BOC Kooragang Cooling Tower Wastewater Sampling Report

BOC Limited Kooragang Island

19 September 2014

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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.

BOC Kooragang currently possess two (2) cooling towers onsite. Currently the cooling tower blowdown (waste) water continues to two (2) 10,000 litre capacity storage tanks onsite, totalling a capacity of 20,000 litres storage onsite. The wastewater is collected by an approved waste contractor approximately once per week.

BOC Kooragang are researching the possibility of utilising the cooling tower wastewater for irrigation purposes in specific grassed areas of the site. In order to research the possibility of utilising the cooling tower wastewater onsite MJM Environmental (MJM) was engaged by BOC Kooragang in August 2014 to undertake water sampling and analysis for a period of three (3) weeks for three (3) samples in total.

This report outlines the results of the wastewater sampling carried out over the three weeks.

2 Site Identification

BOC Kooragang operates a gas facility located at 9 Egret Street Kooragang, New South Wales. The plant vicinity map and location of the cooling towers and wastewater storage tanks are shown in Figure 2-1 and Figure 2-2.

Figure 2-1: BOC Limited Kooragang Vicinity

Figure 2-2: Location of BOC Limited's Cooling Towers and Wastewater Tanks

3 Sampling Plan and Methodology

Three (3) samples are proposed to be taken from the wastewater tanks over a period of three (3) weeks. This report presents the results from all three sampling events.

The analytes tested are presented in Table 3-1, which are taken from the Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 guidelines. The water sampling analysis results were compared to the ANZECC guidelines presented in *Section 4: Primary Industries - 4.2 Water Quality for irrigation and general water use*.

Table 3-1: Cooling Tower Wastewater Sampling Analytes

Analytes		
pH	Herbicides	Iron
Enterococci	Pesticides	Lead
Faecal (thermotolerant) Coliforms	Cadmium	Lithium
Electrical conductivity	Zinc	Manganese
Sodium Absorption Ratio (sodicity)	Aluminium	Mercury
Alkalinity as calcium carbonate (hardness)	Arsenic	Molybdenum
Chloride	Beryllium	Nickel
Sodium	Boron	Selenium
Fluoride	Chromium VI	Uranium
Nitrogen (total)	Cobalt	Vanadium
Phosphorus	Copper	

3.1 Sampling Handling Procedures

Sampling was performed in accordance with ANZECC monitoring standards (AS/NZS 5667.1:1998 and AS/NZS 5667.11:1998). These procedures include the documentation of the name and location of the sample point, date and time of sample collection, the type of sample point, method of sample collection and sample appearance at the time of collection. The water samples were then transferred into clean plastic bottles provided by a NATA accredited laboratory. The NATA laboratory results are presented in Appendix A and field notes in Appendix B.

4 Results

The results for the cooling tower wastewater sampling are presented in Table 4-1 below.

Table 4-1: BOC Limited Cooling Tower Wastewater Sampling Results

Analyte	Units	Result (27/08/2014)	Result (3/09/2014)	Result (11/09/2014)	Average	Recommended Irrigation Thresholds [1]
pH	pH Unit	7.85	7.95	7.83	7.88	6 – 9
Enterococci	CFU/100mL	~9	~4	<1	5	-
Faecal (thermo tolerant) Coliforms	CFU/100mL	<1	<1	<1	<1	<10,000 [4]
Electrical conductivity	µS/cm	1,670	1,690	1,650	1,670	-
Sodium Absorption Ratio	-	5.2	4.61	4.32	4.7	-
Alkalinity as calcium carbonate (hardness)	mg/L	60	58	68	62	-
Chloride	mg/L	294	292	349	312	-
Sodium	mg/L	223	198	179	200	-
Fluoride	mg/L	**7.7**	**7.3**	**7.5**	**7.5**	1.0[2] 2.0[3]
Nitrogen (total)	mg/L	**11.0**	**10.0**	**8.9**	**10.0**	25 - 125[2] 5[3]
Phosphorus	mg/L	**3.62**	**2.77**	**4.17**	**3.52**	0.8 - 12[2] 0.05[3]
Cadmium	mg/L	<0.0001	0.0001	<0.0001	0.0001	0.01[2] 0.05[3]
Zinc	mg/L	0.025	0.025	0.018	0.023	2.0[2] 5.0[3]
Aluminium	mg/L	0.04	0.07	0.04	0.05	5.0[2] 20[3]
Arsenic	mg/L	0.003	0.003	0.003	0.003	0.1[2] 2.0[3]
Beryllium	mg/L	<0.001	<0.001	<0.001	<0.001	0.1[2] 0.5[3]

