ENGAGE ENVIRONMENTAL SERVICES
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GROUNDWATER MONITORING

SCONE WASTE FACILITY
NOBLET ROAD
SCONE NSW

PROJECT NUMBER – E04-0320
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Date – 20-3-2020

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ABBREVIATIONS

The following is a list of common abbreviations used in the Contamination Sector within environmental reports.

B(a)P	Benzo(a)Pyrene
BGL	Below Ground Level
BTEX	Benzene, Toluene, Ethyl Benzene, Xylene
CLM	Contaminated Land Management
CSM	Conceptual Site Model
DA	Development Application
DP	Deposited Plan
DQI	Data Quality Indicator
DQO	Data Quality Objective
EIL	Ecological Investigation Level
EPA	Environment Protection Authority (NSW)
EPL	Environmental Protection License
ESL	Ecological Screening Level
LOR	Limit of Reporting
LOT	Allotment
MW	Monitoring Well
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NSW	New South Wales
OCP	Organochlorine Pesticides
OEH	Office of Environmental and Heritage
OPP	Organophosphorus Pesticides
PAH	Polycyclic Aromatic Hydrocarbons
PCOC	Potential Contaminant of Concern
PCB	Polychlorinated Biphenyls
QA/QC	Quality Assurance and Quality Control
SAC	Site Acceptance Criteria
SEPP	State Environmental Planning Policy
SWL	Standing Water Level
TCLP	Toxicity Characteristic Leaching Procedure
TRH	Total Recoverable Hydrocarbons
UHSC	Upper Hunter Shire Council
VOC	Volatile Organic Compounds
WHS	Work Health Safety

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1.0 INTRODUCTION

General

Under the requirements of the NSW EPA Environmental Protection Licence (EPL) 5863, Upper Hunter Shire Council (UHSC) is required to conduct quarterly and annual groundwater monitoring of the Scone Waste Facility located on Noblet Road, Scone, NSW, 2337.

The Quarterly Groundwater Monitoring Report provides a snapshot of the groundwater conditions at the Site in relation to the current Site Criteria and satisfies the groundwater monitoring requirements of the EPL.

The Scone Waste Facility is an active landfill, it has the potential to be a polluting activity or to adversely impact the groundwater within the immediate vicinity and down hydraulic gradient of the site if there was a leak within the landfill.

Engage Environmental Services (Engage) was commissioned by UHSC to undertake this quarterly round of groundwater monitoring at the site. The quarterly groundwater monitoring was carried out on 5th March 2020.

This report has been prepared utilising information supplied by the client, publicly accessible information, information obtained as part of the onsite fieldwork and analysis, information from Government bodies and from experience, knowledge, and current industry practice.

Briefing

The briefing provided by Upper Hunter Shire Council and contained within EPL 5863 indicates that quarterly groundwater monitoring is required at five locations on the site, monitoring wells A to E (MWA-MWE). Monitoring Well D is located within the landfill and the monitoring well accesses the perched water table (leachate) within the landfill. Comparisons against established criteria and historical data allow for trending of data. Trending of data can highlight seasonal variations, increases in analyte concentrations, decreases in analyte concentrations and fluctuations within the dataset. Over a time period the dataset can reveal increasing/decreasing trends highlighting potential site issues.

Refer to **Figure 1:** *Site Layout with Sample Locations*

2.0 SITE CRITERIA AND SAMPLING FREQUENCY

The groundwater analytical suite and sampling frequency were provided by UHSC and the EPL. Each of the wells have the same sampling regime and analytical suite for sample analysis. The site criterion are sourced from the Australian and New Zealand guidelines for fresh and marine water quality (ANZW 2018) 95% trigger values and National Environment Protection (Assessment of Site Contamination) Measure (NEPM) 2013, unless otherwise stated.

Table 1: Analytes, Site Criteria and Sampling Frequency for Groundwater Monitoring Wells - Quarterly.

	Analytes/Pollutant	Units	Site Criteria NEPM 2013 and ANZW 2018 Fresh Water 95%	Sampling Frequency
IONS	Calcium	mg/L	NA	Quarterly
	Alkalinity (total)	mg/L	NA	Quarterly
	Chloride	mg/L	NA	Quarterly
	Fluoride	mg/L	NA	Quarterly
	Potassium[1]	mg/L	410	Quarterly
	Magnesium	mg/L	NA	Quarterly
	Sulphate	mg/L	NA	Quarterly
HEAVY METALS	Iron	mg/L	0.3	Quarterly
	Manganese	mg/L	1.9	Quarterly
PHENOLS	Total phenolics	mg/L	0.32	Quarterly
OCP	Organochlorine Pesticide[3] (OCP)	mg/L	0.00001	Quarterly
MISC. INORGANICS	pH	pH	6.5 – 8	Quarterly
	Sodium	mg/L	NA	Quarterly
	Ammonia[2]	mg/L	0.9	Quarterly
	Nitrate	mg/L	50	Quarterly
	Total organic carbon	mg/L	4	Quarterly
	Electrical conductivity	µS/cm	NA	Quarterly

1 - World Health Organisation Guidelines for Drinking-water Quality 2009, Poor (acceptable) drinking water criteria.
2 - Criteria value may not protect key species from chronic toxicity, refer to ANZW 2018 for further guidance.
3 - A Trigger value for DDT is used in the absence of a criteria value for Total OCP. DDT has the lowest criteria of OCPs.

