



29 June 2017

██████████
Landfill Advisor
Redland City Council
PO Box 21
CLEVELAND QLD 4163

Our ref: 41/27018
478505
Your ref:

Dear Sir/Madam

Coochiemudlo Island Waste Disposal Facility Groundwater Monitoring Event

1 Introduction

GHD were engaged by Redland City Council (RCC) to undertake a groundwater monitoring event at the Coochiemudlo Island (CM Island) Waste Disposal Facility (WDF). This report details the site observations, gauging results and laboratory results of the preliminary monitoring event.

1.1 Site details

Property description details for CM Island WDF are detailed in Table 1 and the layout of the site is illustrated in Attachment 1.

Table 1 Licensed waste disposal facility details

Address	Lot ID
47-49 Elizabeth Street, Coochiemudlo Island	Lot 3 on SP115493

1.2 Background

Four wells were previously installed by EGIS within the WDF property, corresponding to one background / up gradient monitoring well and three down gradient monitoring wells. This was followed by four water quality monitoring events throughout 2001. GHD understand that no monitoring has been completed at the site since this time.

RCC requested GHD complete a groundwater monitoring event in June 2017. Reconnaissance was conducted by GHD in early June which identified that only one well was in an operational condition, two were obstructed and the remaining well had been decommissioned.

1.3 Scope of works

The scope of works commissioned for this preliminary ground water investigation is presented in the proposal, "*Coochiemudlo Island, QLD, Proposal for Groundwater Sampling at Waste Transfer Facility*", dated June 2017.

Below is a brief outline of the scope of works completed for this investigation:

- Collection of a groundwater sample from operational well, GW3.
- Attempt to clear obstructions previously observed in wells GW1 and GW2 and sample if groundwater is reached.
- Laboratory analysis of the following suite of parameters:
 - Nutrients (including ammonia, nitrate, nitrite, total nitrogen and total phosphorus)
 - Total organic carbon (TOC)
 - Biological oxygen demand (BOD) and chemical oxygen demand (COD)
 - Major anions and cations
 - Metals: aluminium, arsenic, cadmium, chromium, iron, mercury, manganese, nickel, copper, lead, and zinc.
 - Organochlorine and organophosphorus pesticides (OC/OP Pesticides)
- Preparation of this letter report to summarise monitoring works and results.

2 Methodology

2.1 Sampling and field methodology

The sampling and field methodology followed is provided in the following document:

“GHD Report No. 462411 Redland City Council Landfill Environmental Monitoring Program – Environmental Monitoring Program” – dated December 2016. [referred to henceforth as “EMP”].

In accordance to this EMP, disposable bailers were used to purge three well volumes of water prior to sampling.

In an attempt to clear blockages within GW1 and GW2, larger debris items were removed using multiple point hooks. Where debris could not be removed, a clean stainless steel bailer was used to further clear sediment and obstructions within the well. Blockages in well GW1 were cleared to a sufficient status to facilitate sampling. Blockages in well GW2 were unable to be cleared and no sample was collected.

2.2 Groundwater assessment criteria

Groundwater results were compared to the following guideline criteria to provide a reference of the health of the groundwater quality:

- Environmental Protection (Water) Policy (Department of Natural Resource Management, 2010) corresponding to the following:
 - Physico-chemical WQOs for aquatic ecosystem for Wallum/Tannin Freshwater (EPP – Freshwater)
 - Local WQOs for drinking water supply (EPP – Drinking Water)

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Environment and Conservation Council [ANZECC] / Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ], 2000), corresponding to the following:
 - Protection of slightly to moderately disturbed ecosystems (ANZECC 2000 – FW)
 - Long term trigger values for irrigation (ANZECC 2000 – Irrigation)
 - Stock watering (ANZECC 2000 – Stock Watering)

Results were also compared to the range of results provided by the year of quarterly monitoring conducted by EGIS in 2001 to reference if any degradation of water quality has occurred over time.

Assessment of whether groundwater is impacted by landfill leachate is also typically evaluated by comparing results from down gradient wells to upgradient wells as well as assessing concentration trends over time to determine any statistically significant increases. As the data is limited to only to the results from this monitoring event and results from the EGIS monitoring conducted in 2001, these statistical analyses could not be facilitated for this investigation.

3 Monitoring results

Sampling and monitoring was conducted on 14 June 2017. Monitoring locations are presented in Attachment 1. Tabulated monitoring results (compared to the adopted guideline criteria) are provided in Attachment 2 and laboratory documentation is provided in Attachment 3. A summary of the groundwater findings is detailed in the following sections.