Analyte	Units	Result (27/08/2014)	Result (3/09/2014)	Result (11/09/2014)	Average	Recommended Irrigation Thresholds [1]
Boron	mg/L	0.2	0.22	0.17	0.2	0.5[2] 2 – 4[5]
Chromium VI	mg/L	<0.01	<0.01	<0.01	<0.01	0.1[2] 1.0[3]
Cobalt	mg/L	<0.001	<0.001	<0.001	<0.001	0.05[2] 0.1[3]
Copper	mg/L	0.154	0.136	0.146	0.145	0.2[2] 5.0[3]
Iron	mg/L	0.1	0.1	0.07	0.09	0.2[2] 10[3]
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	2.0[2] 5.0[3]
Lithium	mg/L	0.005	0.005	0.005	0.005	2.5[2] 2.5[3]
Manganese	mg/L	0.008	0.007	0.007	0.007	0.2[2] 10[3]
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	0.002[2] 0.002[3]
Molybdenum	mg/L	0.002	0.002	0.002	0.002	0.01[2] 0.05[3]
Nickel	mg/L	0.003	0.003	0.003	0.003	0.2[2] 2.0[3]
Selenium	mg/L	<0.01	<0.01	<0.01	<0.01	0.02[2] 0.05[3]
Uranium	mg/L	<0.001	<0.001	<0.001	<0.001	0.01[2] 0.1[3]
Vanadium	mg/L	<0.01	<0.01	<0.01	<0.01	0.1[2] 0.5[3]
Herbicide (Phenoxyacetic Acid Herbicides)						
4-Chlorophenoxy acetic acid	µg/L	<10	<10	<10	<10	1,000[6]
2.4-DB	µg/L	<10	<10	<10	<10	1,000
Dicamba	µg/L	<10	<10	<10	<10	1,000
Mecoprop	µg/L	<10	<10	<10	<10	1,000
MCPA	µg/L	<10	<10	<10	<10	1,000
2.4-DP	µg/L	<10	<10	<10	<10	1,000
2.4-D	µg/L	<10	<10	<10	<10	1,000
Triclopyr	µg/L	<10	<10	<10	<10	1,000
2.4.5-TP (Silvex)	µg/L	<10	<10	<10	<10	1,000
2.4.5-T	µg/L	<10	<10	<10	<10	1,000
MCPB	µg/L	<10	<10	<10	<10	1,000

