BOC Limited Kooragang Groundwater and Effluent Report July 2019

BOC Limited Kooragang Island

9 September 2019

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1 Introduction

BOC Limited Kooragang Island, herein referred to as BOC Kooragang, owns and operates a gas facility for the production and supply of gas products located at 9 Egret Street Kooragang, New South Wales. The facility operates 24 hours per day, 7 days per week. BOC Kooragang holds NSW Environmental Protection Authority (EPA) Environmental Protection Licence (EPL) 20165. The Scheduled Activities in the EPL include chemical storage waste generation, dangerous goods production and general chemicals storage.

On 16 January 2018 BOC received EPA approval to dispose of cooling tower effluent on specific grassed areas of the site. BOC Kooragang currently possess two (2) cooling towers onsite. The cooling tower blowdown wastewater (effluent) continues to four (4) 10,000 litre capacity storage tanks onsite, totalling a capacity of 40,000 litres storage onsite. The wastewater is applied to specific grassed areas on the BOC site as irrigation. The cooling tower effluent has been pre-treated using a specialised media filter unit, which was targeted at removal of fluoride.

MJM Environmental (MJM) was engaged by BOC Kooragang in July 2019 to undertake quarterly groundwater and effluent sampling and analysis during irrigation on specific grassed areas on the BOC site. This report outlines the results of the groundwater and effluent sampling carried out on 10 July 2019.

2 Site identification and monitoring locations

BOC Kooragang operates a gas facility located at 9 Egret Street Kooragang, New South Wales. The plant vicinity map is shown in Figure 2.1

Figure 2.1: BOC Kooragang site boundary and vicinity (Spatial Information Exchange [SIXMaps] 2017)

The groundwater monitoring points described as BH1 through to BH6 inclusive are shown in Figure 2.2.

Figure 2.2: Location of BOC Kooragang's groundwater boreholes

The location of the cooling towers and wastewater storage tanks are shown in Figure 2-3.

It is noted here that the pre-treatment system is present onsite near the cooling tower effluent storage tanks, however is not currently shown in the figures.

Figure 2-3: Location of BOC Kooragang's cooling towers and wastewater tanks

3 Sampling Methodology

Sampling was done in accordance with ANZECC monitoring standards (AS/NZS 5667.11:1998 and AS/NZS 5667.1:1998). These procedures include the name and location of the sample point, date and time of sample collection, the type of sample point, method of sample collection, depth of sampling and sample appearance at the time of collection.

Groundwater sampling was undertaken by taking grab samples with appropriate bottles provided by a NATA accredited laboratory. A bailer was used to collect samples from all boreholes. Samples were put immediately into an esky to avoid heat and sunlight, and taken directly to the laboratory.

The analytes tested quarterly for groundwater and effluent as per EPL 20165 are presented in Table 3-1.

Table 3-1: Quarterly effluent and groundwater monitoring analytes as per EPL 20165

Analytes		
Effluent – EPL point 1		
pH	Nitrogen (total)	Copper
Electrical conductivity	Total Kjeldahl Nitrogen	Lead
Sodium Adsorption Ratio	Sulphate	Mercury
Alkalinity as calcium carbonate (hardness)	Phosphorus	Nickel
Chloride	Cadmium	Biochemical Oxygen Demand (BOD)
Sodium	Arsenic	Biocides
Fluoride	Chromium	
Total dissolved solids	Zinc	
Groundwater – EPL points 2, 3, 4, 5, 6 and 7		
pH	Nitrate	Chromium
Conductivity	Sulphate	Copper
Sodium Adsorption Ratio	Phosphorus	Nickel
Alkalinity as calcium carbonate (hardness)	Available (Reactive) Phosphorus	Lead
Chloride	Total dissolved solids	Zinc
Sodium	Fluoride	Mercury
Nitrogen (total)	Arsenic	
Total Kjeldahl Nitrogen	Cadmium	

At the conclusion of sampling all individual, marked sealed containers were submitted to Australian Laboratory Services (ALS), a NATA accredited laboratory with accreditation No. 825 located at Mayfield West, 2304. Certificates of analysis are presented in Appendix A and the field notes for the sampling work completed are presented in Appendix B.

Collection and analysis for the dosing chemicals (biocides) was undertaken by Nalco Water. Results were provided to BOC Kooragang and communicated to MJM Environmental.

4 Results

4.1 Effluent Results – EPL Point 1

The results for EPL Point 1 cooling tower effluent sampling performed on 10 July 2019 are presented in Table 4-1.

Table 4-1: BOC Kooragang EPL Point 1 cooling tower effluent sampling results 10 July 2019

Analyte	Units	Result 10 July 2019	Recommended Irrigation Thresholds [1]
pH	pH Unit	8.3	6 – 9
Electrical conductivity	µS/cm	2,490	-
Sodium Adsorption Ratio	-	4.16	-
Alkalinity as calcium carbonate (hardness)	mg/L	218	-
Chloride	mg/L	428	-
Sodium	mg/L	232	-
Biochemical Oxygen Demand (BOD)	mg/L	2	-
Fluoride	mg/L	1.1	1.0[2] 2.0[3]
Nitrogen (total)	mg/L	5	25 - 125[2] 5[3]
Total Kjeldahl Nitrogen	mg/L	1.7	25 - 125[2] 5[3]
Sulfate	mg/L	318	400
Total dissolved solids	mg/L	1,340	1,000
Phosphorus	mg/L	0.21	0.8 - 12[2] 0.05[3]
Arsenic	mg/L	0.001	0.1[2] 2.0[3]
Cadmium	mg/L	<0.0001	0.01[2] 0.05[3]
Chromium	mg/L	<0.001	0.1[2] 1.0[3]
Copper	mg/L	0.033	0.2[2] 5.0[3]
Nickel	mg/L	0.002	0.2[2] 2.0[3]
Lead	mg/L	<0.001	2.0[2] 5.0[3]
Zinc	mg/L	0.009	2.0[2] 5.0[3]
Mercury	mg/L	<0.0001	0.002[2] 0.002[3]
Biocides (active component isothiazoline)	mg/L	<0.05	-
Dosing chemicals (active component benzotriazole)	mg/L	<0.1	-

[1] Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 guidelines - *Section 4: Primary Industries - 4.2 Water Quality for irrigation and general water use*.

[2] Short-term trigger value (STV) – The STV is the maximum concentration (mg/L) of contaminant in the irrigation water which can be tolerated for a shorter period of time (20 years).

[3] Long-term trigger value (LTV) – The LTV is the maximum concentration (mg/L) of contaminant in the irrigation water which can be tolerated assuming 100 years of irrigation.

Figure 4.1 to Figure 4.10 show historical results collected for the effluent samples at BOC Kooragang.

