
33	FB01_20230727	27/7/23	W		1	X											
TOTAL					35	35											

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulfate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl Preserved Plastic; HS = HCl Preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulfate Salts; B = Unpreserved Bag; LI = Lugol's Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

Environmental Division
Sydney
Work Order Reference
ES2325162



Telephone : - 61-2-8764 6555



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Free ice / frozen ice blocks present upon ☒ Yes ☐ No

Random Sample Temperature on Receipt: 2 C

Other comment: 10.1

RELINQUISHED BY:	RECEIVED BY:
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TEST TIME:	DATE/TIME:
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Subcon / Forward Lab / Split WO
Lab / Analysis:
Organised By / Date:
Relinquished By / Date:
Connote / Courier:
WO No:
Attached By PO / Internal Sheet:

[illegible]

Continued on page 10

Forward to Eurofins

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ONC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AO = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic
V = VOA Val HCl Preserved; VB = VOA Val Sodium Bisulfate Preserved; VS = VOA Val Sulfuric Preserved; AV = Airfreight Unpreserved Val SG = Sulfuric Preserved Amber Glass; H = HCl Preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass

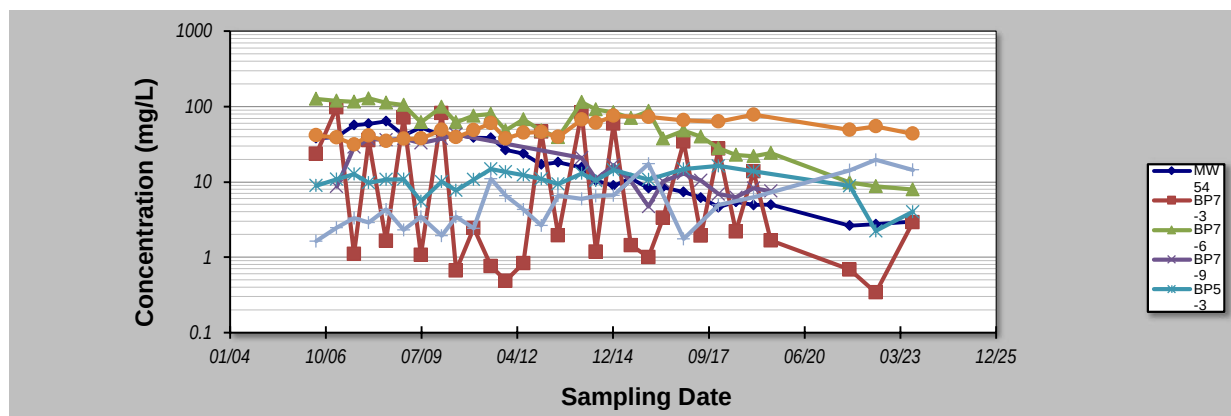
Appendix E

Trend Analysis



Evaluation Date: **3-Aug-23** Job ID: **PS135343**
 Facility Name: **Orica Kooragang Island** Constituent: **Arsenic**
 Conducted By: **Adam Lyne** Concentration Units: **mg/L**

