RCA ref 10408-725/0

24 October 2019

Dungog Shire Council
PO Box 95
DUNGOG NSW 2420

Attention: Damien Reeves

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Sound & Vibration
Occupational Hygiene

WATER QUALITY MONITORING
QUARTER 29 – 24 SEPTEMBER 2019
DUNGOG LANDFILL SITE

Robert Carr & Associates Pty Ltd
T/A RCA Australia ABN 53 063 515 711

92 Hill St, PO Box 175, Carrington NSW 2294
Ph 02 **4902 9200 Fax** 02 **4902 9299**

Email administrator@rca.com.au
Web www.rca.com.au

1 INTRODUCTION

RCA Australia (RCA) was engaged to undertake environmental monitoring for the Dungog Shire Council Waste Facility on the 24 September 2019. The monitoring made up the fourth quarterly round (Q4) of monitoring required to be undertaken for the 2018 – 2019 sampling period. Sampling works for the Q4 monitoring round was undertaken as per the monitoring requirements outlined in the Dungog Shire Council Waste Facility Environmental Protection Licence EPL 5894 (EPL 5894).

2 SCOPE OF WORKS

The objective of this project was to undertake environmental monitoring at the Dungog Landfill site in accordance with the EPL 5894 requirements.

The scope of works for this project included:

- Preparation of safety and environmental documents;
- Quarterly sampling of the Dungog Leachate Dam as well as the annual sampling of the Dungog groundwater monitoring well.
- Analysis of the two collected samples in accordance with the site's EPL 5894 compliance requirements; and
- Compilation of a report summarizing the results from the Q4 2019 sampling event.

3 SITE GUIDELINES AND ASSESSMENT CRITERIA

EPL 5894 requires leachate monitoring to be conducted on a quarterly basis and groundwater sampling on an annual basis in order to assess the water quality present at the site. The analysis suite, as specified in EPL 5894, are for monitoring purposes only and no guideline criteria is specified.

For comparative purposes, this report has used additional water quality guidelines as assessment indicators. Guidelines used include the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC, 2000) and the Australian Drinking Water Guidelines, hereafter referred to as ADWG, (NHRMC, 2011 updated 2018). It should be noted that assessment criteria used in this report, provided in **Table 1**, have not been altered from those presented by the previous sampling contractor for continuity of historical data.

Table 1 *Assessment Criteria*

Parameter	Units	PQL	Australian Drinking Water Quality Guidelines (ADWG) (mg/L) [a]	ANZECC 95% Trigger Values for Fresh Water (mg/L) [b]
Hydroxide Alkalinity as $CaCO_3$	mg/L	1	-	-
Carbonate Alkalinity as $CaCO_3$	mg/L	1	-	-
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	-	-
Total Alkalinity as $CaCO_3$	mg/L	1	-	-
Ammonia as N	mg/L	0.01	0.5[c]	0.9[f]
Calcium	mg/L	1	-	-
Chloride	mg/L	1	250[c]	-
Thermotolerant Faecal Coliforms	cfu/100mL	-	0	1000[g]
Electrical Conductivity	µS/cm	1	125 - 2200	30 - 350[d]
Magnesium	mg/L	1	-	-
Nitrate as N	mg/L	0.01	50	0.7
Potassium	mg/L	1	-	-
pH	pH units	-	6.5 - 8.5	6.5 - 8
Sodium	mg/L	1	180[c]	-
Sulfate	mg/L	1	250[c]	-
Total Dissolved Solids	mg/L	5	600[c]	-
Total Organic Carbon	mg/L	1	-	-
Total Suspended Solids	mg/L	5	-	-

"-" indicates no criterion available

PQL = Practical Quantitation Limit.

a From Australian Drinking Water Guidelines Version 3.5 (NHRMC/ NRMMC, update 2018).

b Primarily from ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Chapter 3 Aquatic Ecosystems (Trigger levels for fresh water slightly - moderately disturbed system)c Guideline based on Aesthetic Criteria.

d Default trigger values for slightly disturbed upland river ecosystems in South-East Australia.

e Based on a value which may result in lime scaling. Alkalinity is an indicator for landfill leachate.

f Trigger value for pH 8.0, other values are listed in ANZECC section 8.3.7.2.

g Trigger value for secondary human contact, see ANZECC Section 5.2.3.