Analyte	Units	Result (27/08/2014)	Result (3/09/2014)	Result (11/09/2014)	Average	Recommended Irrigation Thresholds [1]
Picloram	µg/L	<10	<10	<10	<10	1,000
Clopyralid	µg/L	<10	<10	<10	<10	1,000
Fluroxypyr	µg/L	<10	<10	<10	<10	1,000
2.6-D	µg/L	<10	<10	<10	<10	1,000
2.4.6-T	µg/L	<10	<10	<10	<10	1,000
Pesticide (Organochlorine Pesticides)						
alpha-BHC	µg/L	<0.5	<0.5	<0.5	<0.5	1,000[6]
Hexachlorobenzene (HCB)	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
beta-BHC	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
gamma-BHC	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
delta-BHC	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Heptachlor	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Aldrin	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Heptachlor epoxide	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
trans-Chlordane	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
alpha-Endosulfan	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
cis-Chlordane	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Dieldrin	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
4.4-DDE	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Endrin	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
beta-Endosulfan	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
4.4-DDD	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Endrin aldehyde	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Endosulfan sulfate	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
4.4`-DDT	µg/L	<2.0	<2.0	<2.0	<2.0	1,000
Endrin ketone	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Methoxychlor	µg/L	<2.0	<2.0	<2.0	<2.0	1,000
Pesticide (Organophosphorus Pesticides)						
Dichlorvos	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Demeton-S-methyl	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Monocrotophos	µg/L	<2.0	<2.0	<2.0	<2.0	1,000
Dimethoate	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Diazinon	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Chlorpyrifos-methyl	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Parathion-methyl	µg/L	<2.0	<2.0	<2.0	<2.0	1,000
Malathion	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Fenthion	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Chlorpyrifos	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Parathion	µg/L	<2.0	<2.0	<2.0	<2.0	1,000
Pirimphos-ethyl	µg/L	<0.5	<0.5	<0.5	<0.5	1,000

Analyte	Units	Result (27/08/2014)	Result (3/09/2014)	Result (11/09/2014)	Average	Recommended Irrigation Thresholds [1]
Chlorfenvinphos	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Bromophos-ethyl	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Fenamiphos	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Prothiofos	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Ethion	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Carbophenothion	µg/L	<0.5	<0.5	<0.5	<0.5	1,000
Azinphos Methyl	µg/L	<0.5	<0.5	<0.5	<0.5	1,000

[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.

[4] Trigger value chosen for areas with restricted public access.

[5] Trigger value chosen for moderately tolerant crops.

[6] General limit set for herbicides for NSW.

5 Discussion

MJM Environmental was engaged by BOC Kooragang to investigate the possibility of utilising the cooling tower wastewater stored onsite for irrigation purposes by taking three separate samples over a three week period. The results were compared to the Australian and New Zealand Environment and Conservation Council (ANZECC) 2000 guidelines. The results for the wastewater samples taken on 27 August 2014, 3 September 2014 and 11 September 2014 are presented above.

The Short-term Trigger Values (STV) and Long-term Trigger Values (LTV) presented in Table 4-1 are recommendations from the ANZECC guidelines.

From Table 4-1 it can be seen that Fluoride exceeded the STV and LTV for all three samples with an average of 7.5 mg/L. It is noted that the guidelines state '*the LTV has been set on the assumption that irrigation water could potentially be phytotoxic to sensitive plant or contaminate stock drinking water*'.

Nitrogen (total) was within the STV range, however exceeded the LTV for all three samples with an average of 10.0 mg/L. It is noted that the guidelines state for nitrogen that '*the LTV has been set at a concentration low enough to ensure no decrease in crop yields or quality due to excessive nitrogen concentrations during later flowering and fruiting stages*'.

Phosphorus concentrations for all three samples also exceeded the LTV with an average of 3.52 mg/L. However it is noted that the guidelines state the LTV for phosphorus is set '*to minimise bioclogging of irrigation equipment only*'.

Pesticides and herbicides were not detected.

The remaining analytes were compliant with the recommended threshold levels.

Appendix A – NATA Laboratory Results

CERTIFICATE OF ANALYSIS

Work Order	: **ES1418968**	Page	: 1 of 7
Client	: **MJM ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MS BRIGID KELLY	Contact	: Client Services
Address	: OFFICE 1, 335 WHARF ROAD NEWCASTLE NSW, AUSTRALIA 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: brigid@mjmenvironmental.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 49264222	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 49252570	Facsimile	: +61-2-8784 8500
Project	: 0341264	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 49264222		
C-O-C number	: ----	Date Samples Received	: 27-AUG-2014
Sampler	: AB	Issue Date	: 03-SEP-2014
Site	: ----		
		No. of samples received	: 1
Quote number	: SY/508/14	No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Ashesh Patel	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Lana Nguyen	Senior LCMS Chemist	Sydney Organics
Merrin Avery	Supervisor - Inorganic	Newcastle - Inorganics
Pabi Subba	Senior Organic Chemist	Sydney Organics
Tony De Souza	Senior Microbiologist	Sydney Microbiology