Sampling Point ID:		MW54	BP7-3	BP7-6	BP7-9	BP5-3	BP5-6	BP5-9
Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Jul-06	38.1	23.5	126.0	-	8.9	41.5	1.6
2	Feb-07	39.6	97.6	119.0	8.7	10.9	38.7	2.5
3	Aug-07	56.8	1.1	116.0	28.9	12.7	31.3	3.3
4	Jan-08	58.8	35.6	128.0	37.1	9.8	41.1	2.9
5	Jul-08	63.8	1.7	113.0	36.1	10.8	34.7	4.3
6	Jan-09	41.5	71.3	105.0	37.6	10.9	37.3	2.3
7	Jul-09	53.0	1.1	61.8	32.7	5.5	37.7	3.4
8	Feb-10	41.6	81.6	99.0	37.8	10.1	49.0	1.9
9	Jul-10	42.1	0.7	62.0	42.7	7.8	39.0	3.4
10	Jan-11	38.7	2.4	75.7	-	10.8	48.7	2.4
11	Jul-11	38.5	0.8	79.6	-	14.9	60.0	11.0
12	Dec-11	26.6	0.5	48.3	-	13.6	37.6	6.6
13	Jun-12	23.7	0.8	67.7	-	12.4	44.8	4.3
14	Dec-12	17.1	46.2	48.2	-	11.0	46.0	2.6
15	Jun-13	18.3	2.0	39.0	-	9.4	39.4	6.6
16	Feb-14	15.6	83.2	115.0	21.00	13.0	67.3	5.9
17	Jul-14	10.5	1.2	91.3	10.90	10.4	60.6	6.5
18	Jan-15	8.9	59.0	83.7	16.70	14.5	75.1	6.6
19	Jul-15	11.2	1.44	70.2	10.20	-	-	-
20	Jan-16	8.3	1.0	87.0	4.70	10.8	72.8	17.4
21	Jun-16	8.53	3.3	37.6	10.20	-	-	-
22	Jan-17	7.38	34.2	47.9	13.00	14.8	65.6	1.8
23	Jul-17	6.18	1.9	39.9	10.50	-	-	-
24	Jan-18	4.6	27.6	28.1	6.87	16.3	63.4	4.9
25	Jul-18	5.43	2.19	22.9	6.22	-	-	-
26	Jan-19	4.92	13.8	21.9	8.30	13.9	78.0	6.2
27	Jul-19	4.96	1.66	24.2	7.54	-	-	-
28	Mar-20	-	-	-	-	-	-	-
29	Oct-21	2.62	0.685	9.9	-	8.86	49.1	14.3
30	Jul-22	2.75	0.34	8.78	-	2.23	54.5	19.6
31	Jul-23	2.95	2.89	7.93	-	4	43.5	14.5
32								
33								
34								
35								
Coefficient of Variation:		0.84	1.49	0.57	0.69	0.31	0.27	0.81
Mann-Kendall Statistic (S):		-365	-55	-311	-93	22	146	154
Confidence Factor:		>99.9%	83.1%	>99.9%	99.9%	68.6%	>99.9%	>99.9%
Concentration Trend:		Decreasing	No Trend	Decreasing	Decreasing	No Trend	Increasing	Increasing



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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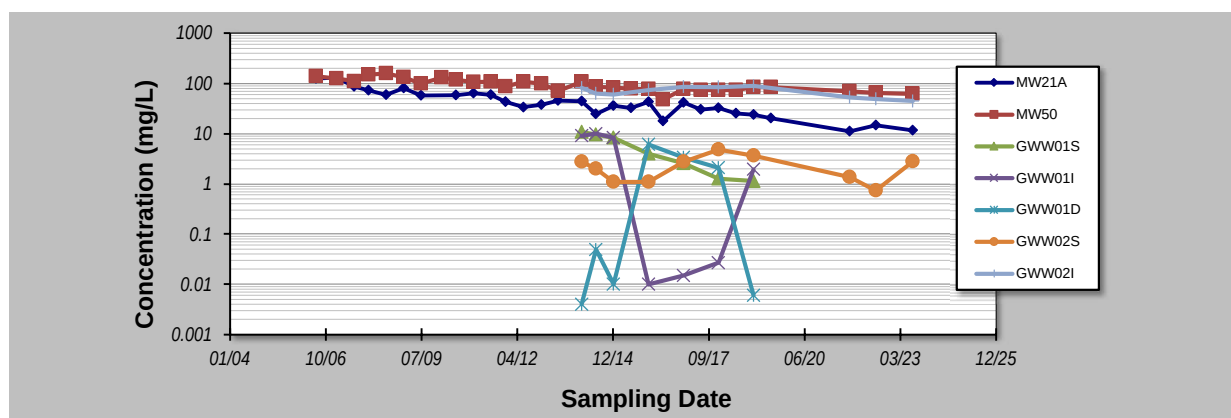
GSI Environmental Inc., www.gsi-net.com

GSI MANN-KENDALL TOOLKIT

for Constituent Trend Analysis

Evaluation Date: 3-Aug-23	Job ID: PS135343
Facility Name: Orica Kooragang Island	Constituent: Arsenic
Conducted By: Adam Lyne	Concentration Units: mg/L