4 FIELDWORK

An environmental technician trained and experienced in water sampling undertook the fieldwork on the 25 September. Sampling was conducted in accordance with Australian Standard AS5667.1998 Water Quality Sampling. The scope of work included:

- Collection of one water samples from the Dungog Leachate Dam.
- Collection of one groundwater sample from the Dungog Landfill site.
- Analysis of the two water samples for the analytes stipulated in EPL 5894.

All samples were preserved as recommended by the analytical laboratory and stored in a chilled esky for preservation purposes. Samples were sent to the laboratory within 24 hours of sampling. All samples were sent under Chain of Custody (COC) documentation detailing the sample identification, required analysis, the name of the sampler and date released from custody.The laboratories acknowledged the receipt of samples by signature and date and returned the COC with a sample receipt notice indicating the condition of the samples received upon receipt.

5 QUALITY CONTROL

The collection of all water samples were undertaken in compliance with RCA methodology. Surface water sample collection methods comprised of direct sampling into the bottle from the surface water body. Groundwater sample collection methods comprised of the use of a hand bailer following the removal of one bore volume.

Surface water and groundwater collection methods were chosen for the site as recommended by the Australian Standard 5667.1:1998 Water Quality Sampling.

The analytical procedures used by RCA Laboratories are based on established internationally recognised procedures such as APHA and Australian Standards. RCA Laboratories - Environmental conduct the NATA accredited analysis of the pH, EC, TDS, TSS and Faecal Coliforms. RCA Australia laboratory report (10408-725) is attached in **Appendix B**.

An external testing laboratory ALS Environmental (NATA accreditation Number 825) was used to obtain analysis of samples that are a part of this report. ALS Report ES1930901 is attached in **Appendix C**.

Quality assurance and control analysis was undertaken as part of the project scope of works. Quality results from the internal RCA Laboratories - Environmental are included within the laboratory report provided in **Appendix C**, whilst external laboratory quality control documents are presented in **Appendix D**.

6 RESULTS

The water quality assessment criteria presented are for comparison purposes only. The Site's EPL requirements do not specify any monitoring criteria to assess the concentration ranges of analytes. Water quality results compared against limit concentrations are presented in **Table 2**.

Table 2 *Water Quality Results versus Assessment Criteria*

Parameter	Units	Dungog Leachate Dam	Dungog Groundwater	Australian Drinking Water Quality Guidelines (mg/L) [a]	ANZECC 95% Trigger Values for Fresh Water (mg/L) [b]
Sample Number		091910408001	091910408002		
Sample Date		24/09/2019	24/09/2019		
Field Technician		KH	KH		
Standing Water Level	m	--	4.50		
pH	pH unit	7.52	7.40	6.5 - 8.5	6.5 - 8.0
Electrical Conductivity	µS/cm	*1517*		125 - 2200	30 - 350[d]
Total Suspended Solids	mg/L	6		-	-
Total Dissolved Solids	mg/L	*985*		600[c]	-
Hydroxide Alkalinity as $CaCO_3$	mg/L	<1		-	-
Carbonate Alkalinity as $CaCO_3$	mg/L	<1		-	-
Bicarbonate Alkalinity as $CaCO_3$	mg/L	416		-	-
Total Alkalinity as $CaCO_3$	mg/L	*416*		200[e]	-
Sulfate	mg/L	116		500, 250[c]	-
Chloride	mg/L	*240*		250[c]	-
Calcium	mg/L	*77*		-	-
Magnesium	mg/L	*43*		-	-
Sodium	mg/L	*182*		180[c]	-
Potassium	mg/L	13	1	-	-
Ammonia as N	mg/L	*0.08*		0.5[c]	0.9[f]
Nitrate as N	mg/L	*<0.01*	<0.01	50	0.7
Thermotolerant Coliforms	cfu/100 mL	*92*		0	1000[g]
Total Organic Carbon	mg/L	*24*		-	-

Notes:

Result in italics indicates that the concentration is exceeding one of the assessment guidelines. Refer to the summary for further details.