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

- **EP202: Poor matrix spike recovery for Picloram and Clopyralid due to sample matrix effects. Confirmed by re-analysis.**
- **Microbiological Comment: Membrane filtration (MF) results for MW023 are reported as an estimate (~) when the growth of bacteria on the filter membrane is counted <10cfu and/or >100cfu.**
- **MW006 is ALS's internal code and is equivalent to AS4276.7.**
- **MW023 is ALS's internal code and is equivalent to AS4276.9.**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[27-AUG-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1418968-001	----	----	----	----
EA005: pH									
pH Value	----	0.01	pH Unit		**7.85**	----	----	----	----
EA006: Sodium Adsorption Ratio (SAR)									
Sodium Adsorption Ratio	----	0.01	-		**5.20**	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**1670**	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**60**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**60**	----	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**294**	----	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**75**	----	----	----	----
Sodium	7440-23-5	1	mg/L		**223**	----	----	----	----
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L		**348**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.04**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.003**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.154**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L		**0.005**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.008**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L		**0.002**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.003**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.025**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[27-AUG-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1418968-001	----	----	----	----
EG020T: Total Metals by ICP-MS - Continued									
Boron	7440-42-8	0.05	mg/L		**0.20**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**0.10**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG050F: Dissolved Hexavalent Chromium									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**7.7**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**8.02**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**3.0**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**11.0**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**3.62**	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L		<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L		<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[27-AUG-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1418968-001	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	----	----	----	----
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDT	50-29-3	2.0	µg/L		<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	----	----	----	----
Methoxychlor	72-43-5	2.0	µg/L		<2.0	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L		<0.5	----	----	----	----
Monocrotophos	6923-22-4	2.0	µg/L		<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L		<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		<0.5	----	----	----	----
Parathion-methyl	298-00-0	2.0	µg/L		<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L		<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L		<0.5	----	----	----	----
Parathion	56-38-2	2.0	µg/L		<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L		<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L		<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L		<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L		<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L		<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L		<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L		<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L		<0.5	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS									
4-Chlorophenoxy acetic acid	122-88-3	10	µg/L		<10	----	----	----	----
2.4-DB	94-82-6	10	µg/L		<10	----	----	----	----
Dicamba	1918-00-9	10	µg/L		<10	----	----	----	----
Mecoprop	93-65-2	10	µg/L		<10	----	----	----	----
MCPA	94-74-6	10	µg/L		<10	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[27-AUG-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1418968-001	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS - Continued									
2.4-DP	120-36-5	10	µg/L		<10	----	----	----	----
2.4-D	94-75-7	10	µg/L		<10	----	----	----	----
Triclopyr	55335-06-3	10	µg/L		<10	----	----	----	----
2.4.5-TP (Silvex)	93-72-1	10	µg/L		<10	----	----	----	----
2.4.5-T	93-76-5	10	µg/L		<10	----	----	----	----
MCPB	94-81-5	10	µg/L		<10	----	----	----	----
Picloram	1918-02-1	10	µg/L		<10	----	----	----	----
Clopyralid	1702-17-6	10	µg/L		<10	----	----	----	----
Fluroxypyr	69377-81-7	10	µg/L		<10	----	----	----	----
2.6-D	575-90-6	10	µg/L		<10	----	----	----	----
2.4.6-T	575-89-3	10	µg/L		<10	----	----	----	----
Microbiological parameters									
Enterococci	----	1	CFU/100mL		**~9**	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<1	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.1	%		**99.1**	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		**106**	----	----	----	----
EP202S: Phenoxyacetic Acid Herbicide Surrogate									
2.4-Dichlorophenyl Acetic Acid	19719-28-9	0.1	%		**116**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	30	120
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	26.8	129
EP202S: Phenoxyacetic Acid Herbicide Surrogate			
2.4-Dichlorophenyl Acetic Acid	19719-28-9	64	140