3.1 Weather

Weather at the time of sampling was wet, with monitoring completed at the end of a five day period of wet conditions. A total of 87.4 mm of rain was recorded over the preceding five days at the Bureau of Meteorology (BoM) Brisbane Aero station (station number 040842).

3.2 Field observations

Four groundwater monitoring wells were located on site. Details of the wells and their observed conditions are presented in Table 2.

Table 2 Well conditions

Well	Sample Collected	Condition
GW1	Yes	<p>Located north of the cricket pitch within heavy vegetation. Singapore Daisy weed prevalent. No lock present, no well cap present. Ants and debris (sticks) in well.</p> <p>During the GHD reconnaissance, GW1 was dry and noted as blocked. During sample collection, a small volume of water was noted with a standing water level of 1.8 mbgl. Heavy rainfall in the week prior to sampling may have contributed to increased groundwater during sample collection.</p>

Well	Sample Collected	Condition
GW2	No	<p>Locked - the lock was removed with bolt cutters during the reconnaissance. This well was also found to be blocked and dry at 1.1 mbgl (ant nest within pvc and rootlets present).</p> <p>An attempt to clear the blockage with a clean stainless steel bailer was made. Sediment and debris were removed/compacted to 2.7 mbgl at which muddy conditions were encountered. A sufficient representative water sample could not be collected.</p> <p>The well was not relocked.</p>
GW3	Yes	No lock present. Well cap present. Water was noted within the well.
GW4	No	Monument cover present but no pvc well located within monument cover (destroyed / decommissioned). Cement/grout had been poured into the monument cover.

The obstruction within well GW1 was able to be removed/compacted to a point where sampling could be completed. As a result, ground water was present in wells GW1 and GW3. Standing water levels (SWL) and total depths (TD) measured in metres below top of casing (mbtoc), as well as purging observations are presented in Table 3.

Table 3 Well depth details

Well	SWL (mbtoc)	TD (mbtoc)		Purging observations
		As measured 14 June 2017	As installed (January 2001)	
GW1	1.832	2.46*	4.5	Clear with moderate to high suspended solids (black organics), no turbidity. Rootlets present. Sulfidic odour, no sheens.
GW2	DRY	2.7*	4.5	Fine debris was compacted to 2.7 m at which muddy conditions were noted. Rootlets present. Sample unable to be collected
GW3	2.766	10.4	10.5	Cloudy pink to red, high suspended solids and high turbidity (silt). Soft silty base noted. No odour or sheen.

*Note – Observed depth during sampling indicates significant siltation of monitoring wells.

Based on the information and conclusion presented by EGIS, it is understood that well GW1 is down gradient of the WDF and GW3 is a background well.

3.3 Results discussion

Results which exceeded the adopted guideline criteria are presented in Table 4. Tabulated monitoring results (compared to the adopted guideline criteria) are provided in Attachment 2 and laboratory documentation is provided in Attachment 3.

Table 4 Guideline criteria exceedances

Well	Parameter	Result value	Guideline	Guideline value
GW1 (down gradient)	EC	664 µS/cm	EPP - Wallum/Tannin Freshwater	626 µS/cm
	pH	6.2	EPP - Wallum/Tannin Freshwater	6.5-8.0
	Aluminium	0.1 mg/L	ANZECC 2000 FW Slight-Mod. Disturbed	0.055 mg/L
	Iron	0.16 mg/L	EPP - Drinking Water	0.05 mg/L
	Ammonia	0.03 mg/L	EPP - Wallum/Tannin Freshwater	0.02 mg/L
GW3 (up gradient)	pH	5.06	EPP - Wallum/Tannin Freshwater	6.5-8.0
	Aluminium	1.47 mg/L	ANZECC 2000 FW Slight-Mod. Disturbed	0.055 mg/L
	Chromium (total)	0.002 mg/L	ANZECC 2000 FW Slight-Mod. Disturbed	0.001 mg/L
	Copper	0.002 mg/L	ANZECC 2000 FW Slight-Mod. Disturbed	0.0014 mg/L
			ANZECC 2000 FW Slight-Mod. Disturbed	0.3 mg/L
	Iron	0.59 mg/L	ANZECC 2000 - Irrigation	0.2 mg/L
			EPP - Drinking Water	0.05 mg/L
	Zinc	0.014 mg/L	ANZECC 2000 FW Slight-Mod. Disturbed	0.008 mg/L
	Ammonia	0.04 mg/L	EPP - Wallum/Tannin Freshwater	0.02 mg/L
	Nitrate	0.69 mg/L	ANZECC 2000 FW Slight-Mod. Disturbed	0.158 mg/L
	Nitrite + Nitrate as N	0.69 mg/L	EPP - Wallum/Tannin Freshwater	0.5 mg/L
	Total nitrogen	6.5 mg/L	ANZECC 2000 - Irrigation	5 mg/L
			EPP - Wallum/Tannin Freshwater	0.5 mg/L
Phosphorus	6.13 mg/L	ANZECC 2000 - Irrigation	0.05 mg/L	
		EPP - Wallum/Tannin Freshwater	0.05 mg/L	