"-" indicates no criterion available.

PQL = Practical Quantitation Limit.

a From Australian Drinking Water Guidelines Version 3.5 (NHRMC/NRMMC,update 2018).

b Primarily from ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality - Chapter 3 Aquatic Ecosystems (Trigger levels for fresh water slightly - moderately disturbed system).

c Guideline based on Aesthetic Criteria.

d Default trigger values for slightly disturbed upland river ecosystems in South-East Australia.

e Based on a value which may result in lime scaling. Alkalinity is an indicator for landfill leachate.

f Trigger value for pH 8.0, other values are listed in ANZECC section 8.3.7.2.

g Trigger value for secondary human contact, see ANZECC Section 5.2.3.

Analysis not required

Analytical laboratory NATA reports and quality assurance documentation are presented in **Appendices B**, **C** and **D**.

During the Q4 monitoring round, there were five results in excess of the assessment criteria as summarized below:

- Electrical conductivity was above the upper criterion indicated in the ANZECC 95% protection level for fresh water for both the Dungog and Martins Creek Dam samples. Both leachate samples were within the range outlined in the ADWG.
- Total dissolved solids concentrations in both leachate dam samples were in excess of the ADWG aesthetic criterion. This aesthetic guideline is based upon the taste factor.
- Alkalinity concentrations of the Dungog Leachate dam were in excess of the ADWG aesthetic criterion
- Thermotolerant coliforms were below the limits indicated in the ANZECC 95% protection level for fresh water but were above the range outlined in the ADWG
- The sodium concentration was marginally greater than the ADWG aesthetic criterion in the Dungog Leachate Dam sample. No health effects have been associated with TDS concentrations, and the aesthetic guideline is based upon the taste factor.

7 LIMITATIONS

This report has been prepared for Dungog Shire Council in accordance with an agreement with RCA dated 2 December 2013. The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the use of Dungog Shire Council. The report for September does not contain sufficient information for purposes of other users or for parties other than Dungog Shire Council. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without written permission from RCA.

Environmental conditions including contaminant concentrations can change in a limited period of time. This should be considered if the report is used following a significant period of time after the date of issue.

The information in this report is considered accurate at the date of issue. Please contact the undersigned if you have any queries on the above.

Yours faithfully
RCA AUSTRALIA

Laura Schofield
Environmental Laboratory Manager
RCA Australia

Neena Tewari
Senior Environmental Microbiologist
RCA Australia

REFERENCES

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

NHMRC/NRMMC (2018) National Water Quality Management Strategy; Australian Drinking Water Guidelines version 3.5 (National Health and Medical Research Council/National Resource Management Ministerial Council).

Appendix A

Water Sample Locations

Legend

- Quarterly surface water sample location
- Annual groundwater sample location

N

0 37.5 75 150 225 300 375 metres

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

DUNGOG SHIRE COUNCIL
WASTE MANAGEMENT FACILITY
QUARTERLY AND ANNUAL
EPL MONITORING LOCATION

CLIENT	Dungog Shire Council			RCA Ref	10408-725/0
DRAWN BY	LS	SCALE	1:10,000 (A3)	DRAWING 1	REV 0
APPROVED BY	NT	DATE	24/09/2019	OFFICE	NEWCASTLE

Appendix B

Internal Laboratory Reports

Robert Carr & Associates Pty Ltd Trading as RCA Laboratories – Environmental
92 Hill Street PO Box 175, Carrington NSW 2294
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NATA Accredited Laboratory 9811
Corporate Site Number 18077
Accredited for compliance with ISO/IEC 17025-Testing