CERTIFICATE OF ANALYSIS

Work Order	: **ES1419610**	Page	: 1 of 7
Client	: **MJM ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MS BRIGID KELLY	Contact	: Client Services
Address	: OFFICE 1, 335 WHARF ROAD NEWCASTLE NSW, AUSTRALIA 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: brigid@mjmenvironmental.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 49264222	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 49252570	Facsimile	: +61-2-8784 8500
Project	: 0341264	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 49264222		
C-O-C number	: ----	Date Samples Received	: 03-SEP-2014
Sampler	: AB	Issue Date	: 09-SEP-2014
Site	: ----		
		No. of samples received	: 1
Quote number	: SY/508/14	No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Dian Dao		Sydney Inorganics
Edwandy Fadjar	Organic Coordinator	Sydney Organics
Lana Nguyen	Senior LCMS Chemist	Sydney Organics
Merrin Avery	Supervisor - Inorganic	Newcastle - Inorganics
Tony De Souza	Senior Microbiologist	Sydney Microbiology

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

- **Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.**
- **EP202: Poor matrix spike recoveries for Picloram and Clopyralid due to matrix effects.**
- **Microbiological Comment: Membrane filtration (MF) results for MW023 are reported as an estimate (~) when the growth of bacteria on the filter membrane is counted <10cfu and/or >100cfu.**
- **MW006 is ALS's internal code and is equivalent to AS4276.7.**
- **MW023 is ALS's internal code and is equivalent to AS4276.9.**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[03-SEP-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1419610-001	----	----	----	----
EA005: pH									
pH Value	----	0.01	pH Unit		**7.95**	----	----	----	----
EA006: Sodium Adsorption Ratio (SAR)									
Sodium Adsorption Ratio	----	0.01	-		**4.61**	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**1690**	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**58**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**58**	----	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**292**	----	----	----	----
ED093F: Dissolved Major Cations									
Sodium	7440-23-5	1	mg/L		**198**	----	----	----	----
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L		**349**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.07**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.003**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0001**	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.136**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L		**0.005**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.007**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L		**0.002**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.003**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.025**	----	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.22**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[03-SEP-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1419610-001	----	----	----	----
EG020T: Total Metals by ICP-MS - Continued									
Iron	7439-89-6	0.05	mg/L		**0.10**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG050F: Dissolved Hexavalent Chromium									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**7.3**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**7.39**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.6**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**10.0**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**2.77**	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L		<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L		<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L		<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[03-SEP-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1419610-001	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDT	50-29-3	2.0	µg/L		<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	----	----	----	----
Methoxychlor	72-43-5	2.0	µg/L		<2.0	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L		<0.5	----	----	----	----
Monocrotophos	6923-22-4	2.0	µg/L		<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L		<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		<0.5	----	----	----	----
Parathion-methyl	298-00-0	2.0	µg/L		<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L		<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L		<0.5	----	----	----	----
Parathion	56-38-2	2.0	µg/L		<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L		<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L		<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L		<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L		<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L		<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L		<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L		<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L		<0.5	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS									
4-Chlorophenoxy acetic acid	122-88-3	10	µg/L		<10	----	----	----	----
2.4-DB	94-82-6	10	µg/L		<10	----	----	----	----
Dicamba	1918-00-9	10	µg/L		<10	----	----	----	----
Mecoprop	93-65-2	10	µg/L		<10	----	----	----	----
MCPA	94-74-6	10	µg/L		<10	----	----	----	----
2.4-DP	120-36-5	10	µg/L		<10	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[03-SEP-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1419610-001	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS - Continued									
2.4-D	94-75-7	10	µg/L		<10	----	----	----	----
Triclopyr	55335-06-3	10	µg/L		<10	----	----	----	----
2.4.5-TP (Silvex)	93-72-1	10	µg/L		<10	----	----	----	----
2.4.5-T	93-76-5	10	µg/L		<10	----	----	----	----
MCPB	94-81-5	10	µg/L		<10	----	----	----	----
Picloram	1918-02-1	10	µg/L		<10	----	----	----	----
Clopyralid	1702-17-6	10	µg/L		<10	----	----	----	----
Fluroxypyr	69377-81-7	10	µg/L		<10	----	----	----	----
2.6-D	575-90-6	10	µg/L		<10	----	----	----	----
2.4.6-T	575-89-3	10	µg/L		<10	----	----	----	----
Microbiological parameters									
Enterococci	----	1	CFU/100mL		~4	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<1	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.1	%		97.2	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		104	----	----	----	----
EP202S: Phenoxyacetic Acid Herbicide Surrogate									
2.4-Dichlorophenyl Acetic Acid	19719-28-9	0.1	%		130	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	30	120
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	26.8	129
EP202S: Phenoxyacetic Acid Herbicide Surrogate			
2.4-Dichlorophenyl Acetic Acid	19719-28-9	64	140