Sampling Point ID:		MW21A	MW50	GWW01S	GWW01I	GWW01D	GWW02S	GWW02I
Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Jul-06	125	140					
2	Feb-07	131	125					
3	Aug-07	87.3	111					
4	Jan-08	73.2	149					
5	Jul-08	59.7	158					
6	Jan-09	81.1	133					
7	Jul-09	57.8	99.5					
8	Feb-10	NS	132					
9	Jul-10	58.6	118					
10	Jan-11	63.6	107					
11	Jul-11	59.7	109					
12	Dec-11	43.3	87.2					
13	Jun-12	33.8	108					
14	Dec-12	38.0	100					
15	Jun-13	45.8	70.6					
16	Feb-14	44.4	108	10.8	9.2	0.004	2.8	81.9
17	Jul-14	24.8	86	9.7	10.0	0.05	2.0	63.2
18	Jan-15	36.1	82.8	8.3	8.3	0.01	1.1	60.4
19	Jul-15	32.7	78.4	-	-	-	-	-
20	Jan-16	42.8	77.4	4	0.01	6.1	1.1	74.6
21	Jun-16	17.9	47.8	-	-	-	-	-
22	Jan-17	41.8	77	2.6	0.02	3.4	2.8	85.5
23	Jul-17	30.2	74.3	-	-	-	-	-
24	Jan-18	32.8	73.9	1.3	0.03	2.1	4.8	85.0
25	Jul-18	25.4	74.6	-	-	-	-	-
26	Jan-19	23.8	84.4	1.1	1.96	0.006	3.6	89.3
27	Jul-19	20.4	84.2	-	-	-	-	-
28	Mar-20	-	-	-	-	-	-	-
29	Oct-21	11.1	70.3	-	-	-	1.4	53.0
30	Jul-22	14.8	65.2	-	-	-	0.74	49.3
31	Jul-23	11.6	61.8	-	-	-	2.8	44.6
32								
33								
34								
35								
Coefficient of Variation:		0.64	0.29	0.76	1.12	1.42	0.56	0.24
Mann-Kendall Statistic (S):		-321	-310	-21	-7	3	1	-13
Confidence Factor:		>99.9%	>99.9%	100.0%	80.9%	61.4%	50.0%	85.4%
Concentration Trend:		Decreasing	Decreasing	Decreasing	No Trend	No Trend	No Trend	Stable



Notes:

- At least four independent sampling events per well are required for calculating the trend. Methodology is valid for 4 to 40 samples.
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, Ground Water, 41(3):355-367, 2003.

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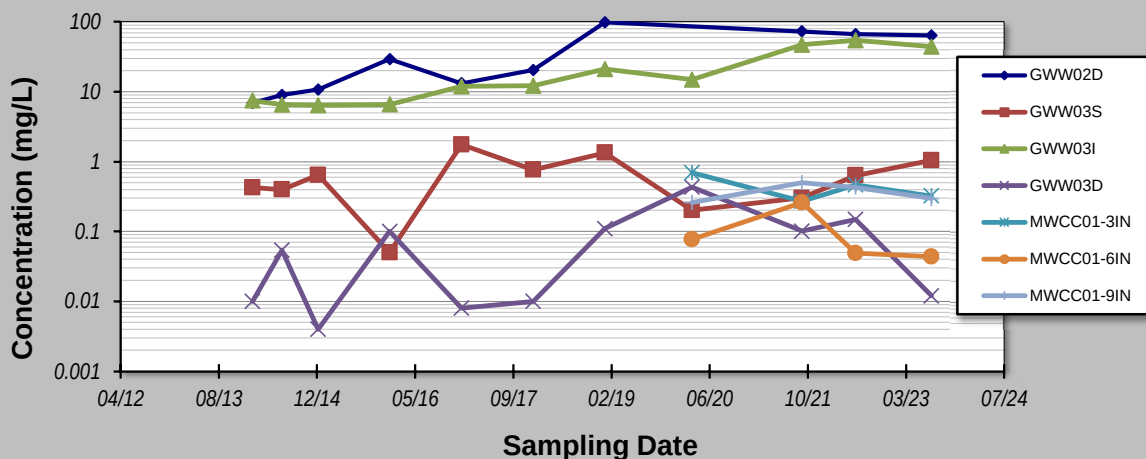
GSI MANN-KENDALL TOOLKIT

for Constituent Trend Analysis

Evaluation Date: 3-Aug-23	Job ID: PS135343
Facility Name: Orica Kooragang Island	Constituent: Arsenic
Conducted By: Adam Lyne	Concentration Units: mg/L

Sampling Point ID:	GWW02D	GWW03S	GWW03I	GWW03D	MWCC01-3IN	MWCC01-6IN	MWCC01-9IN
--------------------	---------------	---------------	---------------	---------------	-------------------	-------------------	-------------------