Dungog Shire Council
PO Box 95
DUNGOG NSW 2420

Attention: Mr Damien Reeves

Project:	RCA ref 10408-725/WATER/0		
Date:	14/10/2019		
Client reference:	Dungog Landfill Leachate Dam Quarterly Sample		
Received date:	24/09/2019	**Number of samples:**	1
Client order number:	Not Supplied	**Testing commenced:**	24/09/2019

CERTIFICATE OF ANALYSIS

1 ANALYTICAL TEST METHODS

ANALYSIS	METHOD	UNITS	ANALYSING LABORATORY	NATA ANALYSIS/ NON NATA
pH	ENV-LAB006*	pH	RCA Laboratories - Environmental	NATA
Conductivity	ENV-LAB010*****	µS/cm	RCA Laboratories - Environmental	NATA
Total Suspended Solids	ENV-LAB009*****	mg/L	RCA Laboratories - Environmental	NATA
Total Dissolved Solids	ENV-LAB020*****	mg/L	RCA Laboratories - Environmental	NATA

***** The analytical procedures used by RCA Laboratories - Environmental are based on established internationally recognised procedures such as APHA and Australian Standards

2 RESULTS

ANALYSIS	UNITS	Dungog Leachate Dam
Water		
Sample Number	-	091910408001
Date Sampled	-	24/09/2019
Sampled By		KH
pH Value	pH unit	7.52
Conductivity	µS/cm	1517
Total Suspended Solids	mg/L	6
Total Dissolved Solids	mg/L	985

Water

NATA Scope of Accreditation covers the sampling of surface and ground waters by RCA.

Analysis of samples is on an as received basis.

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3 QUALITY CONTROL RESULTS

Water Quality Control Sample Results

DATE	ANALYSIS	METHOD	UNITS	QUALITY CONTROL STANDARD VALUE	QUALITY CONTROL ACCEPTANCE CRITERIA	QUALITY CONTROL STANDARD RESULT
24/09/2019	pH	ENV-LAB006	pH	7.00	6.95 - 7.05	6.97
24/09/2019	Conductivity	ENV-LAB010*	µS/cm	1413	1385 - 1441	1424
25/09/2019	Total Suspended Solids	ENV-LAB009	mg/L	75	67.5 – 82.5	69
24/09/2016	Total Dissolved Solids	ENV-LAB020	mg/L	35	31.5 – 38.5	38

Water Duplicate Analysis Results

SAMPLE NUMBER	DATE	ANALYSIS	METHOD	UNITS	LOR	SAMPLE RESULT	SAMPLE DUPLICATE RESULT
091910408001	24/09/2019	pH	ENV-LAB006	pH	-	7.52	7.54
061910408001	24/09/2019	Conductivity	ENV-LAB010	µS/cm	1	1517	1520
091910748001 BATCH	25/09/2019	Total Suspended Solids	ENV-LAB009	mg/L	5	98	92
091910748001 BATCH	24/09/2016	Total Dissolved Solids	ENV-LAB020	mg/L	5	11673	11620

Please contact the undersigned if you have any queries.

Yours sincerely

Laura Schofield
Environmental Laboratory Manager
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories – Environmental
Approved Signatory

Neena Tewari
Senior Environmental Microbiologist
Robert Carr & Associates Pty Ltd Trading as
RCA Laboratories - Environmental

Robert Carr & Associates Pty Ltd Trading as RCA Laboratories – Environmental
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RCA Internal Quality Review

General

1. Laboratory QC results for Method Blanks, Duplicates and Laboratory Control Samples are included in this QC report where applicable. Additional QC data maybe available on request.
2. RCA QC Acceptance / Rejection Criteria are available on request.
3. Proficiency Trial results are available on request.
4. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
5. When individual results are qualified in the body of a report, refer to the qualifier descriptions that follow.
6. Samples were analysed on an 'as received' basis.
7. Sampled dates in this report are those listed on the COC or sample jars; if no sample dates are noted, the date the samples are received at the laboratory have been used.
8. All soil results are reported on a dry basis, unless otherwise stated. (ACID SULPHATE SOILS)
9. This report replaces any interim results previously issued.