CERTIFICATE OF ANALYSIS

Work Order	: **ES1420374**	Page	: 1 of 7
Client	: **MJM ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: MS BRIGID KELLY	Contact	: Client Services
Address	: OFFICE 1, 335 WHARF ROAD NEWCASTLE NSW, AUSTRALIA 2300	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: brigid@mjmenvironmental.com.au	E-mail	: sydney@alsglobal.com
Telephone	: +61 49264222	Telephone	: +61-2-8784 8555
Facsimile	: +61 02 49252570	Facsimile	: +61-2-8784 8500
Project	: 0341264	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: 49264222		
C-O-C number	: ----	Date Samples Received	: 11-SEP-2014
Sampler	: AB	Issue Date	: 18-SEP-2014
Site	: ----		
		No. of samples received	: 1
Quote number	: SY/508/14	No. of samples analysed	: 1

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.**
- **MW006 is ALS's internal code and is equivalent to AS4276.7.**
- **MW023 is ALS's internal code and is equivalent to AS4276.9.**

NATA Accredited Laboratory 825

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Signatories

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

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Tony DeSouza	Senior Microbiologist	Sydney Microbiology

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[11-SEP-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1420374-001	----	----	----	----
EA005: pH									
pH Value	----	0.01	pH Unit		**7.83**	----	----	----	----
EA006: Sodium Adsorption Ratio (SAR)									
Sodium Adsorption Ratio	----	0.01	-		**4.32**	----	----	----	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		**1650**	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**68**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**68**	----	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	1	mg/L		**349**	----	----	----	----
ED093F: Dissolved Major Cations									
Sodium	7440-23-5	1	mg/L		**179**	----	----	----	----
ED093F: SAR and Hardness Calculations									
Total Hardness as CaCO3	----	1	mg/L		**326**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.04**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.003**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.146**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L		**0.005**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.007**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L		**0.002**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.003**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Uranium	7440-61-1	0.001	mg/L		<0.001	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.018**	----	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.17**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[11-SEP-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1420374-001	----	----	----	----
EG020T: Total Metals by ICP-MS - Continued									
Iron	7439-89-6	0.05	mg/L		**0.07**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG050F: Dissolved Hexavalent Chromium									
Hexavalent Chromium	18540-29-9	0.01	mg/L		<0.01	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**7.5**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**6.02**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.9**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**8.9**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**4.17**	----	----	----	----
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L		<0.5	----	----	----	----
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L		<0.5	----	----	----	----
beta-BHC	319-85-7	0.5	µg/L		<0.5	----	----	----	----
gamma-BHC	58-89-9	0.5	µg/L		<0.5	----	----	----	----
delta-BHC	319-86-8	0.5	µg/L		<0.5	----	----	----	----
Heptachlor	76-44-8	0.5	µg/L		<0.5	----	----	----	----
Aldrin	309-00-2	0.5	µg/L		<0.5	----	----	----	----
Heptachlor epoxide	1024-57-3	0.5	µg/L		<0.5	----	----	----	----
trans-Chlordane	5103-74-2	0.5	µg/L		<0.5	----	----	----	----
alpha-Endosulfan	959-98-8	0.5	µg/L		<0.5	----	----	----	----