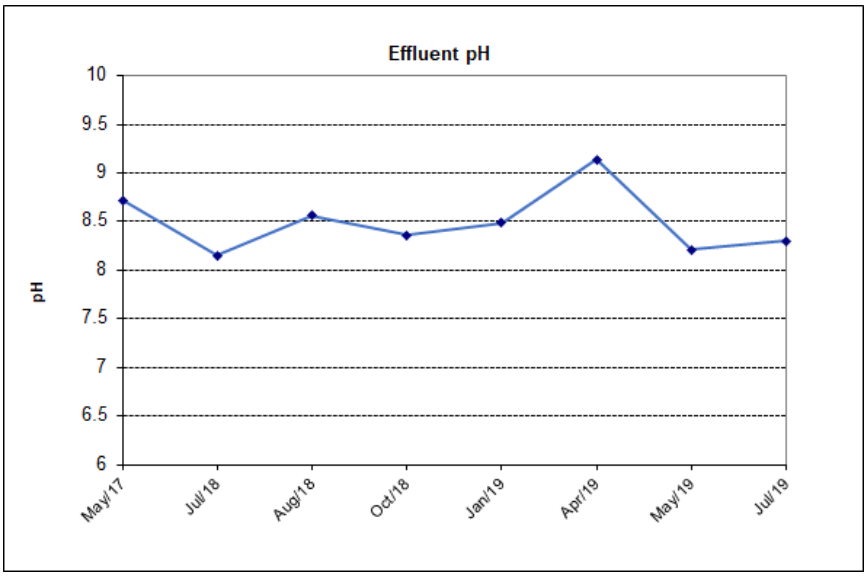

Figure 4.1: Effluent pH Results

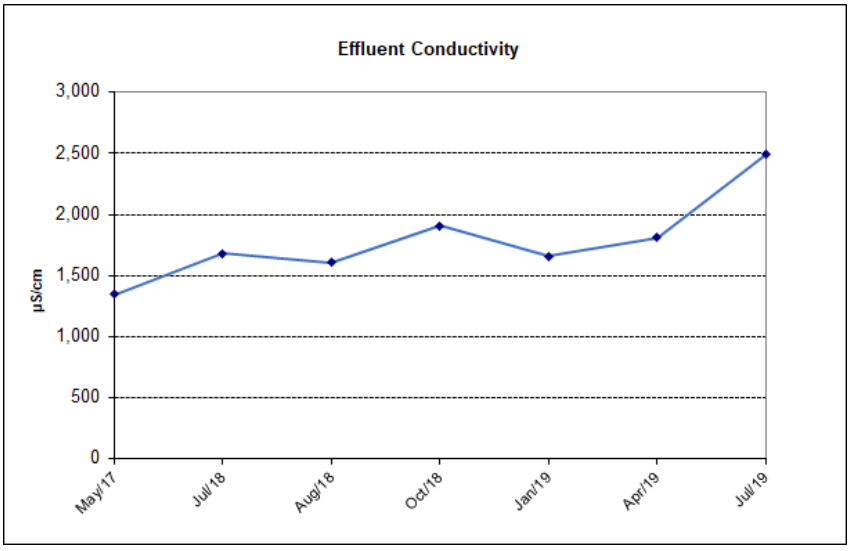

Figure 4.2: Effluent Conductivity Results

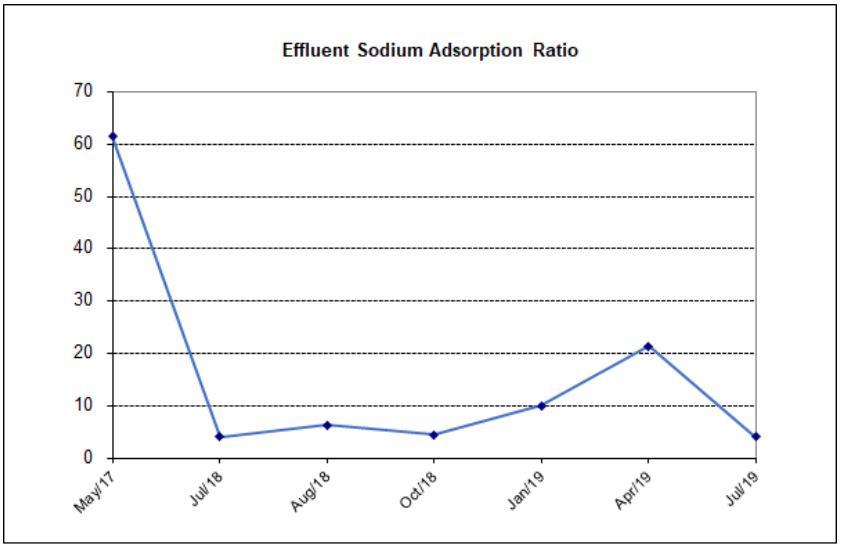

Figure 4.3: Effluent Sodium Adsorption Ratio Results

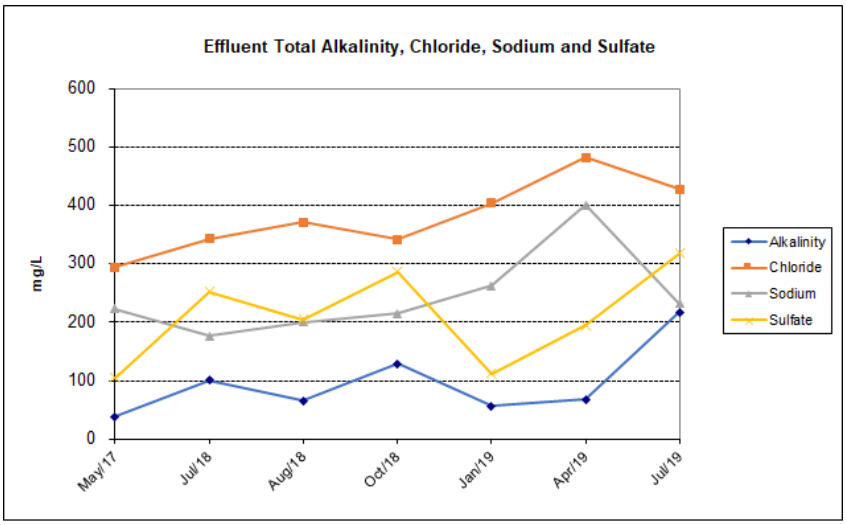

Figure 4.4: Effluent Total Alkalinity as $CaCO_3$, Chloride, Sodium and Sulfate Results