Holding Times.

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 Sample

Receipt Acknowledgment.

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.

**NOTE: pH duplicates are reported as a range NOT as RPD

QC - ACCEPTANCE CRITERIA

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%

QC DATA GENERAL COMMENTS

1. 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.

2. 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.

3. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Glossary

UNITS

mg/kg: milligrams per Kilogram

ug/l: micrograms per litre ppm: Parts per million

ppb: Parts per billion %: Percentage

org/100ml: Organisms per 100 millilitres NTU: Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per Litre

TERMS

Dry Where moisture has been determined on a solid sample the result is expressed on a dry basis.

LOR Limit of Reporting.

RPD Relative Percent Difference between two Duplicate pieces of analysis can be obtained upon request.

QCS Quality Control Sample - reported as value recovery

Method Blank In the case of solid samples these are performed on laboratory certified clean sands.

In the case of water samples these are performed on de-ionised water.

Duplicate A second piece of analysis from the same sample and reported in the same units as the result to show comparison.

Batch Duplicate A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.

USEPA United States Environment Protection Authority

APHA American Public Health Association

COC Chain of Custody

CP Client Parent - QC was performed on samples pertaining to this report

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

< indicates less than

> Indicates greater than

ND Not Detected

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NATA Accredited Laboratory 9811
Corporate Site Number 22072
Accredited for compliance with ISO/IEC 17025- Testing

Damien Reeves
Dungog Shire Council
PO Box 95
DUNGOG NSW 2420

Analytical Report

Project: RCA ref 10408-725/Micro/0
Sample Received: 24/09/19

Number of Samples: 1
Report Date: 27/09/19

Results

		Dungog Shire Council
Client ID		***Leachate Storage Pond***
Date Sampled		**24/09/19**
Time Sampled		**12:30PM**
Laboratory ID	**Units**	**091910408001**
Method: Thermotolerant Coliforms MF (AS)(AS/NZS 4276.7 – 2007)	**cfu/100mL**	**92**

Tests Commenced on the Day of Receipt of Samples
The results stated in this report relate only to the sample(s) as Collected by the client and/or by RCA Laboratories – Sampling is not covered by NATA Scope of Accreditation and analysis on as received basis. Symbols Used:

< Less Than
> More Than
~ Estimate Number
ND Not Detected
cfu Colony Forming Units

Measurement of Uncertainty (MU) calculated for *Thermotolerant coliforms* method is ±0.10 with a coverage factor 2 (95% confidence level of the accuracy)

Neena Tewari
Microbiologist
B.Sc; M.Sc; Ph.D Microbiology

Laura Schofield
Laboratory Manager

Appendix C

External Laboratory Reports

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1930901**	Page	: 1 of 3
Client	: **ROBERT CARR & ASSOCIATES P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS LAURA SCHOFIELD	Contact	: Customer Services ES
Address	: PO BOX 175 92 HILL ST CARRINGTON NSW 2294	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49029200	Telephone	: +61-2-8784 8555
Project	: 10408 DUNGOG SHIRE COUNCIL	Date Samples Received	: 24-Sep-2019 13:35
Order number	: ----	Date Analysis Commenced	: 25-Sep-2019
C-O-C number	: ----	Issue Date	: 30-Sep-2019 11:15
Sampler	: ----		
Site	: ----		
Quote number	: SY/029/12 V3		
No. of samples received	: 2		
No. of samples analysed	: 2		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	091910408001 DUNGOG LEACHATE DAM (POINT 1)	091910408002 DUNGOG GROUND WATER (POINT 2)	----	----	----
			Client sampling date / time	24-Sep-2019 00:00	24-Sep-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	ES1930901-001	ES1930901-002	--------	--------	--------
				Result	Result	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**416**	**746**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**416**	**746**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**116**	**172**	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**240**	**582**	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**77**	**112**	----	----	----
Magnesium	7439-95-4	1	mg/L	**43**	**98**	----	----	----
Sodium	7440-23-5	1	mg/L	**182**	**394**	----	----	----
Potassium	7440-09-7	1	mg/L	**13**	**1**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.08**	**0.01**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.04**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.04**	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**17.5**	**34.9**	----	----	----
ø Total Cations	----	0.01	meq/L	**15.6**	**30.8**	----	----	----
ø Ionic Balance	----	0.01	%	**5.63**	**6.22**	----	----	----
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	**24**	**6**	----	----	----