cis-Chlordane	5103-71-9	0.5	µg/L		<0.5	----	----	----	----
Dieldrin	60-57-1	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDE	72-55-9	0.5	µg/L		<0.5	----	----	----	----
Endrin	72-20-8	0.5	µg/L		<0.5	----	----	----	----
beta-Endosulfan	33213-65-9	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDD	72-54-8	0.5	µg/L		<0.5	----	----	----	----
Endrin aldehyde	7421-93-4	0.5	µg/L		<0.5	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[11-SEP-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1420374-001	----	----	----	----
EP068A: Organochlorine Pesticides (OC) - Continued									
Endosulfan sulfate	1031-07-8	0.5	µg/L		<0.5	----	----	----	----
4.4`-DDT	50-29-3	2.0	µg/L		<2.0	----	----	----	----
Endrin ketone	53494-70-5	0.5	µg/L		<0.5	----	----	----	----
Methoxychlor	72-43-5	2.0	µg/L		<2.0	----	----	----	----
^ Total Chlordane (sum)	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of DDD + DDE + DDT	----	0.5	µg/L		<0.5	----	----	----	----
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L		<0.5	----	----	----	----
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L		<0.5	----	----	----	----
Demeton-S-methyl	919-86-8	0.5	µg/L		<0.5	----	----	----	----
Monocrotophos	6923-22-4	2.0	µg/L		<2.0	----	----	----	----
Dimethoate	60-51-5	0.5	µg/L		<0.5	----	----	----	----
Diazinon	333-41-5	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L		<0.5	----	----	----	----
Parathion-methyl	298-00-0	2.0	µg/L		<2.0	----	----	----	----
Malathion	121-75-5	0.5	µg/L		<0.5	----	----	----	----
Fenthion	55-38-9	0.5	µg/L		<0.5	----	----	----	----
Chlorpyrifos	2921-88-2	0.5	µg/L		<0.5	----	----	----	----
Parathion	56-38-2	2.0	µg/L		<2.0	----	----	----	----
Pirimphos-ethyl	23505-41-1	0.5	µg/L		<0.5	----	----	----	----
Chlorfenvinphos	470-90-6	0.5	µg/L		<0.5	----	----	----	----
Bromophos-ethyl	4824-78-6	0.5	µg/L		<0.5	----	----	----	----
Fenamiphos	22224-92-6	0.5	µg/L		<0.5	----	----	----	----
Prothiofos	34643-46-4	0.5	µg/L		<0.5	----	----	----	----
Ethion	563-12-2	0.5	µg/L		<0.5	----	----	----	----
Carbophenothion	786-19-6	0.5	µg/L		<0.5	----	----	----	----
Azinphos Methyl	86-50-0	0.5	µg/L		<0.5	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS									
4-Chlorophenoxy acetic acid	122-88-3	10	µg/L		<10	----	----	----	----
2.4-DB	94-82-6	10	µg/L		<10	----	----	----	----
Dicamba	1918-00-9	10	µg/L		<10	----	----	----	----
Mecoprop	93-65-2	10	µg/L		<10	----	----	----	----
MCPA	94-74-6	10	µg/L		<10	----	----	----	----
2.4-DP	120-36-5	10	µg/L		<10	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	COOLING TOWER	----	----	----	----
				Client sampling date / time	[11-SEP-2014]	----	----	----	----
Compound	CAS Number	LOR	Unit		ES1420374-001	----	----	----	----
EP202A: Phenoxyacetic Acid Herbicides by LCMS - Continued									
2.4-D	94-75-7	10	µg/L		<10	----	----	----	----
Triclopyr	55335-06-3	10	µg/L		<10	----	----	----	----
2.4.5-TP (Silvex)	93-72-1	10	µg/L		<10	----	----	----	----
2.4.5-T	93-76-5	10	µg/L		<10	----	----	----	----
MCPB	94-81-5	10	µg/L		<10	----	----	----	----
Picloram	1918-02-1	10	µg/L		<10	----	----	----	----
Clopyralid	1702-17-6	10	µg/L		<10	----	----	----	----
Fluroxypyr	69377-81-7	10	µg/L		<10	----	----	----	----
2.6-D	575-90-6	10	µg/L		<10	----	----	----	----
2.4.6-T	575-89-3	10	µg/L		<10	----	----	----	----
Microbiological parameters									
Enterococci	----	1	CFU/100mL		<1	----	----	----	----
MW006: Faecal Coliforms & E.coli by MF									
Faecal Coliforms	----	1	CFU/100mL		<1	----	----	----	----
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.1	%		117	----	----	----	----
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.1	%		83.6	----	----	----	----
EP202S: Phenoxyacetic Acid Herbicide Surrogate									
2.4-Dichlorophenyl Acetic Acid	19719-28-9	0.1	%		125	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	30	120
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	26.8	129
EP202S: Phenoxyacetic Acid Herbicide Surrogate			
2.4-Dichlorophenyl Acetic Acid	19719-28-9	64	140