3.0 SAMPLING METHODOLOGY

Groundwater Sampling

The five well locations were identified on the site. The site map was cross-referenced to the markings on the monitoring wells to ensure the correct wells were being sampled. Purging and sampling of monitoring wells was conducted in accordance with the NEPM (NEPC, 2013) and the *Guidelines for the Assessment and Management of Groundwater Contamination* (NSW DECC, 2007).

Purging is the process of removing stagnant water from a well, immediately prior to sampling, causing its replacement by groundwater from the adjacent formation that is representative of actual aquifer conditions. In order to determine when a well has been adequately purged, the physical parameters (pH ± 0.1 unit, electrical conductivity ± 5%, temperature ± 0.20, reduction-oxidation (redox) ± 10%; and dissolved oxygen ± 10%.) are monitored while the groundwater is removed during purging.

The physical parameters were measured at regular intervals using a YSI Quatro Pro Plus Water Quality Meter. Stable conditions were indicated by monitoring for three consecutive readings of the physical parameters.

Collection of samples were direct into laboratory issued sampling containers for specific analytes. Samples were obtained using a disposable bailer. Care was taken so the bailer did not contact the sample container. All samples were collected and filled into the correct sample containers, a meniscus was formed on each sampling container prior to sealing to reduce or eliminate head space. The samples were placed immediately into a chilled esky to prevent the loss of potential volatile components.

Decontamination procedures between sampling events and sampling locations was undertaken. Sampling equipment was cleaned before and after sampling to prevent cross contamination. The cleaning procedure included:

- New nitrile disposable gloves for each well;
- Washing and wipe down with phosphate free laboratory grade detergent;
- Rinsing of brush before using brush on equipment;
- Using a brush on equipment if necessary;
- Rinsing with deionised water and wipe down with new wipe if necessary; and,
- New disposable bailer used for each well.

Appropriate decontamination procedures were appropriate during groundwater sampling.

4.0 RESULTS

The five groundwater monitoring wells were sampled during the March 2020 sampling event, results are detailed in **Tables 2** to **6**. Comparisons have been made to the previous round of monitoring (December 2019). Refer to **Attachment 1** – NATA Accredited Laboratory Results and **Attachment 3** – Data Log.

There were no exceedances of the site criteria for March in MWA. Refer to Table 2.

Table 2 – Quarterly Groundwater Results and Comparison Dec 2019 – Mar 2020 (MWA)

	Analytes	Units	Site Criteria (mg/L)	MWA Dec 2019	MWA Mar 2020
IONS	Calcium	mg/L	NA	600	570
	Alkalinity (total)	mg/L	NA	510	500
	Chloride	mg/L	NA	6900	7700
	Fluoride	mg/L	NA	0.2	0.1
	Potassium[1]	mg/L	410	3.3	2.4
	Magnesium	mg/L	NA	1100	1100
	Sulphate	mg/L	NA	41	47
HEAVY METALS	Iron	mg/L	0.3	<LOR	<LOR
	Manganese	mg/L	1.9	0.007	0.01
Phenols	Total phenolics	mg/L	0.32	<LOR	<LOR
OCPs	OCP[3]	mg/L	0.00001	<LOR	<LOR
MISC. INORGANICS	pH	pH	6.5 – 8	6.8	6.7
	Sodium	mg/L	NA	1900	2000
	Ammonia[2]	mg/L	0.9	<LOR	<LOR
	Nitrate	mg/L	0.7	0.57	0.56
	Total Organic Carbon	mg/L	4	**5**	**4**
	EC	µS/cm	NA	18000	19000

Highlighted results exceed site criteria

<LOR = No Detection. Analyte is below the Laboratory LOR

1 - World Health Organisation Guidelines for Drinking-water Quality 2009, Poor (acceptable) drinking water criteria.

2 - Criteria value may not protect key species from chronic toxicity, refer to ANZW 2018 for further guidance.

3 - A Trigger value for DDT is used in the absence of a criteria value for Total OCP. DDT has the lowest criteria of OCPs.

There was one exceedance of the site criteria for March in MWB, TOC at a concentration of 6mg/L. Refer to Table 3.