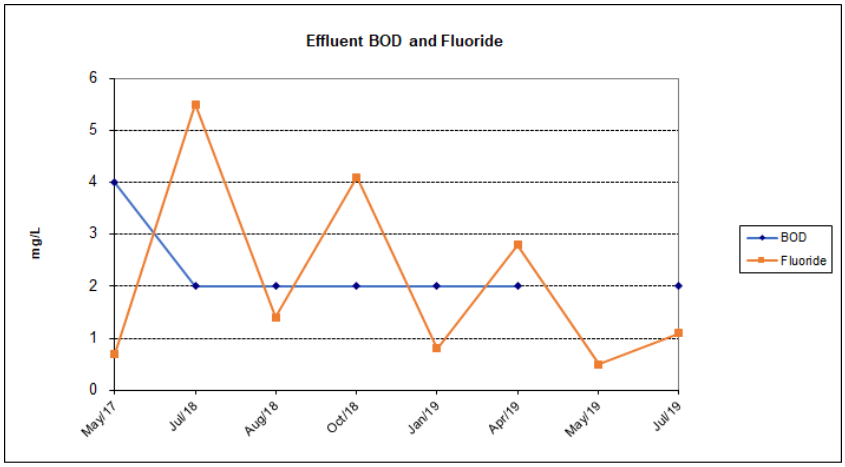

Figure 4.5: Effluent BOD and Fluoride Results

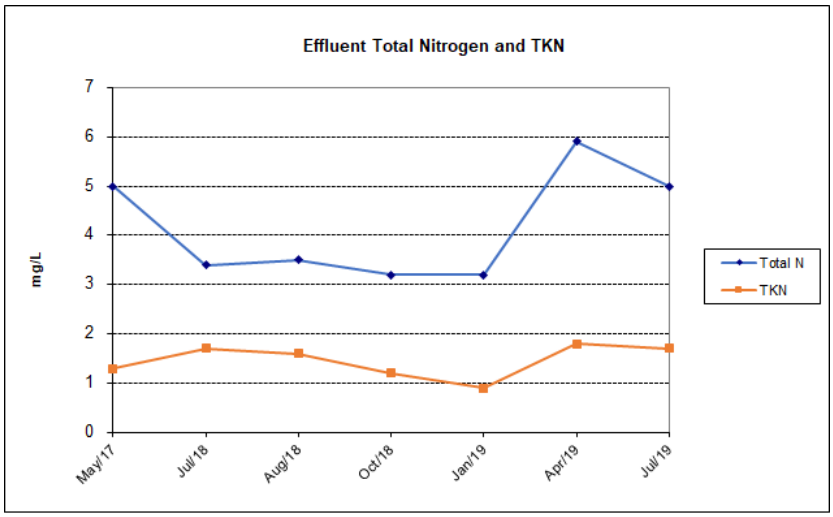

Figure 4.6: Effluent Nitrogen and TKN Results

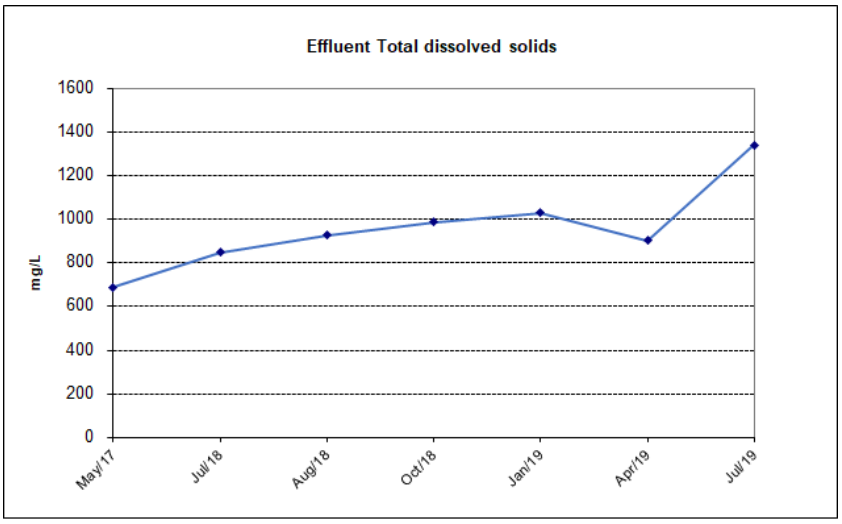

Figure 4.7: Effluent TDS Results

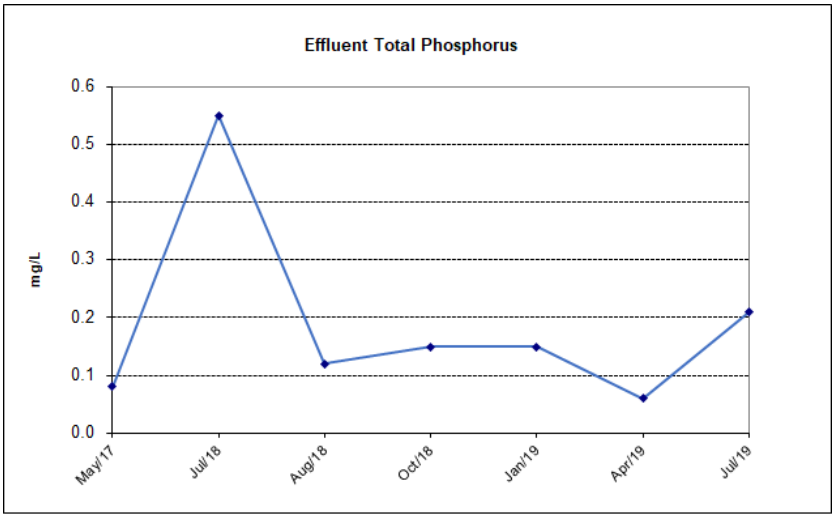

Figure 4.8: Effluent Phosphorus Results

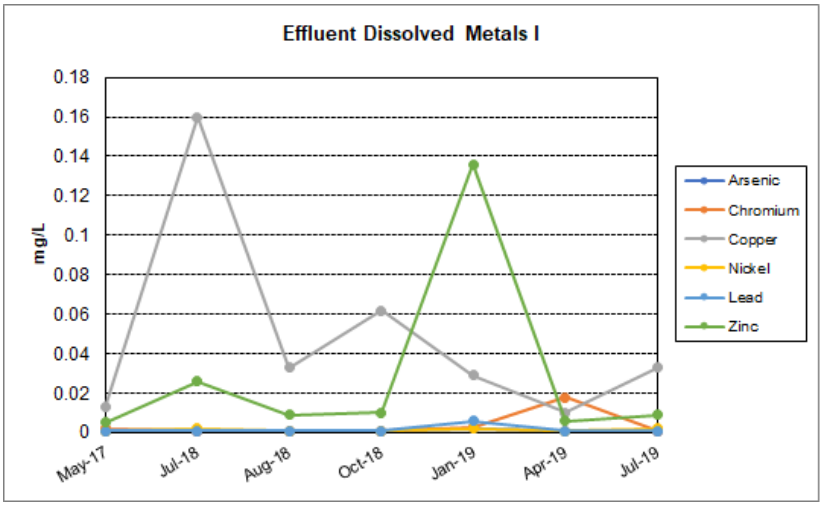

Figure 4.9: Effluent Dissolved Metals Results I

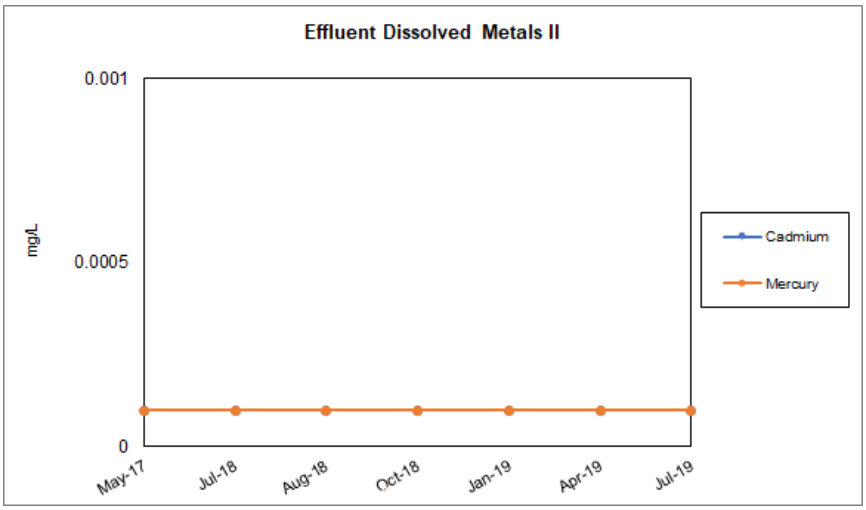

Figure 4.10: Effluent Dissolved Metals Results II

4.2 Groundwater Results – EPL Points 2, 3, 4, 5, 6 and 7

The results for the 10 July 2019 groundwater monitoring event are presented in the following table.

Table 4-2: BOC Kooragang groundwater results – 10 July 2019

Analyte	Units	BH1 EPL Point 2	BH2 EPL Point 3	BH3 EPL Point 4	BH4 EPL Point 5	BH5 EPL Point 6	BH6 EPL Point 7
pH	pH	7.76	7.62	7.9	7.64	7.93	8.13
Conductivity	µS/cm	682	879	534	1,890	760	688
Sodium Adsorption Ratio	-	0.48	0.28	0.73	3.22	0.8	0.74
Total Alkalinity as $CaCO_3$	mg/L	202	274	171	217	242	241
Chloride	mg/L	20	20	22	293	39	35
Sodium	mg/L	19	13	25	158	31	28
Nitrogen (total)	mg/L	4.6	3.7	4.3	3.5	4	3.1
Total Kjeldahl Nitrogen	mg/L	4.5	3.1	4	3.5	3.3	2.2
Nitrate	mg/L	0.07	0.6	0.27	0.03	0.7	0.86
Sulfate	mg/L	93	119	42	220	38	17
Phosphorus	mg/L	2.38	1.04	8.89	7.37	3.96	2.36
Reactive (available) Phosphorus	mg/L	0.02	<0.01	0.19	<0.01	0.17	0.42
Total dissolved solids	mg/L	452	528	281	1,100	408	360
Fluoride	mg/L	0.5	0.8	0.6	0.8	0.7	0.9
Standing Water Level	m	2	2	2	2	2	2
Metals (dissolved)							
Arsenic	mg/L	<0.001	<0.001	0.002	<0.001	0.001	0.001
Cadmium	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	mg/L	<0.001	0.002	<0.001	0.002	0.003	0.001
Zinc	mg/L	<0.005	0.016	<0.005	<0.005	0.007	<0.005
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Figure 4.11 to Figure 4.33 show historical results collected for the groundwater samples at BOC Kooragang.