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Feb-14	6.9	0.4	7.5	0.01			
2	Jul-14	9.0	0.4	6.5	0.1			
3	Jan-15	10.8	0.6	6.4	0.004			
4	Jul-15	-	-	-	-			
5	Jan-16	29.4	0.1	6.6	0.1			
6	Jun-16	-	-	-	-			
7	Jan-17	13.2	1.8	12.0	0.008			
8	Jul-17	-	-	-	-			
9	Jan-18	20.5	0.8	12.2	0.010			
10	Jul-18	-	-	-	-			
11	Jan-19	98.6	1.34	21.2	0.110			
12	Jul-19	-	-	-	-			
13	Mar-20	-	0.2	14.9	0.430	0.695	0.077	0.26
14	Oct-21	73.0	0.3	47.2	0.101	0.272	0.259	0.5
15	Jul-22	66.6	0.636	54.4	0.148	0.465	0.049	0.43
16	Jul-23	63.9	1.05	44.3	0.012	0.324	0.044	0.296
17								
18								
19								
20								
Coefficient of Variation:		0.85	0.75	0.86	1.38	0.43	0.95	0.30
Mann-Kendall Statistic (S):		29	7	41	22	-2	-4	0
Confidence Factor:		99.5%	67.6%	100.0%	94.9%	62.5%	83.3%	37.5%
Concentration Trend:		Increasing	No Trend	Increasing	Prob. Increasing	Stable	Stable	Stable



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing ($S > 0$) or decreasing ($S < 0$): $> 95\%$ = Increasing or Decreasing; $\geq 90\%$ = Probably Increasing or Probably Decreasing; $< 90\%$ and $S > 0$ = No Trend; $< 90\%$, $S \leq 0$, and $COV \geq 1$ = No Trend; $< 90\%$ and $COV < 1$ = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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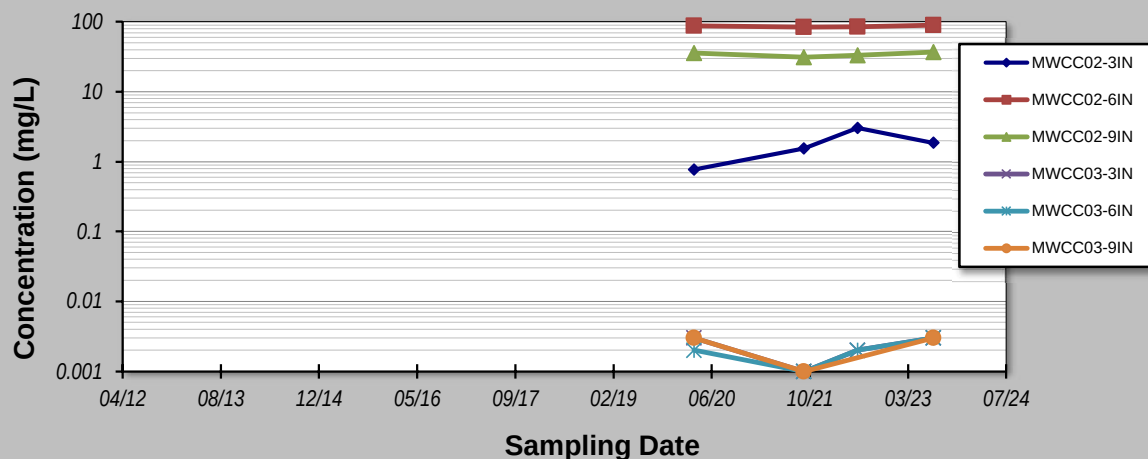
GSI MANN-KENDALL TOOLKIT

for Constituent Trend Analysis

Evaluation Date: **3-Aug-23** Job ID: **PS135343**
 Facility Name: **Orica Kooragang Island** Constituent: **Arsenic**
 Conducted By: **Adam Lyne** Concentration Units: **mg/L**

Sampling Point ID: **MWCC02-3IN MWCC02-6IN MWCC02-9IN MWCC03-3IN MWCC03-6IN MWCC03-9IN**