Discussion of results are presented in the following sections:

3.3.1 Field parameters

- EC at well GW1 (664 µS/cm) exceeded the EPP Freshwater guideline of 626 µS/cm.
- Both wells reported pH readings which were less than the EPP Freshwater guideline range of 6.5 to 8.0 (6.2 at GW1 and 5.06 at GW3).

These field parameter results are believed to be typical of the surrounding groundwater conditions. It is noted that the EC result for GW1 (81.3 $\mu\text{S}/\text{cm}$) is notably lower than to the range observed by EGIS (~800 $\mu\text{S}/\text{cm}$ to ~1000 $\mu\text{S}/\text{cm}$) in the 2001 monitoring and may be attributable to the recent rainfall at the time of sampling.

3.3.2 Metals

- Concentrations of aluminium for both wells GW1 (0.01 mg/L) and GW3 (1.47 mg/L) exceeded the ANZECC 2000 FW guideline value of 0.055 mg/L.
- Concentrations of iron for both wells GW1 (0.16 mg/L) and GW3 (0.59 mg/L) exceeded the EPP – Drinking Water guideline. The iron result for GM3 (0.59 mg/L) also exceeded the guideline values for ANZECC 2000 Irrigation (0.2 mg/L) and ANZECC 2000 FW (0.3 mg/L) criteria.
- Concentrations of chromium (0.002 mg/L), copper (0.002 mg/L) and zinc (0.014 mg/L) for well GW3 also exceeded the ANZECC 2000 FW guideline criteria (0.001 mg/L, 0.0014 mg/L and 0.008 mg/L respectively). Copper was also analysed for during the monitoring conducted by EGIS in 2001 and the current copper results are consistent to those observed previously.

3.3.3 General water quality parameters

- Calcium at GW1 (64 mg/L) was higher than the range of concentrations observed during the monitoring conducted in 2001 by EGIS (<5 mg/L).
- Sulfate at GW1 (133 mg/L) was higher than the range of concentrations observed during the monitoring conducted in 2001 by EGIS (~70 mg/L to ~100 mg/L).
- Chloride at GW3 (14 mg/L) was notably lower than the range of concentrations observed during the monitoring conducted in 2001 by EGIS (~200 mg/L to ~400 mg/L).

3.3.4 Nutrients

- Concentrations of ammonia for both well MW1 (0.03 mg/L) and MW3 (0.04 mg/L) marginally exceeded the EPP- Fresh Water guideline of 0.02 mg/L. These results however were below the ANZECC 2000 FW toxicity guideline value of 0.9 mg/L. These concentrations are consistent to results observed during the monitoring conducted by EGIS in 2001.
- The nitrate concentration for well GW3 (0.69 mg/L) exceeded the ANZECC 2000 FW guideline of 0.158 mg/L. This concentration is also greater than the range observed during the monitoring conducted in 2001 by EGIS (<0.1 mg/L).
- The oxidised nitrogen (nitrate+nitrite) concentration (0.69 mg/L) also exceeded the EPP – Freshwater guideline value of 0.06 mg/L.
- The total nitrogen concentration for GW3 (6.5 mg/L) exceeded the ANZECC 2000 Irrigation (5 mg/L) and EPP – Freshwater (0.5 mg/L) guideline values.
- The total phosphorus concentration for well GW3 (6.13 mg/L) exceeded the ANZECC 2000 Irrigation and EPP – Freshwater guideline.

The results for nitrogen containing compounds aren't believed to be indicative of leachate impact. Leachate impact is commonly characterised by reduced forms of nitrogen, being ammonia. Only marginal ammonia concentrations were observed during the current monitoring event.

3.3.5 OC/OPs

All results for OC/OPs were less than the laboratory limit of reporting (LOR).

3.3.6 TOC and oxygen demands

TOC and BOD results were consistent to those observed in 2001 during the monitoring conducted by EGIS. It is noted that the COD result for background well GW3 (272 mg/L) is notably higher than that of GW1 (23 mg/L).