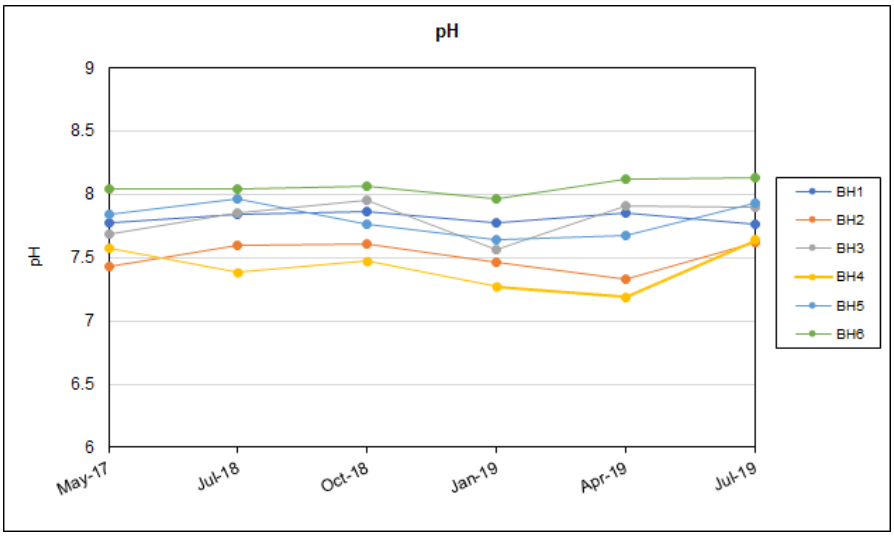

Figure 4.11: Groundwater pH Results

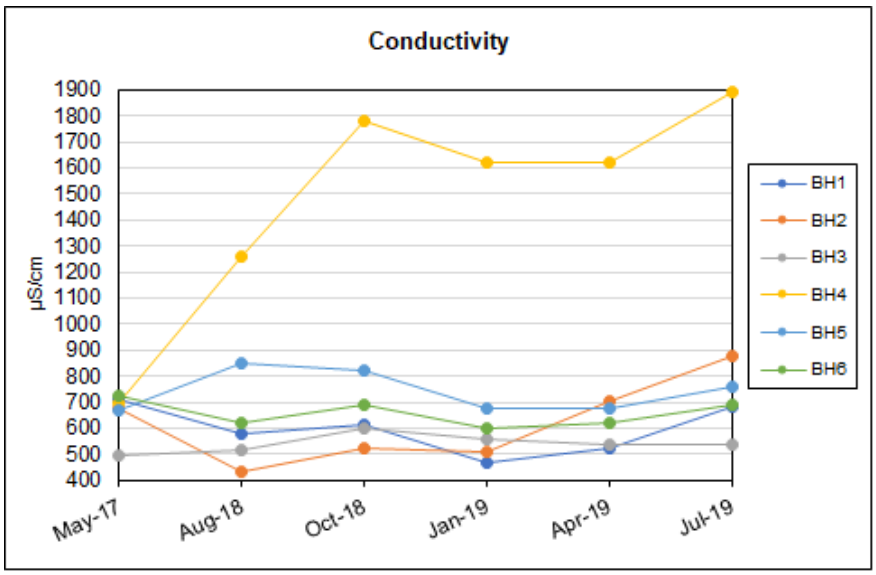

Figure 4.12: Groundwater Conductivity Results

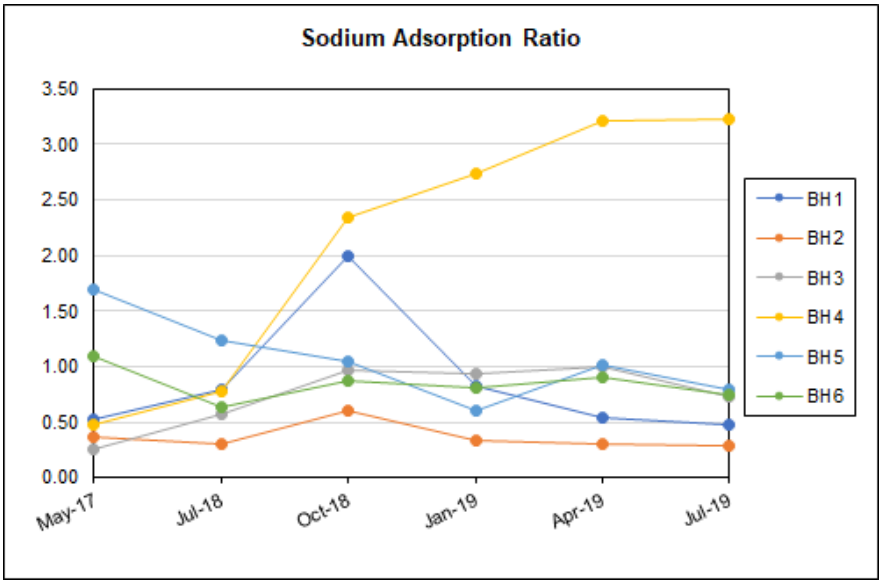

Figure 4.13: Groundwater Sodium Adsorption Ratio Results

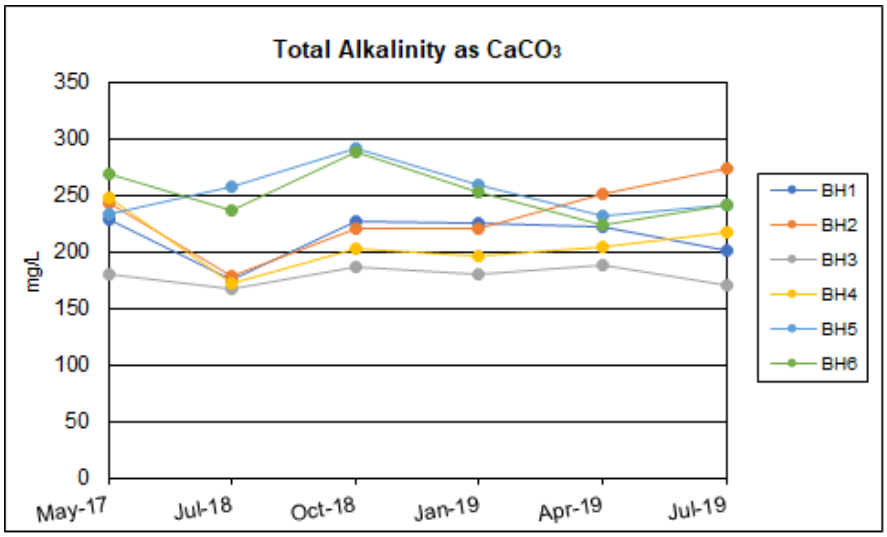

Figure 4.14: Groundwater Total Alkalinity as CaC03 Results

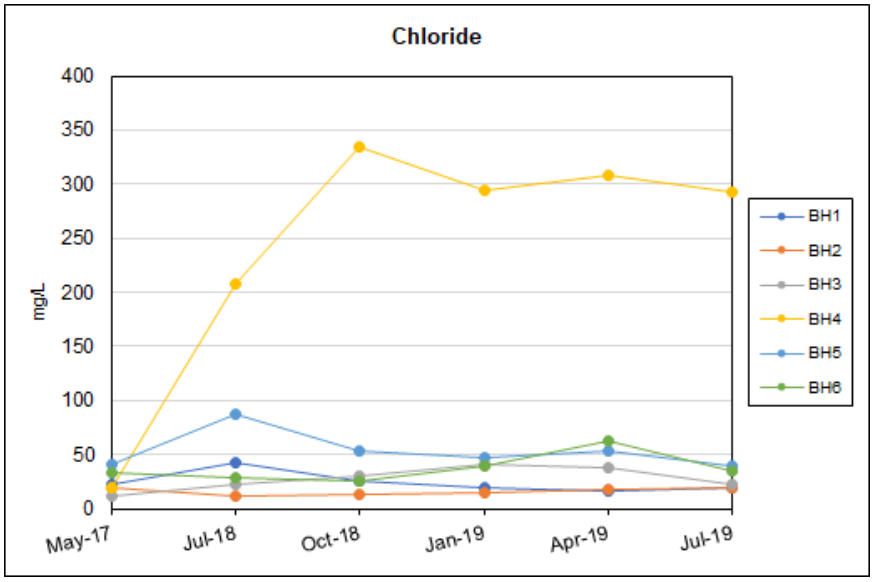

Figure 4.15: Groundwater Chloride Results

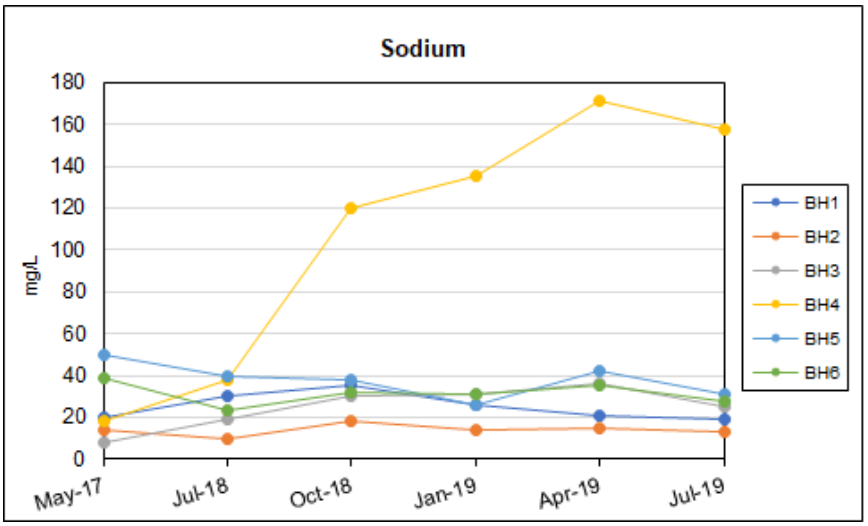

Figure 4.16: Groundwater Sodium Results

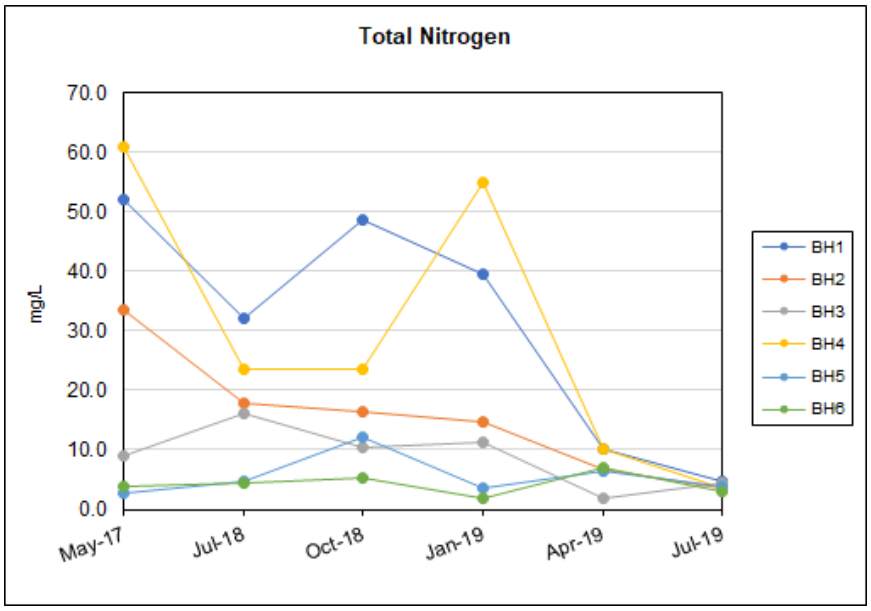

Figure 4.17: Groundwater Total Nitrogen Results

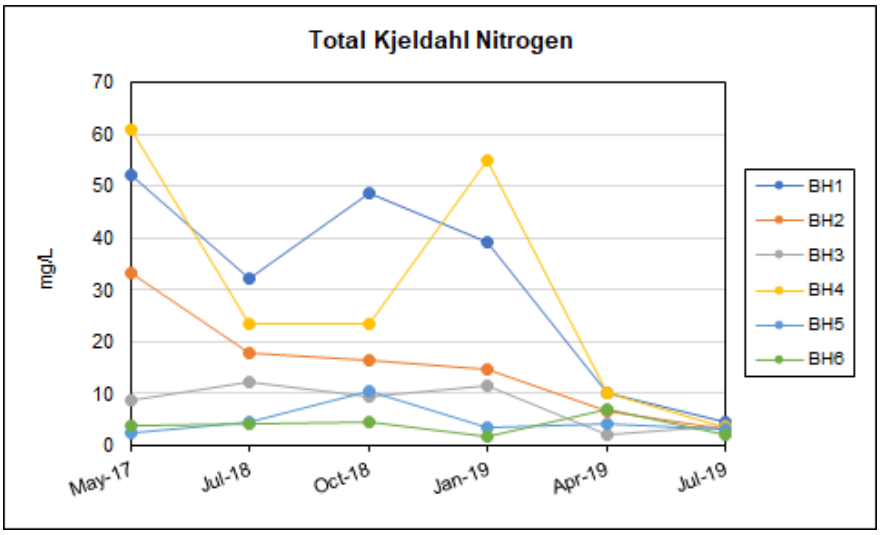

Figure 4.18: Groundwater Total Kjeldahl Nitrogen Results

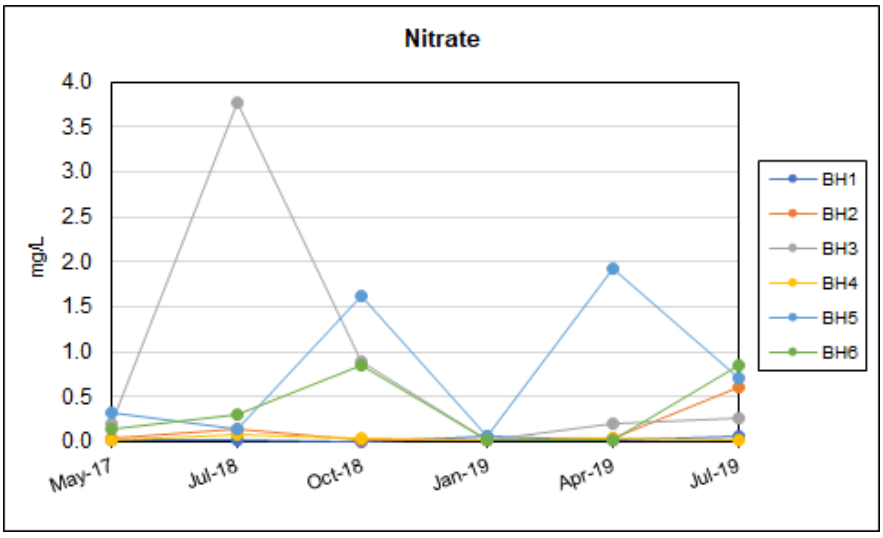

Figure 4.19: Groundwater Nitrate Results

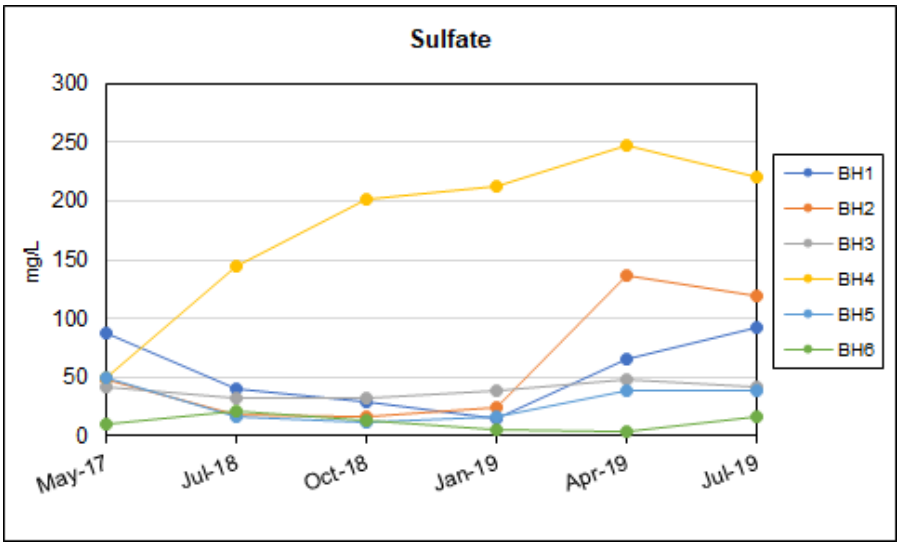

Figure 4.20: Groundwater Sulfate Results

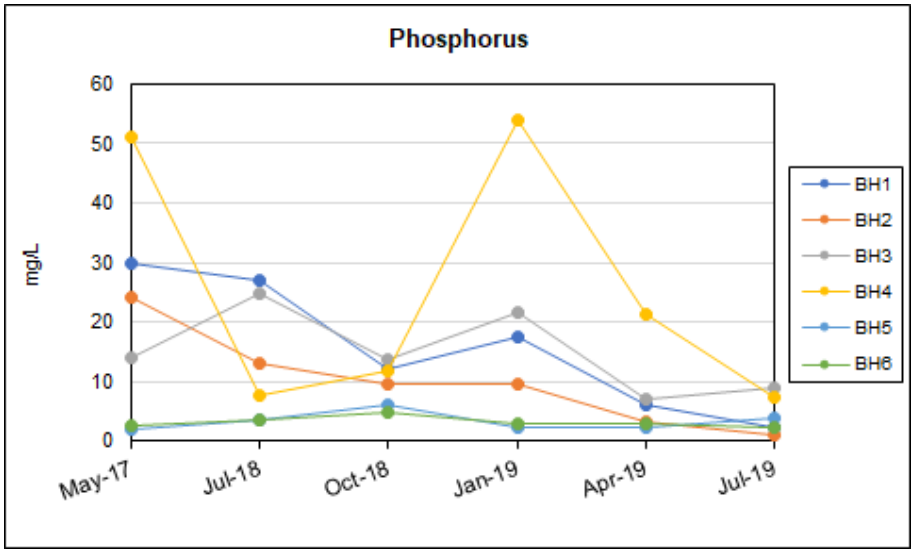

Figure 4.21: Groundwater Phosphorus Results

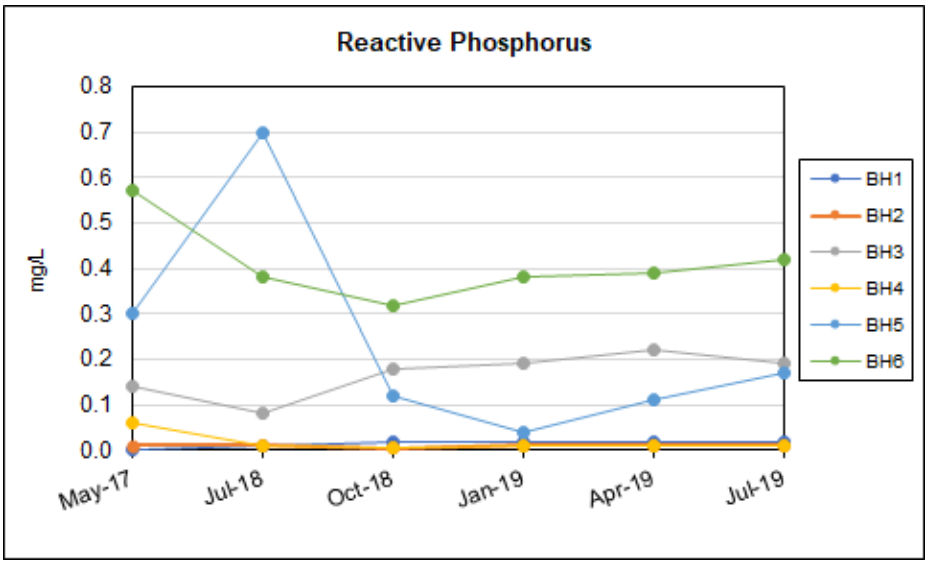

Figure 4.22: Groundwater Reactive Phosphorus

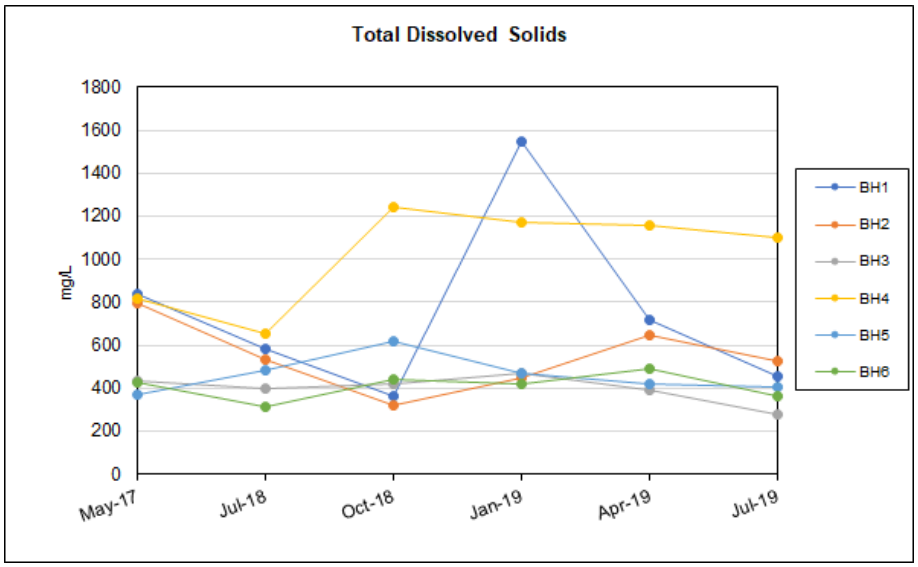

Figure 4.23: Groundwater Total Dissolved Solids Results

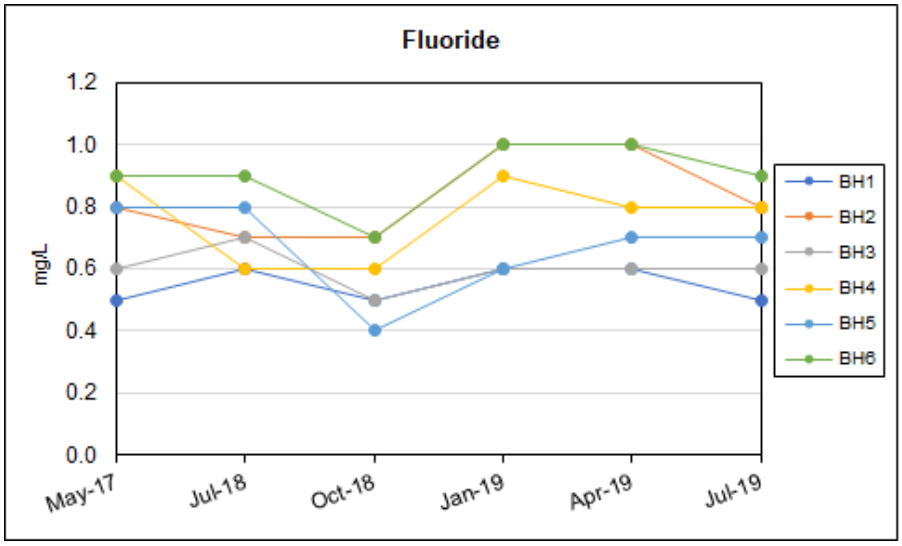

Figure 4.24: Groundwater Fluoride Results

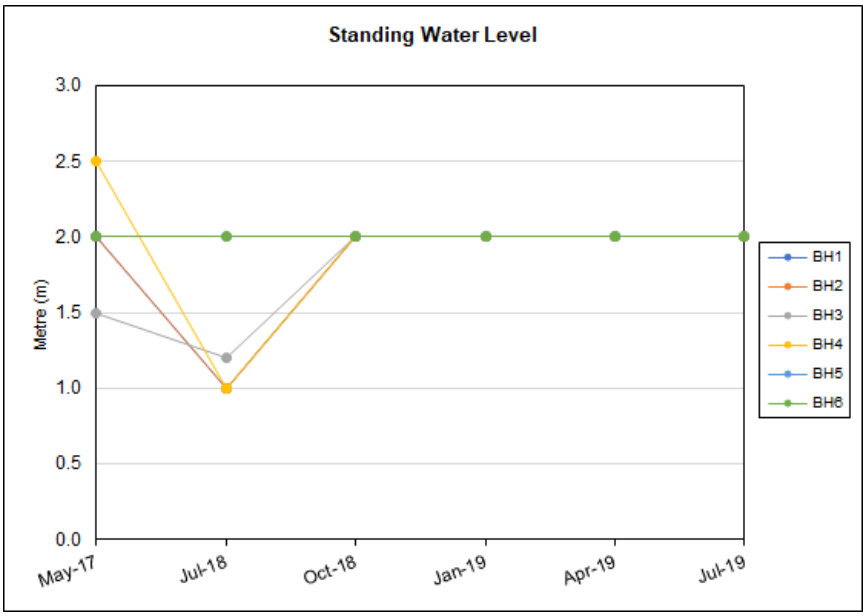