Appendix D

External Quality Control Documents

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **ES1930901**	Page	: 1 of 5
Client	: **ROBERT CARR & ASSOCIATES P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS LAURA SCHOFIELD	Contact	: Customer Services ES
Address	: PO BOX 175 92 HILL ST CARRINGTON NSW 2294	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49029200	Telephone	: +61-2-8784 8555
Project	: 10408 DUNGOG SHIRE COUNCIL	Date Samples Received	: 24-Sep-2019
Order number	: ----	Date Analysis Commenced	: 25-Sep-2019
C-O-C number	: ----	Issue Date	: 30-Sep-2019
Sampler	: ----		
Site	: ----		
Quote number	: SY/029/12 V3		
No. of samples received	: 2		
No. of samples analysed	: 2		

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

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

This 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	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by 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

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	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED037P: Alkalinity by PC Titrator (QC Lot: 2611219)									
ES1930857-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	114	120	6.03	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	114	120	6.03	0% - 20%
ES1930879-007	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	58	58	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	58	58	0.00	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2605805)									
ES1930901-002	091910408002 DUNGOG GROUND WATER (POINT 2)	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	172	173	0.00	0% - 20%
ES1930879-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.00	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 2605804)									
ES1930901-002	091910408002 DUNGOG GROUND WATER (POINT 2)	ED045G: Chloride	16887-00-6	1	mg/L	582	596	2.35	0% - 20%
ES1930879-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	290	288	0.562	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 2606635)									
ES1930768-004	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	134	133	1.09	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	98	97	1.48	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	318	316	0.361	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	18	18	0.00	0% - 50%
ES1930945-010	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	5	5	0.00	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	1	1	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	6	6	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED093F: Dissolved Major Cations (QC Lot: 2606635) - continued									
ES1930945-010	Anonymous	ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2603586)									
ES1930901-001	091910408001 DUNGOG LEACHATE DAM (POINT 1)	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.08	0.08	0.00	No Limit
ES1930915-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	1.04	1.04	0.00	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2605806)									
ES1930901-002	091910408002 DUNGOG GROUND WATER (POINT 2)	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
ES1930879-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2603585)									
ES1930879-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.02	0.04	57.6	No Limit
ES1930901-002	091910408002 DUNGOG GROUND WATER (POINT 2)	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.04	0.04	0.00	No Limit
EP005: Total Organic Carbon (TOC) (QC Lot: 2603987)									
EP1909589-001	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	24	24	0.00	0% - 20%
ES1930834-009	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	9	8	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (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 Spike (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	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 2611219)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	101	81.0	111
				----	50 mg/L	107	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2605805)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	90.0	82.0	122
				<1	500 mg/L	120	82.0	122
ED045G: Chloride by Discrete Analyser (QCLot: 2605804)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	116	80.9	127
				<1	1000 mg/L	116	80.9	127
ED093F: Dissolved Major Cations (QCLot: 2606635)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	86.4	80.0	114
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	96.6	90.0	116
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	94.2	82.0	120
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	96.6	85.0	113
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2603586)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	108	90.0	114
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2605806)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	103	82.0	114
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2603585)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	106	91.0	113
EP005: Total Organic Carbon (TOC) (QCLot: 2603987)								
EP005: Total Organic Carbon	----	1	mg/L	<1	10 mg/L	87.4	72.0	120