Table 3 – Quarterly Groundwater Results and Comparison Dec 2019 – Mar 2020 (MWB)

	Analytes	Units	Site Criteria (mg/L)	MWB Dec 2019	MWB Mar 2020
IONS	Calcium	mg/L	NA	570	520
	Alkalinity (total)	mg/L	NA	410	420
	Chloride	mg/L	NA	5200	5700
	Fluoride	mg/L	NA	0.2	0.3
	Potassium[1]	mg/L	410	2.8	2
	Magnesium	mg/L	NA	690	670
	Sulphate	mg/L	NA	69	88
HEAVY METALS	Iron	mg/L	0.3	ND	<LOR
	Manganese	mg/L	1.9	0.007	0.01
OCP	OCP[3]	mg/L	0.00001	ND	<LOR
PHENOLS	Total phenolics	mg/L	0.32	ND	<LOR
MISC. INORGANICS	pH	pH	6.5 – 8	7	6.9
	Sodium	mg/L	NA	1500	1500
	Ammonia[2]	mg/L	0.9	0.15	0.015
	Nitrate	mg/L	0.7	**0.73**	**0.51**
	Total Organic Carbon (TOC)	mg/L	4	**10**	**6**
	EC	µS/cm	NA	14000	14000

Highlighted results exceed site criteria

<LOR = No Detection. Analyte is below the Laboratory LOR

1 - World Health Organisation Guidelines for Drinking-water Quality 2009, Poor (acceptable) drinking water criteria.

2 - Criteria value may not protect key species from chronic toxicity, refer to ANZW 2018 for further guidance.

3 - A Trigger value for DDT is used in the absence of a criteria value for Total OCP. DDT has the lowest criteria of OCPs.

There were three exceedances of the site criteria for March in MWC; Manganese, Nitrate and TOC at concentrations of 6mg/L, 1.2mg/L and 8mg/L respectively. Refer to Table 4.

Table 4 – Quarterly Groundwater Results and Comparison Dec 2019 – Mar 2020 (MWC)

	Analytes	Units	Site Criteria (mg/L)	MWC Dec 2019	MWC Mar 2020
IONS	Calcium	mg/L	NA	400	390
	Alkalinity (total)	mg/L	NA	770	680
	Chloride	mg/L	NA	4600	5200
	Fluoride	mg/L	NA	0.3	0.2
	Potassium[1]	mg/L	410	2.4	1.8
	Magnesium	mg/L	NA	580	570
	Sulphate	mg/L	NA	140	150
HEAVY METALS	Iron	mg/L	0.3	ND	<LOR
	Manganese	mg/L	1.9	**5.4**	6
PHENOLS	Total phenolics	mg/L	0.32	ND	<LOR
OCP	OCP[3]	mg/L	0.00001	ND	<LOR
MISC. INORGANICS	pH	pH	6.5 – 8	6.9	6.8
	Sodium	mg/L	NA	1700	1700
	Ammonia[2]	mg/L	0.9	**1.2**	0.018
	Nitrate	mg/L	0.7	**1.7**	**1.2**
	Total Organic Carbon (TOC)	mg/L	4	**13**	**8**
	EC	µS/cm	NA	13000	13000

Highlighted results exceed site criteria

<LOR = No Detection. Analyte is below the Laboratory LOR

1 - World Health Organisation Guidelines for Drinking-water Quality 2009, Poor (acceptable) drinking water criteria.

2 - Criteria value may not protect key species from chronic toxicity, refer to ANZW 2018 for further guidance.

3 - A Trigger value for DDT is used in the absence of a criteria value for Total OCP. DDT has the lowest criteria of OCPs.

MWD is a leachate monitoring well which provides access to the perched landfill leachate water table. The Site Criteria for this particular well is only used as a general indicator of the leachate water quality. Refer to Table 5.

Table 5 – Quarterly Groundwater Results and Comparison Dec 2019 – Mar 2020 (MWD)

	Analytes	Units	Site Criteria (mg/L)	MWD (leachate) Dec 2019	MWD (leachate) Mar 2020
IONS	Calcium	mg/L	NA	130	130
	Alkalinity (total)	mg/L	NA	2300	2300
	Chloride	mg/L	NA	3300	2600
	Fluoride	mg/L	NA	0.3	0.3
	Potassium[1]	mg/L	410	220	160
	Magnesium	mg/L	NA	320	250
	Sulphate	mg/L	NA	30	160
HEAVY METALS	Iron	mg/L	0.3	**1.4**	**1.5**
	Manganese	mg/L	1.9	0.18	0.25
PHENOLS	Total phenolics	mg/L	0.32	0.2	<LOR
OCP	OCP[3]	mg/L	0.00001	ND	<LOR
MISC. INORGANICS	pH	pH	6.5 – 8	7.7	7.5
	Sodium	mg/L	NA	1900	1500
	Ammonia[2]	mg/L	0.9	**340**	**260**
	Nitrate	mg/L	0.7	ND	<LOR
	Total Organic Carbon (TOC)	mg/L	4	**330**	**250**
	EC	µS/cm	NA	13000	11000

Highlighted results exceed site criteria

<LOR = No Detection. Analyte is below the Laboratory LOR

1 - World Health Organisation Guidelines for Drinking-water Quality 2009, Poor (acceptable) drinking water criteria.