Figure 4.25: Groundwater Standing Water Level Results

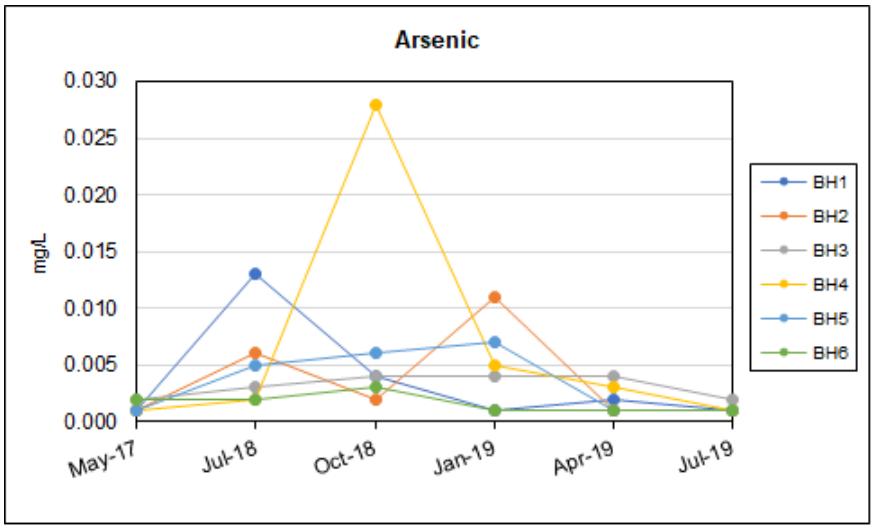

Figure 4.26: Groundwater Arsenic Results

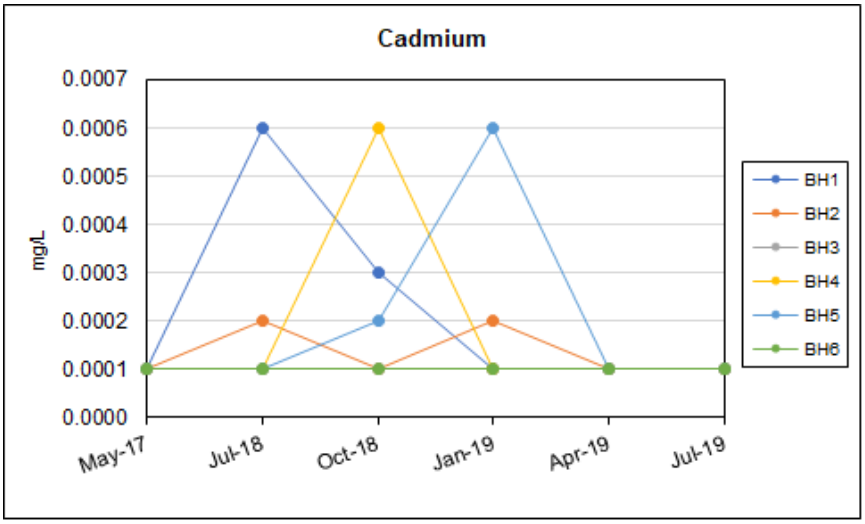

Figure 4.27: Groundwater Cadmium Results

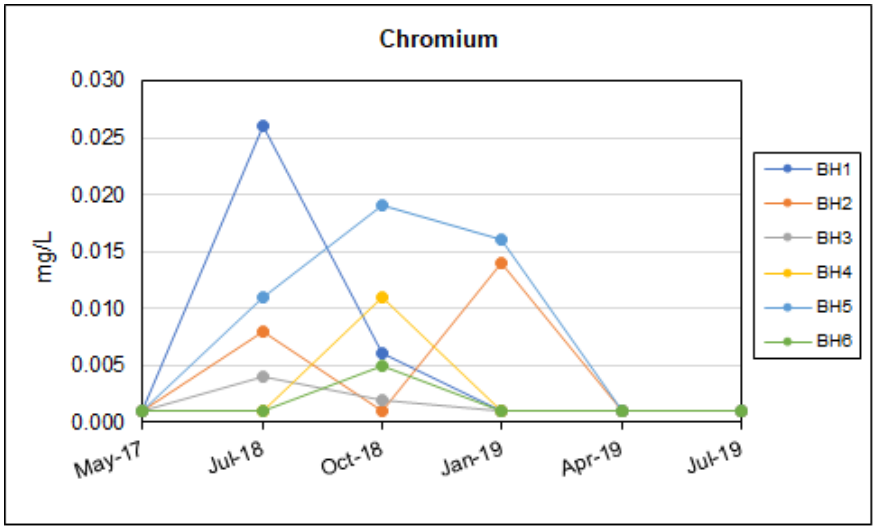

Figure 4.28: Groundwater Chromium Results

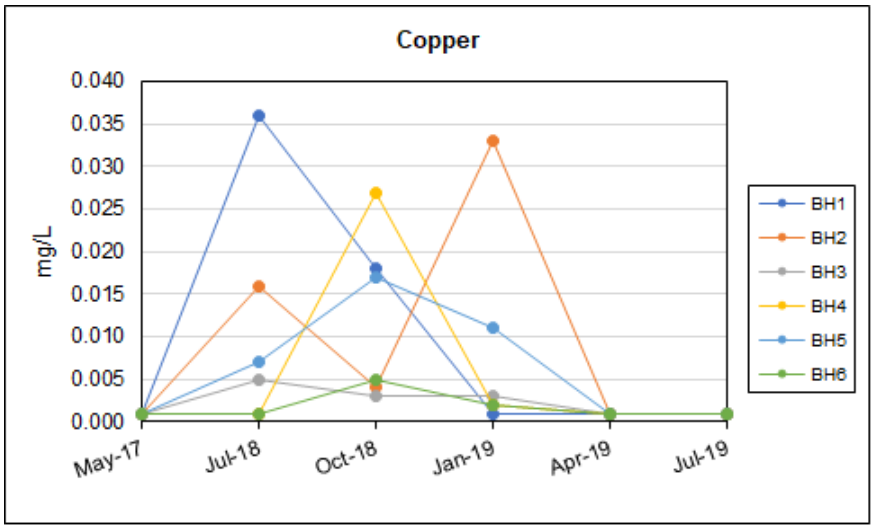

Figure 4.29: Groundwater Copper Results

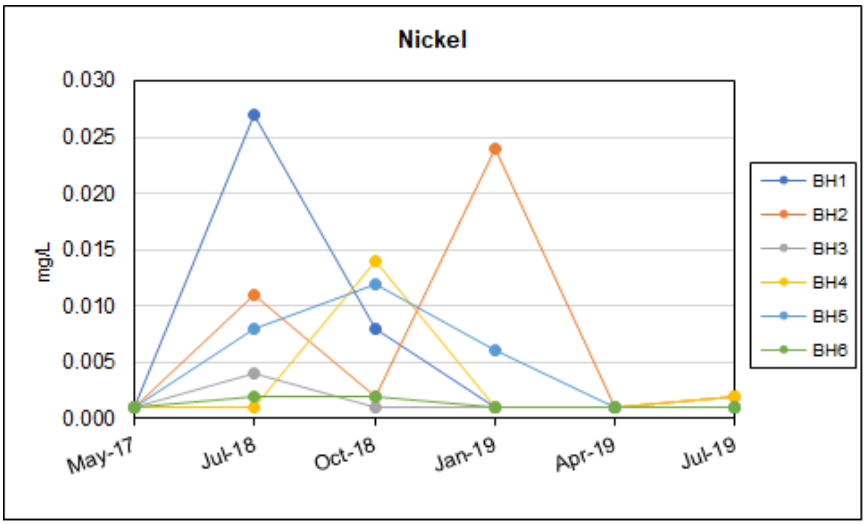

Figure 4.30: Groundwater Nickel Results

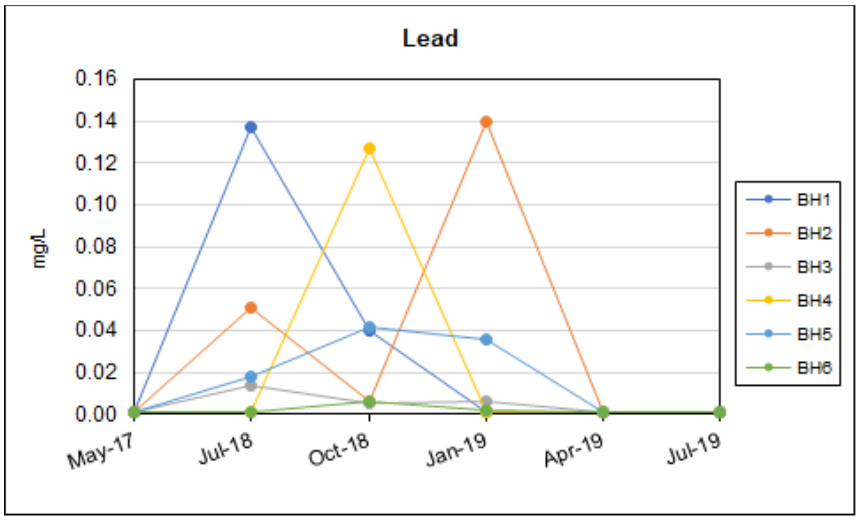

Figure 4.31: Groundwater Lead Results

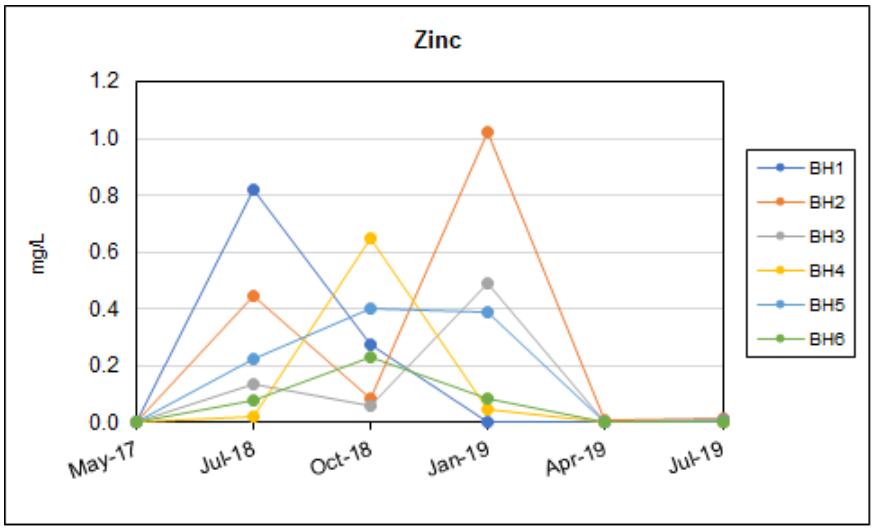

Figure 4.32: Groundwater Zinc Results

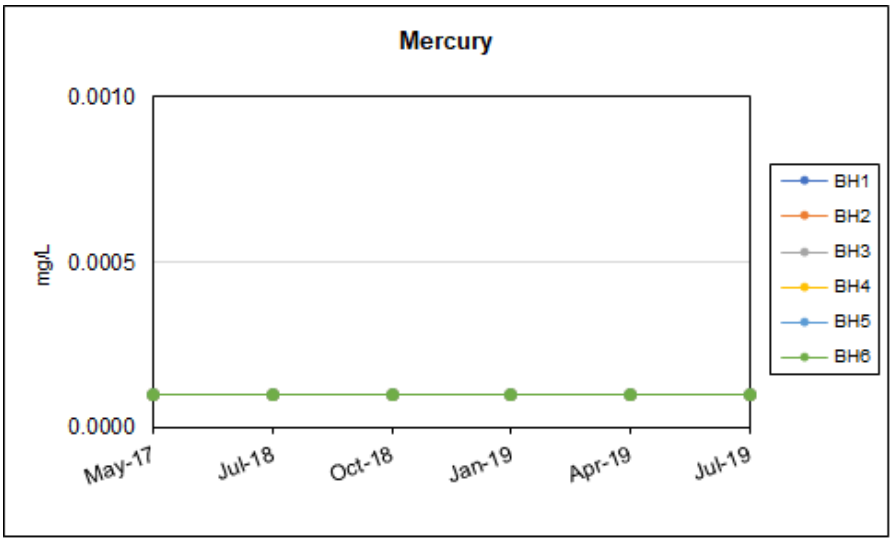

Figure 4.33: Groundwater Mercury Results

5 Discussion

MJM Environmental was engaged by BOC Kooragang to monitor groundwater and cooling tower effluent by undertaking sampling and analysis during irrigation on specific grassed areas.

Effluent and groundwater sampling was performed on 10 July 2019. BOC Kooragang's EPL does not specify limits for the effluent and groundwater quality. The Short-term Trigger Values (STV) and Long-term Trigger Values (LTV) presented in Table 4-1 are recommendations from the ANZECC guidelines. The effluent results have also been compared to the baseline monitoring results performed in May 2017.