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Feb-14							
2	Jul-14							
3	Jan-15							
4	Jul-15							
5	Jan-16							
6	Jun-16							
7	Jan-17							
8	Jul-17							
9	Jan-18							
10	Jul-18							
11	Jan-19							
12	Jul-19							
13	Mar-20	0.774	87.5	35.8	0.003	0.002	0.003	
14	Oct-21	1.55	84	31.1	0.001	0.001	0.001	
15	Jul-22	3.04	84.7	33.3	0.002	0.002	<0.001	
16	Jul-23	1.86	89.8	36.8	0.003	0.003	0.003	
17								
18								
19								
20								
Coefficient of Variation:		0.52	0.03	0.07	0.43	0.41	0.49	
Mann-Kendall Statistic (S):		4	2	2	1	3	0	
Confidence Factor:		83.3%	62.5%	62.5%	50.0%	72.9%		
Concentration Trend:		No Trend	No Trend	No Trend	No Trend	No Trend		



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing ($S > 0$) or decreasing ($S < 0$): $>95\%$ = Increasing or Decreasing; $\geq 90\%$ = Probably Increasing or Probably Decreasing; $< 90\%$ and $S > 0$ = No Trend; $< 90\%$, $S \leq 0$, and $COV \geq 1$ = No Trend; $< 90\%$ and $COV < 1$ = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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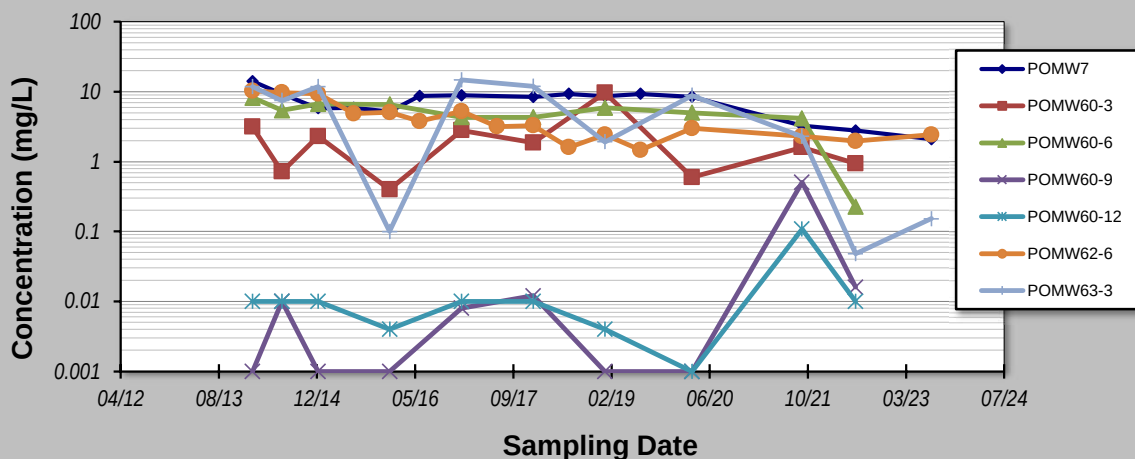
GSI MANN-KENDALL TOOLKIT

for Constituent Trend Analysis

Evaluation Date: **3-Aug-23** Job ID: **PS135343**
 Facility Name: **Orica Kooragang Island** Constituent: **Arsenic**
 Conducted By: **Adam Lyne** Concentration Units: **mg/L**

Sampling Point ID: **POMW7** **POMW60-3** **POMW60-6** **POMW60-9** **POMW60-12** **POMW62-6** **POMW63-3**

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Feb-14	14.1	3.2	8.2	0.00	0.01	10.3	11.8
2	Jul-14	9.3	0.7	5.4	0.0	0.01	9.73	7.47
3	Jan-15	5.8	2.3	6.7	0.001	0.01	9.4	11.8
4	Jul-15	5.9					4.88	
5	Jan-16	5.2	0.4	6.6	0.0	0.004	5.1	0.1
6	Jun-16	8.7					3.8	
7	Jan-17	8.9	2.8	4.3	0.008	0.01	5.25	14.8
8	Jul-17						3.19	
9	Jan-18	8.5	1.9	4.3	0.012	0.01	3.29	12
10	Jul-18	9.4					1.61	
11	Jan-19	8.7	9.71	5.9	0.001	0.004	2.44	1.92
12	Jul-19	9.3					1.46	
13	Mar-20	8.5	0.6	5.0	0.001	0.001	3.0	8.9
14	Oct-21	3.3	1.6	4.2	0.507	0.108	2.3	2.3
15	Jul-22	2.8	0.9	0.2	0.016	0.01	2.0	0.0
16	Jul-23	2.1					2.4	0.2
17								
18								
19								
20								
Coefficient of Variation:		0.43	1.13	0.42	2.84	1.80	0.67	0.88
Mann-Kendall Statistic (S):		-37	-7	-31	15	-3	-86	-20
Confidence Factor:		96.3%	70.0%	99.8%	89.2%	56.9%	>99.9%	92.9%
Concentration Trend:		Decreasing	No Trend	Decreasing	No Trend	No Trend	Decreasing	Prob. Decreasing