2 - Criteria value may not protect key species from chronic toxicity, refer to ANZW 2018 for further guidance.

3 - A Trigger value for DDT is used in the absence of a criteria value for Total OCP. DDT has the lowest criteria of OCPs.

There was one exceedance of the site criteria for March in MWE, TOC at concentrations of 6 mg/L. Refer to Table 6.

Table 6 –Quarterly Groundwater Results and Comparison Dec 2019 – Mar 2020 (MWE)

	Analytes	Units	Threshold Criteria (mg/L)	MWE Dec 2019	MWE Mar 2020
IONS	Calcium	mg/L	NA	70	60
	Alkalinity (total)	mg/L	NA	1100	1100
	Chloride	mg/L	NA	530	520
	Fluoride	mg/L	NA	0.6	0.5
	Potassium[1]	mg/L	410	0.6	0.6
	Magnesium	mg/L	NA	73	63
	Sulphate	mg/L	NA	140	130
HEAVY METALS	Iron	mg/L	0.3	ND	0.018
	Manganese	mg/L	1.9	0.022	0.24
PHENOLS	Total phenolics	mg/L	0.32	ND	<LOR
OCP	OCP[3]	mg/L	0.00001	ND	<LOR
MISC. INORGANICS	pH	pH	6.5 – 8	7.3	7.3
	Sodium	mg/L	NA	750	720
	Ammonia[2]	mg/L	0.9	0.2	<LOR
	Nitrate	mg/L	0.7	0.006	0.006
	Total Organic Carbon (TOC)	mg/L	4	**6**	**6**
	EC	µS/c	NA	3400	3400

Highlighted results exceed site criteria

<LOR = No Detection. Analyte is below the Laboratory LOR

1 - World Health Organisation Guidelines for Drinking-water Quality 2009, Poor (acceptable) drinking water criteria.

2 - Criteria value may not protect key species from chronic toxicity, refer to ANZW 2018 for further guidance.

3 - A Trigger value for DDT is used in the absence of a criteria value for Total OCP. DDT has the lowest criteria of OCPs

5.0 DISCUSSION

The inferred hydraulic gradient for the site is a down gradient towards Parsons Gully to the west. The location of the four wells surrounding the landfill place wells MWA, MWB and MWC down-hydraulic gradient and well MWE up-hydraulic gradient of the landfill. Well MWD is located within the perched landfill water table, this enables access to the leachate within the landfill.

The following is a summary of the significant results for March 2020 in relation to the Site Criteria. Key increasing trends, decreasing trends and exceedances of the threshold criteria are indicated.

MWA

MWA is located in the north west section of the site and is considered to be a down-hydraulic gradient monitoring well. There is farmland adjoining to the north and west of this location. The following changes have occurred in the water quality of MWA:

- Total Organic Carbon has decreased from 5mg/L to 4mg/L, to not exceeding the site criteria.

All other analytes reported concentrations consistent with previous monitoring data.

MWB

MWB is located in the south west section of the site and is considered to be a down-hydraulic gradient monitoring well. There is farmland to the south and west of this location. The well has remained relatively stable since last sampling period. There is one exceedance of the site criteria:

- A concentration of TOC (6 mg/L) was reported in MWB exceeding the Site Criteria (4 mg/L). This is a reduction from the previous reporting period of 10mg/L; and,
- Nitrate has decreased from 0.73mg/L to 0.51mg/L, to be below the site criteria.

All other analytes reported concentrations consistent with previous monitoring data.

MWC

MWC is located on the southern boundary of the site, down hydraulic gradient of the landfill and onsite dam. There is farmland to the south of well, along with a stand of vegetation immediately south of the well. This well has shown increasing turbidity with sedimentation in observations from the field. There were three concentrations which exceeded the site criteria. The following changes have occurred in the water quality of MWC:

- A concentration of Manganese (6 mg/L) was reported in MWC exceeding the Site Criteria (1.9 mg/L). This is an increase from the previous reporting period;
- A concentration of TOC (8 mg/L) was reported in MWC exceeding the Site Criteria (1.9 mg/L), which is a decrease from the previous reported concentration in December 2019 (13 mg/L);
- A concentration of Nitrate (1.2 mg/L) was reported in MWC exceeding the Site Criteria (0.7 mg/L), which is a decrease from the previous reported concentration in December 2019 (1.7 mg/L); and,
- A concentration of Ammonia was a non detection decreasing from the December sampling event of 1.2 mg/L.

All other analytes reported concentrations consistent with previous monitoring data.

MWD

The water collected and analysed from well MWD is landfill leachate and as such the Site Criteria is not used to compare the results against. The results of MWD are used as an indicator of current conditions within the landfill with trends and seasonal variations apparent. MWD is also to be used as a comparison to the external monitoring wells.

Well MWD was reported to contain no detection of Nitrate, giving no indication that the Nitrate in the affected wells is sourced from the landfill being as this well is located in the perched leachate water table. The Nitrate may be migrating onto the site from the farmland to the north through the local ground water.