During the July monitoring event the effluent Fluoride result slightly exceeded the recommended short-term irrigation threshold of 1.0 mg/L with a result of 1.1 mg/L.

The effluent TDS result exceeded the recommended irrigation threshold of 1,000 mg/L with a result of 1,340 mg/L.

Total phosphorus exceeded the LTV limit of 0.05 mg/L with a result of 0.21 mg/L. However, it is noted that the guidelines state the LTV for phosphorus is set '*to minimise bioclogging of irrigation equipment only*'.

The following trends were noted among the remaining analytes for the cooling tower effluent:

- Conductivity, TDS and Alkalinity have increased as a general trend.
- Sodium Adsorption Ratio and Sodium results have returned to historical levels.
- Sulfate has increased for the past two (2) monitoring events.
- Metals have returned to historical levels.

All other effluent samples are comparable to the baseline monitoring period in 2017.

Groundwater sampling was carried out for BH1 to BH6 on 10 July 2019. It is noted that BH4 is located in the irrigation area.

The groundwater results have been compared to the baseline monitoring results performed in May 2017 in the graphs provided. The following trends were noted:

- Conductivity increased for all bores compared to April 2019 results. Conductivity at BH4 remained higher than the baseline testing result of 694 µS/cm with a result of 1,890 µS/cm.
- SAR, Chloride and Sodium levels at BH4 remained high in comparison to historical data.
- Total Nitrogen, TKN, Nitrate and Phosphorus (total) have decreased as an overall trend.
- Nitrate results at all bores have returned to historical baseline levels.
- Sulphate levels have remained high at BH4 from a baseline value of 50 mg/L to 220 mg/L.
- All bores showed a reduction in dissolved metals compared to April 2019 monitoring.

All other groundwater samples are comparable to the baseline monitoring period in 2017.

Appendix A – NATA Laboratory Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1921771**	Page	: 1 of 6
Client	: **MJM ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: BRIGID KELLY	Contact	: Customer Services ES
Address	: OFFICE 1, 335 WHARF ROAD NEWCASTLE NSW, AUSTRALIA 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 49264222	Telephone	: +61-2-8784 8555
Project	: 185-2013	Date Samples Received	: 12-Jul-2019 10:27
Order number	: 185-1987	Date Analysis Commenced	: 13-Jul-2019
C-O-C number	: ----	Issue Date	: 18-Jul-2019 18:09
Sampler	: JC		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 7		
No. of samples analysed	: 7		