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing ($S > 0$) or decreasing ($S < 0$): $> 95\%$ = Increasing or Decreasing; $\geq 90\%$ = Probably Increasing or Probably Decreasing; $< 90\%$ and $S > 0$ = No Trend; $< 90\%$, $S \leq 0$, and $COV \geq 1$ = No Trend; $< 90\%$ and $COV < 1$ = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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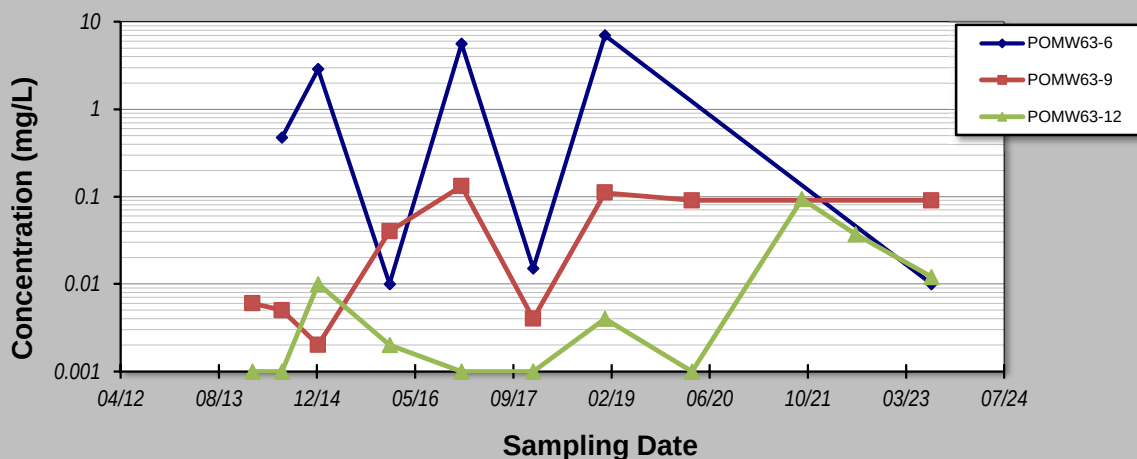
GSI MANN-KENDALL TOOLKIT

for Constituent Trend Analysis

Evaluation Date: **3-Aug-23** Job ID: **PS135343**
 Facility Name: **Orica Kooragang Island** Constituent: **Arsenic**
 Conducted By: **Adam Lyne** Concentration Units: **mg/L**

Sampling Point ID: **POMW63-6** **POMW63-9** **POMW63-12**

Sampling Event	Sampling Date	ARSENIC CONCENTRATION (mg/L)						
1	Feb-14		0.006	0.001				
2	Jul-14	0.5	0.005	0.001				
3	Jan-15	2.9	0.002	0.010				
4	Jul-15							
5	Jan-16	0.0	0.040	0.002				
6	Jun-16							
7	Jan-17	5.6	0.132	0.001				
8	Jul-17							
9	Jan-18	0.0	0.004	0.001				
10	Jul-18							
11	Jan-19	7.0	0.11	0.004				
12	Jul-19							
13	Mar-20	0	0.09	0.001				
14	Oct-21			0.094				
15	Jul-22			0.037				
16	Jul-23	0.01	0.09	0.012				
17								
18								
19								
20								
Coefficient of Variation:		1.43	0.98	1.90				
Mann-Kendall Statistic (S):		-5	11	21				
Confidence Factor:		68.3%	84.6%	94.0%				
Concentration Trend:		No Trend	No Trend	Prob. Increasing				



Notes:

- At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
- Confidence in Trend = Confidence (in percent) that constituent concentration is increasing ($S > 0$) or decreasing ($S < 0$): $> 95\%$ = Increasing or Decreasing; $\geq 90\%$ = Probably Increasing or Probably Decreasing; $< 90\%$ and $S > 0$ = No Trend; $< 90\%$, $S \leq 0$, and $COV \geq 1$ = No Trend; $< 90\%$ and $COV < 1$ = Stable.
- Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

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Appendix F

Limitations





Limitation Statement

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