The following changes occurred in the water quality of the landfill leachate well MWD:

- Ammonia has decreased and is at a concentration of 260 mg/L;
- Iron concentration of 1.5 mg/L has slightly increased since December 2019 concentration of 1.4 mg/L; and,
- TOC has decreased from 330 mg/L in December 2019 to a concentration of 250mg/L.

MWE

MWE is located on the eastern boundary of the site and is considered to be an up-gradient groundwater monitoring well. There are a series of dams to the east of the well. The following changes have occurred in the water quality of MWC:

- A concentration of TOC (6 mg/L) was reported in MWE remaining unchanged from previous testing, exceeding site criteria.

All other analytes reported concentrations consistent with previous monitoring data.

The following analytes exceeded the Threshold Criteria during the March 2020 sampling event, excluding the Leachate Monitoring well (MWD); TOC in MWB, MWC and MWE, Nitrate in MWC and Manganese in MWC. Refer to **Attachment 3** – Data Log.

Site and Maintenance

The area has been in drought for some time and may be factors influencing the groundwater concentrations of some analytes in wells.

The weather conditions (drought and rain events) and surrounding land uses are likely impacting the local groundwater conditions. The apparent anomalies in the last few rounds of monitoring may have been influenced by the rain event preceding the sampling events.

The concrete surrounding the base of several of the wells are cracked. These can be easily maintained, which would also reset a barrier for surface migrating into the groundwater. There was additional waste on the western side of the landfill, more than normal.

6.0 CONCLUSIONS

There are seasonal fluctuations observed with regional groundwater conditions. The recent weather conditions of drought and the rain may have influenced the groundwater conditions. Trending of these analytes over time may indicate a seasonal fluctuation, an anomaly or highlight an issue on the site (or surrounding area). The trending of analytes occurs in the annual groundwater monitoring report with a running comparison in the quarterly monitoring reports.

The results and discussion of the laboratory sample analysis from the Scone Waste Facility during the March 2020 quarterly sampling event displayed several ongoing exceedances of the Site Criteria from the previous monitoring period.

The following analytes exceeded the Site Criteria for the March 2020 sampling event; TOC in MWB, MWC and MWE, Nitrate in MWC and Manganese in MWC

Continued sampling and data collection will allow robust trending and statistical analysis of data to occur.

The next water sampling event will be an annual monitoring event which will be undertaken in June 2020.

REFERENCES

- *Australian and New Zealand Guidelines for the Management of Contaminated Sites* (ANZECC/NHMRC 1992);
- *Australia and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZW, 2018);
- *Australian Drinking Water Guidelines, National Water Quality Management Strategy* 2011;
- *Contaminated Land Management Act 1997* (NSW);
- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (NSW EPA 2011);
- *Contaminated Sites: Guidelines on Duty to Report Contamination under the Contamination Land Management Act 1997* (NSW DECC, 2009);
- *Contaminated Sites: Guidelines for the Assessment and Management of Groundwater Contamination* (NSW DEC, 2007);
- *Contaminated Sites: Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report* (NSW EPA 1999);
- *Contaminated Sites: Sampling Design Guidelines* (NSW EPA 1995);
- *Environmental Guidelines: Solid Waste Landfills* (NSW EPA, 1996);
- *Environmental Guidelines Solid Waste Landfills* Second edition, (NSW EPA 2016);
- *Health - Based Soil Investigation Levels,* Imray, P & Langley, A*, National Environmental Health Forum Monographs, Soil Series No. 2 (2nd Ed), South Australian Health Commission* (NEHF 1998);
- *National Environment Protection (Assessment of Site Contamination) Measure (No.1)* (NEPM, 2013) as amended;
- *Storage and Handling of Dangerous Goods Code of Practice 2005*;
- *Work Health and Safety Act 2011* (NSW) and associated regulations.

FIGURES

Legend

Monitoring Well Location

Image: Google Maps 2019

N

ENGAGE Environmental Services Pty Limited
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0478 362005

Title: Figure 1 - Site Layout and Well Locations

Client	Project No.	Figure No	Date
UHSC	E04-0619	1	17/6/2019
admin@engage-es.com.au	Scale: NA	Compiled: SC	Revision: 3

ATTACHMENT 1

NATA ACCREDITED LABORATORY RESULTS

Envirolab Services Pty Ltd
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CERTIFICATE OF ANALYSIS 238397

Client Details

Client	Engage Environmental Services
Attention	Stephen Challinor
Address	113 Reservoir Rd, GLENDALE, NSW, 2285

Sample Details

Your Reference	**E04-0320-UHSC**
Number of Samples	5 Water
Date samples received	09/03/2020
Date completed instructions received	09/03/2020