Appendix B – Sampling Field Notes

WASTE WATER SAMPLING FORM

Client Name: BOC Limited Kooragang Island

Date 27 (Day) 8 (Month) 2014 (Year) Time: 10:00 am

Reasons for sampling: Research the possiblity of using cooling tower wastewater for irrigation

Location of sampling point: Near cooling towers, close to Egret St

Nature of sampling point

[ ] Groundwater [ ] Tradewaste sump [ ] Surface water

[ ] Stormwater [X] Other Please specify

Wastewater stored in 10,000 L Poly Tanks

Sample ID: Cooling Tower

Depth sample taken: 1 m

Sample appearance Clear

Water Level in ~~BH~~ TANK Full 1.2 m

Volume of sample taken 1.5 L

Name of Sampler AB

Method of sampling In-situ bailer

Nature of sample point Storage Tank

COC Reference No. AB270814

Number of Bottles 10

Other comments:

Sample taken from tank closest to cooling tower

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

WASTE WATER SAMPLING FORM

Client Name: BOC Limited Kooragang Island

Date 3 9 2014 Time: 10:17am

Day Month Year

Reasons for sampling: Research the possiblity of using cooling tower wastewater for irrigation

Location of sampling point: Near cooling towers, close to Egret St

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

[ ] Stormwater [X] Other Please specify

Wastewater stored in 10,000 L Poly Tanks

Sample ID: Cooling Tower

Depth sample taken: 1 m

Sample appearance Clear

Water Level in BH Full 1.2 m

Volume of sample taken 1.5 L

Name of Sampler AB

Method of sampling In-situ bailer

Nature of sample point Storage Tank

COC Reference No. AB030914

Number of Bottles 10

Other comments:

tank full.

Samples taken from tank closest to cooling towers.

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

WASTE WATER SAMPLING FORM

Client Name: BOC Limited Kooragang Island

Date 11 (Day) 9 (Month) 2014 (Year) Time: 9:50 am

Reasons for sampling: Research the possiblity of using cooling tower wastewater for irrigation

Location of sampling point: Near cooling towers, close to Egret St

Nature of sampling point
[ ] Groundwater [ ] Tradewaste sump [ ] Surface water
[ ] Stormwater [X] Other Please specify
Wastewater stored in 10,000 L Poly Tanks

Sample ID: Cooling Tower
Depth sample taken: 1 m
Sample appearance Clear
Water Level in BH Full 1.2 m
Volume of sample taken 1.5 L
Name of Sampler AB
Method of sampling In-situ bailer
Nature of sample point Storage Tank
COC Reference No. AB11091 4
Number of Bottles 10
Other comments:

Sample taken from tank closest to cooling tower.

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