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
Ashesh Patel	Senior 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	BH1	BH2	BH3	BH4	BH5
				Client sampling date / time	12-Jul-2019 00:00	12-Jul-2019 00:00	12-Jul-2019 00:00	12-Jul-2019 00:00	12-Jul-2019 00:00
Compound	CAS Number	LOR	Unit		ES1921771-001	ES1921771-002	ES1921771-003	ES1921771-004	ES1921771-005
					Result	Result	Result	Result	Result
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		7.76	7.62	7.90	7.64	7.93
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		682	879	534	1890	760
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L		452	528	281	1100	408
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		202	274	171	217	242
Total Alkalinity as CaCO3	----	1	mg/L		202	274	171	217	242
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		93	119	42	220	38
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		20	20	22	293	39
ED093F: Dissolved Major Cations									
Sodium	7440-23-5	1	mg/L		19	13	25	158	31
ED093F: SAR and Hardness Calculations									
^ Sodium Adsorption Ratio	----	0.01	-		0.48	0.28	0.73	3.22	0.80
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		<0.001	<0.001	0.002	<0.001	0.001
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L		<0.001	0.002	<0.001	0.002	0.003
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L		<0.005	0.016	<0.005	<0.005	0.007
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		0.5	0.8	0.6	0.8	0.7
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		0.01	<0.01	0.01	<0.01	0.02
EK058G: Nitrate as N by Discrete Analyser									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BH1	BH2	BH3	BH4	BH5
				Client sampling date / time	12-Jul-2019 00:00	12-Jul-2019 00:00	12-Jul-2019 00:00	12-Jul-2019 00:00	12-Jul-2019 00:00
Compound	CAS Number	LOR	Unit		ES1921771-001	ES1921771-002	ES1921771-003	ES1921771-004	ES1921771-005
					Result	Result	Result	Result	Result
EK058G: Nitrate as N by Discrete Analyser - Continued									
Nitrate as N	14797-55-8	0.01	mg/L		**0.07**	**0.60**	**0.27**	**0.03**	**0.70**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.08**	**0.60**	**0.28**	**0.03**	**0.72**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**4.5**	**3.1**	**4.0**	**3.5**	**3.3**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**4.6**	**3.7**	**4.3**	**3.5**	**4.0**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**2.38**	**1.04**	**8.89**	**7.37**	**3.96**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.02**	<0.01	**0.19**	<0.01	**0.17**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BH6	EFF1	----	----	----
				Client sampling date / time	12-Jul-2019 00:00	12-Jul-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1921771-006	ES1921771-007	--------	--------	--------
					Result	Result	----	----	----
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		**8.13**	**8.30**	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**688**	**2490**	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L		**360**	**1340**	----	----	----
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	**2**	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**241**	**215**	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**241**	**218**	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**17**	**318**	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**35**	**428**	----	----	----
ED093F: Dissolved Major Cations									
Sodium	7440-23-5	1	mg/L		**28**	**232**	----	----	----
ED093F: SAR and Hardness Calculations									
^ Sodium Adsorption Ratio	----	0.01	-		**0.74**	**4.16**	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		**0.001**	**0.001**	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L		<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L		<0.001	**0.033**	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.001**	**0.002**	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	**0.009**	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.9**	**1.1**	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.03**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BH6	EFF1	----	----	----
				Client sampling date / time	12-Jul-2019 00:00	12-Jul-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1921771-006	ES1921771-007	--------	--------	--------
					Result	Result	----	----	----
EK058G: Nitrate as N by Discrete Analyser - Continued									
Nitrate as N	14797-55-8	0.01	mg/L		**0.86**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.89**	**3.30**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.2**	**1.7**	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**3.1**	**5.0**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**2.36**	**0.21**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.42**	----	----	----	----
EP030: Biochemical Oxygen Demand (BOD)									
Biochemical Oxygen Demand	----	2	mg/L		----	<2	----	----	----

Customer Analytical Services

Ecolab Nalco Unit 12, 2 Eden Park Drive Macquarie Park NSW 2113

Phone: (612)8870 8433 Email: customeranalyticalservices@nalco.com

Amended - Report Number: 2693747
Replaces previous report number: 2693701 24-Jul-2019 9:38

BOC GASES KOORAGANG ISLAND
EGRET STREET
KOORAGANG NSW 2304 AUSTRALIA
Sold To: 0150199260 **Ship To**: 0150199260
Representative: Clive Stacey

Sample Number:	AW076607
Date Sampled:	09-Jul-2019
Date Received:	19-Jul-2019
Date Completed:	24-Jul-2019
Date Authorised:	24-Jul-2019

Analytical Report

This sample was analysed as received, the results being as follows:

Sampling point: Tower Blowdown Effluent Storage Tank

Water

Other **Test Method: AMW0117**	**Filtered**
Isothiazoline	<0.05 mg/L

Product Residuals **Test Method: CP15003**	**Filtered**
Benzotriazole	<0.1 mg/L
Tolytriazole	<0.1 mg/L

Authorised by Arjan Kraak
Senior RD&E Group Leader

Appendix B – Sampling Field Notes

WATER SAMPLING FORM

Client Name: BOC Limited - Kooragang

Date 10 7 2019 Time 11.30 AM

Day Month Year

Reasons for sampling: Cooling tower water monitoring

Location of sampling point: Effluent - Cooling tower

Nature of sampling point [ ] Groundwater [ ] Tradewaste sump [ ] Surface water

[ ] Stormwater [x] Other Please specify

Outlet tap

Sample ID: Eff1

Depth sample taken: N/A m

Sample appearance Clear

Water Level in BH N/A m

Volume of sample taken 1.0 L

Name of Sampler JC

Method of sampling Tap Outlet

Nature of sample point Tap Outlet

COC Reference No. 185-2013

Number of Bottles 4

Other comments:

Slightly foamy

NOTE: ONE WATER SAMPLING FORM TO BE COMPLETED FOR EACH SAMPLE POINT

GROUND WATER SAMPLING FORM

Client Name: BOC Limited - Kooragang

Date 10 7 19 Time 11:55

Day Month Year

Reasons for sampling: Baseline soil water monitoring

Location of sampling point: Borehole 1

Nature of sampling point [x] Groundwater [ ] Tradewaste sump [ ] Surface water

[ ] Stormwater [ ] Other Please specify

Sample ID: BH1

Depth sample taken: 2 m

Sample appearance Very Dark

Water Level in BH 2 m

Volume of sample taken 2.0 L

Name of Sampler JC

Method of sampling In-situ bailer

Nature of sample point Bore hole

COC Reference No. 185-2013

Number of Bottles 4

Other comments:

Dark; high particulate load

NOTE: ONE WATER SAMPLING FORM TO BE COMPLETED FOR EACH SAMPLE POINT

GROUND WATER SAMPLING FORM

Client Name: BOC Limited - Kooragang

Date 10 7 19 Time 10.45AM

Day Month Year

Reasons for sampling: Baseline soil water monitoring

Location of sampling point: Borehole 2

Nature of sampling point [x] Groundwater [ ] Tradewaste sump [ ] Surface water

[ ] Stormwater [ ] Other Please specify

Sample ID: BH2

Depth sample taken: 2 m

Sample appearance Dark

Water Level in BH 2 m

Volume of sample taken 2.0 L

Name of Sampler JC

Method of sampling In-situ bailer

Nature of sample point Bore hole

COC Reference No. 185-2013

Number of Bottles 4

Other comments:

Dark and sandy; particulates present

NOTE: ONE WATER SAMPLING FORM TO BE COMPLETED FOR EACH SAMPLE POINT

GROUND WATER SAMPLING FORM

Client Name: BOC Limited - Kooragang

Date 10 7 2019 Time 11.00AM

Day Month Year

Reasons for sampling: Baseline soil water monitoring

Location of sampling point: Borehole 3

Nature of sampling point [x] Groundwater [ ] Tradewaste sump [ ] Surface water

[ ] Stormwater [ ] Other Please specify

Sample ID: BH3

Depth sample taken: 2 m

Sample appearance Murky

Water Level in BH 2 m

Volume of sample taken 2.0 L

Name of Sampler JC

Method of sampling In-situ bailer

Nature of sample point Bore hole

COC Reference No. 185-2013

Number of Bottles 4

Other comments:

Sandy

NOTE: ONE WATER SAMPLING FORM TO BE COMPLETED FOR EACH SAMPLE POINT

GROUND WATER SAMPLING FORM

Client Name: BOC Limited - Kooragang

Date 10 7 2019 Time 10.50AM

Day Month Year

Reasons for sampling: Baseline soil water monitoring

Location of sampling point: Borehole 4

Nature of sampling point [x] Groundwater [ ] Tradewaste sump [ ] Surface water

[ ] Stormwater [ ] Other Please specify

Sample ID: BH4

Depth sample taken: 2 m

Sample appearance Murky Brown (sand)

Water Level in BH 2 m

Volume of sample taken 2.0 L

Name of Sampler JC

Method of sampling In-situ bailer

Nature of sample point Bore hole

COC Reference No. 185-2013

Number of Bottles 4

Other comments:

High sediment load. Very sandy

NOTE: ONE WATER SAMPLING FORM TO BE COMPLETED FOR EACH SAMPLE POINT

GROUND WATER SAMPLING FORM

Client Name: BOC Limited - Kooragang

Date 10 7 2019 Time 11.25AM

Day Month Year

Reasons for sampling: Baseline soil water monitoring

Location of sampling point: Borehole 5

Nature of sampling point [x] Groundwater [ ] Tradewaste sump [ ] Surface water

[ ] Stormwater [ ] Other Please specify

Sample ID: BH5

Depth sample taken: 2 m

Sample appearance Mostly clear

Water Level in BH 2 m

Volume of sample taken 2.0 L

Name of Sampler JC

Method of sampling In-situ bailer

Nature of sample point Bore hole

COC Reference No. 185-2013

Number of Bottles 4

Other comments:

Some particulates present

NOTE: ONE WATER SAMPLING FORM TO BE COMPLETED FOR EACH SAMPLE POINT

GROUND WATER SAMPLING FORM

Client Name: BOC Limited - Kooragang

Date 10 7 2019 Time 11.15AM

Day Month Year

Reasons for sampling: Baseline soil water monitoring

Location of sampling point: Borehole 6

Nature of sampling point [x] Groundwater [ ] Tradewaste sump [ ] Surface water

[ ] Stormwater [ ] Other Please specify

Sample ID: BH6

Depth sample taken: 2 m

Sample appearance Grey Murky

Water Level in BH 2 m

Volume of sample taken 2.0 L

Name of Sampler JC

Method of sampling In-situ bailer

Nature of sample point Bore hole

COC Reference No. 185-2013

Number of Bottles 4

Other comments:

Particulate matter present

NOTE: ONE WATER SAMPLING FORM TO BE COMPLETED FOR EACH SAMPLE POINT