Analysis Details

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

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

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

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

Report Details

Date results requested by	16/03/2020
Date of Issue	16/03/2020

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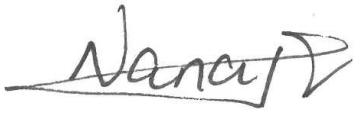
Results Approved By
Diego Bigolin, Team Leader, Inorganics
Jaimie Loa-Kum-Cheung, Metals Supervisor
Josh Williams, Senior Chemist
Priya Samarawickrama, Senior Chemist

Authorised By



Nancy Zhang, Laboratory Manager

Organochlorine Pesticides in Water						
Our Reference		238397-1	238397-2	238397-3	238397-4	238397-5
Your Reference	UNITS	MWA	MWB	MWC	MWD	MWE
Date Sampled		05/03/2020	05/03/2020	05/03/2020	05/03/2020	05/03/2020
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020
Date analysed	-	11/03/2020	11/03/2020	11/03/2020	11/03/2020	11/03/2020
alpha-BHC	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
HCB	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
beta-BHC	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
gamma-BHC	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Heptachlor	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
delta-BHC	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Aldrin	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Heptachlor Epoxide	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
gamma-Chlordane	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
alpha-Chlordane	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan I	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
pp-DDE	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Dieldrin	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan II	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
pp-DDD	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endrin Aldehyde	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
pp-DDT	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Endosulfan Sulphate	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Methoxychlor	µg/L	<0.2	<0.2	<0.2	<0.2	<0.2
Surrogate TCMX	%	83	73	94	78	68

Total Phenolics in Water						
Our Reference		238397-1	238397-2	238397-3	238397-4	238397-5
Your Reference	UNITS	MWA	MWB	MWC	MWD	MWE
Date Sampled		05/03/2020	05/03/2020	05/03/2020	05/03/2020	05/03/2020
Type of sample		Water	Water	Water	Water	Water
Date extracted	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020
Date analysed	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020
Total Phenolics (as Phenol)	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05

Ion Balance						
Our Reference		238397-1	238397-2	238397-3	238397-4	238397-5
Your Reference	UNITS	MWA	MWB	MWC	MWD	MWE
Date Sampled		05/03/2020	05/03/2020	05/03/2020	05/03/2020	05/03/2020
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020
Date analysed	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020
Calcium - Dissolved	mg/L	570	520	390	130	60
Potassium - Dissolved	mg/L	2.4	2.0	1.8	160	0.6
Sodium - Dissolved	mg/L	2,000	1,500	1,700	1,500	720
Magnesium - Dissolved	mg/L	1,100	670	570	250	63
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Bicarbonate Alkalinity as $CaCO_3$	mg/L	500	420	680	2,300	1,100
Carbonate Alkalinity as $CaCO_3$	mg/L	<5	<5	<5	<5	<5
Total Alkalinity as $CaCO_3$	mg/L	500	420	680	2,300	1,100
Sulphate, SO4	mg/L	47	88	150	160	130
Chloride, Cl	mg/L	7,700	5,700	5,200	2,600	520
Ionic Balance	%	-5.0	-9.0	-8.0	-12	0

HM in water - dissolved						
Our Reference	UNITS	238397-1	238397-2	238397-3	238397-4	238397-5
Your Reference		MWA	MWB	MWC	MWD	MWE
Date Sampled		05/03/2020	05/03/2020	05/03/2020	05/03/2020	05/03/2020
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020
Date analysed	-	10/03/2020	10/03/2020	10/03/2020	10/03/2020	10/03/2020
Iron-Dissolved	µg/L	<10	<10	<10	1,500	18
Manganese-Dissolved	µg/L	10	10	6,000	250	240

Miscellaneous Inorganics						
Our Reference	UNITS	238397-1	238397-2	238397-3	238397-4	238397-5
Your Reference		MWA	MWB	MWC	MWD	MWE
Date Sampled		05/03/2020	05/03/2020	05/03/2020	05/03/2020	05/03/2020
Type of sample		Water	Water	Water	Water	Water
Date prepared	-	09/03/2020	09/03/2020	09/03/2020	09/03/2020	09/03/2020
Date analysed	-	09/03/2020	09/03/2020	09/03/2020	09/03/2020	09/03/2020
pH	pH Units	6.7	6.9	6.8	7.5	7.3
Electrical Conductivity	µS/cm	19,000	14,000	13,000	11,000	3,400
Ammonia as N in water	mg/L	<0.005	0.015	0.18	260	<0.005
Fluoride, F	mg/L	0.1	0.3	0.2	0.3	0.5
Total Organic Carbon	mg/L	4	6	8	250	6
Nitrate as N in water	mg/L	0.56	0.51	1.2	<0.050	0.006