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	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2605805)							
ES1930879-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	10 mg/L	93.8	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 2605804)							
ES1930879-001	Anonymous	ED045G: Chloride	16887-00-6	250 mg/L	108	70.0	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2603586)							
ES1930901-001	091910408001 DUNGOG LEACHATE DAM (POINT 1)	EK055G: Ammonia as N	7664-41-7	1 mg/L	107	70.0	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2605806)							
ES1930879-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.5 mg/L	99.7	70.0	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2603585)							
ES1930879-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.5 mg/L	109	70.0	130
EP005: Total Organic Carbon (TOC) (QCLot: 2603987)							
EP1909589-002	Anonymous	EP005: Total Organic Carbon	----	100 mg/L	100	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **ES1930901**	Page	: 1 of 5
Client	: **ROBERT CARR & ASSOCIATES P/L**	Laboratory	: Environmental Division Sydney
Contact	: MS LAURA SCHOFIELD	Telephone	: +61-2-8784 8555
Project	: 10408 DUNGOG SHIRE COUNCIL	Date Samples Received	: 24-Sep-2019
Site	: ----	Issue Date	: 30-Sep-2019
Sampler	: ----	No. of samples received	: 2
Order number	: ----	No. of samples analysed	: 2

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.**
- **NO Matrix Spike outliers occur.**
- **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.**

Analysis Holding Time Compliance

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.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
091910408001 - DUNGOG LEACHATE DAM (POINT 1),	091910408002 - DUNGOG GROUND WATER (POINT 2)	**24-Sep-2019**	**----**	----	----	**27-Sep-2019**	08-Oct-2019 ✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
091910408001 - DUNGOG LEACHATE DAM (POINT 1),	091910408002 - DUNGOG GROUND WATER (POINT 2)	**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	22-Oct-2019 ✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
091910408001 - DUNGOG LEACHATE DAM (POINT 1),	091910408002 - DUNGOG GROUND WATER (POINT 2)	**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	22-Oct-2019 ✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural (ED093F)							
091910408001 - DUNGOG LEACHATE DAM (POINT 1),	091910408002 - DUNGOG GROUND WATER (POINT 2)	**24-Sep-2019**	**----**	----	----	**26-Sep-2019**	01-Oct-2019 ✓
EK055G: Ammonia as N by Discrete Analyser							
Amber TOC Vial - Sulfuric Acid (EK055G)							
091910408001 - DUNGOG LEACHATE DAM (POINT 1)		**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	22-Oct-2019 ✓
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
091910408002 - DUNGOG GROUND WATER (POINT 2)		**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	22-Oct-2019 ✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
091910408001 - DUNGOG LEACHATE DAM (POINT 1),	091910408002 - DUNGOG GROUND WATER (POINT 2)	**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	26-Sep-2019 ✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Amber TOC Vial - Sulfuric Acid (EK059G)							
091910408001 - DUNGOG LEACHATE DAM (POINT 1)		**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	22-Oct-2019 ✓
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
091910408002 - DUNGOG GROUND WATER (POINT 2)		**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	22-Oct-2019 ✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP005: Total Organic Carbon (TOC)							
Amber TOC Vial - Sulfuric Acid (EP005)							
091910408001 - DUNGOG LEACHATE DAM (POINT 1)	**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	22-Oct-2019	✓
Clear Plastic Bottle - Natural (EP005)							
091910408002 - DUNGOG GROUND WATER (POINT 2)	**24-Sep-2019**	**----**	----	----	**25-Sep-2019**	25-Sep-2019	✓

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)							
Alkalinity by PC Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	18	**5.56**	**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
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)
Total Organic Carbon	EP005	WATER	In house: Referenced to APHA 5310 B, The automated TOC analyzer determines Total and Inorganic Carbon by IR cell. TOC is calculated as the difference. This method is compliant with NEPM (2013) Schedule B(3)