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25°C in accordance with APHA latest edition 2510 and Rayment & Lyons.
Inorg-006	Alkalinity - determined titrimetrically in accordance with APHA latest edition, 2320-B.
Inorg-026	Fluoride determined by ion selective electrode (ISE) in accordance with APHA latest edition, 4500-F-C.
Inorg-031	Total Phenolics by segmented flow analyser (in line distillation with colourimetric finish). Solids are extracted in a caustic media prior to analysis.
Inorg-040	The concentrations of the major ions (mg/L) are converted to milliequivalents and summed. The ionic balance should be within +/- 10% ie total anions = total cations +/-10%.
Inorg-055	Nitrate - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Inorg-079	TOC determined using a TOC analyser using the combustion method. Dissolved requires filtering prior to determination. Analysis using APHA latest edition 5310B.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Waters samples are filtered on receipt prior to analysis. Alternatively determined by colourimetry/turbidity using Discrete Analyser.
Metals-020	Determination of various metals by ICP-AES.
Metals-022	Determination of various metals by ICP-MS.
Org-012/017	Soil samples are extracted with Dichloromethane/Acetone and waters with Dichloromethane and analysed by GC-MS and/or GC-MS/MS.

QUALITY CONTROL: Organochlorine Pesticides in Water					Duplicate				Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	
Date extracted	-			10/03/2020	[NT]	[NT]	[NT]	[NT]	10/03/2020	[NT]
Date analysed	-			11/03/2020	[NT]	[NT]	[NT]	[NT]	11/03/2020	[NT]
alpha-BHC	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	80	[NT]
HCB	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
beta-BHC	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	86	[NT]
gamma-BHC	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Heptachlor	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	74	[NT]
delta-BHC	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Aldrin	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	88	[NT]
Heptachlor Epoxide	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	88	[NT]
gamma-Chlordane	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
alpha-Chlordane	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan I	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDE	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	78	[NT]
Dieldrin	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	90	[NT]
Endrin	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	108	[NT]
Endosulfan II	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDD	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	86	[NT]
Endrin Aldehyde	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
pp-DDT	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Endosulfan Sulphate	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	84	[NT]
Methoxychlor	µg/L	0.2	Org-012/017	<0.2	[NT]	[NT]	[NT]	[NT]	[NT]	[NT]
Surrogate TCMX	%		Org-012/017	80	[NT]	[NT]	[NT]	[NT]	82	[NT]

QUALITY CONTROL: Total Phenolics in Water						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	238397-2
Date extracted	-			10/03/2020	1	10/03/2020	10/03/2020		10/03/2020	10/03/2020
Date analysed	-			10/03/2020	1	10/03/2020	10/03/2020		10/03/2020	10/03/2020
Total Phenolics (as Phenol)	mg/L	0.05	Inorg-031	<0.05	1	<0.05	<0.05	0	91	75

QUALITY CONTROL: Ion Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	238397-2
Date prepared	-			10/03/2020	1	10/03/2020	10/03/2020		10/03/2020	10/03/2020
Date analysed	-			10/03/2020	1	10/03/2020	10/03/2020		10/03/2020	10/03/2020
Calcium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	570	560	2	97	[NT]
Potassium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	2.4	2.4	0	94	[NT]
Sodium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	2000	1900	5	99	[NT]
Magnesium - Dissolved	mg/L	0.5	Metals-020	<0.5	1	1100	1100	0	99	[NT]
Hydroxide Alkalinity (OH^-) as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	<5	0	[NT]	[NT]
Bicarbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	500	500	0	[NT]	[NT]
Carbonate Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	<5	<5	0	[NT]	[NT]
Total Alkalinity as $CaCO_3$	mg/L	5	Inorg-006	<5	1	500	500	0	104	[NT]
Sulphate, SO4	mg/L	1	Inorg-081	<1	1	47	47	0	108	#
Chloride, Cl	mg/L	1	Inorg-081	<1	1	7700	7800	1	101	#
Ionic Balance	%		Inorg-040	[NT]	1	-5.0	-7.0	-33	[NT]	[NT]

QUALITY CONTROL: HM in water - dissolved						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W5	[NT]
Date prepared	-			10/03/2020	1	10/03/2020	10/03/2020		10/03/2020	[NT]
Date analysed	-			10/03/2020	1	10/03/2020	10/03/2020		10/03/2020	[NT]
Iron-Dissolved	µg/L	10	Metals-022	<10	1	<10	<10	0	108	[NT]
Manganese-Dissolved	µg/L	5	Metals-022	<5	1	10	10	0	100	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	238397-2
Date prepared	-			09/03/2020	1	09/03/2020	09/03/2020		09/03/2020	09/03/2020
Date analysed	-			09/03/2020	1	09/03/2020	09/03/2020		09/03/2020	09/03/2020
pH	pH Units		Inorg-001	[NT]	1	6.7	6.8	1	100	[NT]
Electrical Conductivity	µS/cm	1	Inorg-002	<1	1	19000	19000	0	101	[NT]
Ammonia as N in water	mg/L	0.005	Inorg-057	<0.005	1	<0.005	<0.005	0	108	114
Fluoride, F	mg/L	0.1	Inorg-026	<0.1	1	0.1	0.1	0	95	78
Total Organic Carbon	mg/L	1	Inorg-079	<1	1	4	4	0	100	96
Nitrate as N in water	mg/L	0.005	Inorg-055	<0.005	1	0.56	0.53	6	103	113

Result Definitions

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

Quality Control Definitions

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

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

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

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

Laboratory Acceptance Criteria

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

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

Spikes for Physical and Aggregate Tests are not applicable.

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

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

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

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

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

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

Measurement Uncertainty estimates are available for most tests upon request.

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

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

Report Comments

pH/Nitrate
Samples were out of the recommended holding time for this analysis.

Ion Balance
Percent recovery is not possible to report due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.

Ion Balance - The PQL has been raised due to the sample matrix requiring dilution.

CHAIN OF CUSTODY - Client

ENVIROLAB GROUP - National phone number 1300 42 43 44

Sydney Lab - Envirolab Services
12 Ashley St, Chatswood, NSW 2067
Ph 02 9910 6200 / sydney@envirolab.com.au

Combo1=TRH/BTEX/Pb
Combo2=TRH/BTEX/PAH/Pb
Combo3=TRH/BTEX/PAH/Met
Combo4=TRH/BTEX/PAH/Met/Phen
Combo5=TRH/BTEX/PAH/OC/PCB/Mot
Combo6=TRH/BTEX/PAH/OC/OP/PCB/Mot
Combo7=TRH/BTEX/PAH/OC/PCB/Met/Phen
Combo8=TRH/BTEX/PAH/OC/OP/PCB/Met/Phen
Combo9=TRH/BTEX/PAH/OC/PCB/Met/Phen/CN
Combo10=TRH/BTEX/PAH/OC/OP/PCB/Met/Phen/CN
Combo11=TRH/BTEX/PAH/OC/PCB/12met/Phen/CN
Combo12=TRH/BTEX/PAH/OC/PCB/Met/TCLP-PAH ,6 Met
Combo13=TRH/BTEX/PAH/OC/OP/PCB/Met/TCLP-PAH ,6Met

A Combo with an 'A' indicates Asbestos is also needed.

Client: Engage Environmental Services	Client Project Name / Number / Site etc (ie report title): E04-0320 - UHSC
Contact Person: Stephen Challinor	
Project Mgr: Stephen	PO No.:
Sampler: Stephen Challinor	Envirolab Quote No. :
Address: 113 Reservoir Rd, Glendale NSW 2285	Date results required: Or choose: STANDARD *Note: Inform lab in advance if urgent turnaround is required - surcharges apply*
Phone: 0478 362 005 Mob: 0478362005	Report format: esdat / equis /
Email: stephen.challinor@engage-es.com.au; admin@engage-es.com.au	Lab Comments:

Sample Information					Tests Required														Comments
Envirolab Sample ID	Client Sample ID or information	Depth	Date sampled	Type of sample	OCP	Cation suite: Ca, K, Na, Mg	Anions major: Chloride, Sulfate, alkalinity	phenols	Ammonia	iron	manganese	Fluoride	TOC	Nitrate	EC	pH				Provide as much information about the sample as you can
1	MWA		5-3-20	Water	X	X	X	X	X	X	X	X	X	X	X	X				
2	MWB		5-3-20	Water	X	X	X	X	X	X	X	X	X	X	X	X				
3	MWC		5-3-20	Water	X	X	X	X	X	X	X	X	X	X	X	X				
4	MWD		5-3-20	Water	X	X	X	X	X	X	X	X	X	X	X	X				leachate
5	MWE		5-3-20	Water	X	X	X	X	X	X	X	X	X	X	X	X				

Relinquished by (Company): Engage Environmental Services	Received by (Company): ES	*Lab use only:*
Print Name: Stephen Challinor	Print Name: Andy Zhang	Samples Received: Cool or Ambient (circle one)
Date & Time: 5-3-20	Date & Time: 09/03 10:22	Temperature Received at: 21.7 (if applicable)
Signature:	Signature: AZ	Transported by: Hand delivered / courier

White - Lab copy / Blue - Client copy / Pink - Retain in Book

Page No:

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

Job No: 238397

Date Received: 09/03
Time Received: 10:22
Received By: AZ
Temp: Cool/Ambient
Cooling: Ice/Icepack
Security: Intact/Broken/None

ATTACHMENT 2

CALIBRATION CERTIFICATE

ATTACHMENT 3

DATALOG

Multi Parameter Water Meter

airmet

Air-Met Scientific Pty Ltd
1300 137 067

Instrument YSI Quatro Pro Plus
Serial No. 12D100011

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		330737	pH 6.92
2. pH 4.00		pH 4.00		330734	pH 4.11
3. pH 10.00		pH 10.00		324189	pH 9.70
3. mV		231.8mV		338782/337308	231.6mV
4. EC		2.76mS		333787	2.77mS
6. D.O		0.00 ppm		329994	0.02ppm
7. Temp		20.5°C		MultiTherm	20.7°C

Calibrated by: Sarah Lian

Calibration date: 02/03/2020

Next calibration due: 02/04/2020