4 Analysis of laboratory quality assurance

A review of laboratory quality assurance and quality control (QA/QC) has been undertaken and summarised as follows:

- No method blank outliers
- No duplicate outliers
- No holding time outliers
- No sample control frequency outliers
- A control spike outlier was reported for OPs
- Matrix spike recoveries were reported for oxidised nitrogen and OC

Although minor outliers were reported, the quality assurance is considered to demonstrate that the laboratory analysis was completed to a suitable standard and results may be relied upon.

5 Conclusions and recommendations

Two wells (GW1 and GW3) were sampled during the groundwater monitoring event conducted in June 2017. Based on data provided by EGIS, GW1 is understood to be a downgradient well and GW3 is understood to be a background well. Although some exceedances of adopted ecological criteria were reported for both wells for field parameters, metals and nutrients, the results are not indicative of landfill leachate impact.

Based on the findings of this monitoring event, further monitoring of groundwater at the site is not considered to be warranted. Should RCC wish to pursue the option of further groundwater monitoring, it is however recommended to reinstate the groundwater monitoring network on site. This would entail replacing one monitoring well and redeveloping GW1 and GW2.

Should you have any queries in regards to this investigation, feel free to contact the undersigned below.

Sincerely



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GHD Pty Ltd

Attachment 1 – Site Figure
Attachment 2 – Tabulated results
Attachment 3 – Laboratory results

Coochiemudlo Disposal Facility

Monitoring well locations

Legend

- Destroyed/decomissioned
- Obstructed
- Sampled



Google Earth

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100 m





**Attachment 2
Tabulated GW Results**

	TOC	Field Parameters					Inorganics		Metals										OC Pesticides																													
	Total Organic Carbon	DO (mg/L) (Field)	Electrical conductivity (field)	pH (Field)	Redox (Field)	Temperature (Field)	BOD	COD	Aluminium (Filtered)	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (III+VI) (Filtered)	Copper (Filtered)	Iron (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Zinc (Filtered)	4,4-DDE	a-BHC	Aldrin	Aldrin + Dieldrin	b-BHC	Chlordane	Chlordane (cis)	Chlordane (trans)	d-BHC	4,4 DDD	4,4 DDT	DDT+DDE+DDD - Lab Calc	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor					
	mg/L	mg/L	µS/cm	pH Units	mV	°C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L			
LOR	1						2	10	0.01	0.001	0.0001	0.001	0.001	0.05	0.001	0.001	0.001	0.005	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	
ANZECC 2000 FW Med-Low Reliability													0.3						0.03		0.001																							0.05	0.005			
ANZECC 2000 FW Slight-Mod. Disturbed									0.055	0.013	0.0002	0.001	0.0014		0.0034	1.9	0.00006	0.011	0.008					0.03					0.006							0.01												
ANZECC 2000 Irrigation - Long-term Trigger Values									5	0.1	0.01	0.1	0.2	0.2	2	0.2	0.002	0.2	2																													
ANZECC 2000 Stock Watering									5	0.5	0.01	1	0.5		0.1		0.002	1	20																													
Morton Bay - Schedule 1 EPP (water) - Drinking Water	4	1000												0.05	0.05																																	
Morton Bay - Schedule 1 EPP (water) - Wallum/Tannin Freshwater		626	6.5-8																																													

Location_Code	Sampled Date	3	4.09	664	6.2	-39.6	21	<2	23	0.01	<0.001	<0.0001	<0.001	<0.001	0.16	<0.001	0.016	<0.0001	<0.001	<0.005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5			
GW1	14/06/2017																																																	
GW3	14/06/2017	8	5.07	81.3	5.06	23.8	23.8	<2	272	1.47	<0.001	<0.0001	0.002	0.002	0.59	<0.001	0.007	<0.0001	<0.001	0.014	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Statistical Summary		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2			
Number of Results																																																		
Minimum Concentration		3	4.09	81.3	5.06	-39.6	21	<2	23	0.01	<0.001	<0.0001	<0.001	<0.001	0.16	<0.001	0.007	<0.0001	<0.001	<0.005	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
Maximum Concentration		8	5.07	664	6.2	23.8	23.8	<2	272	1.47	<0.001	<0.0001	0.002	0.002	0.59	<0.001	0.016	<0.0001	<0.001	0.014	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5



Attachment 2
Tabulated GW Results

	OP Pesticides															Alkalinity				Major Ions							Nutrients																	
	Azinophos methyl	Bromophos-ethyl	Carbophenothion	Chlorfenvinphos	Chlorpyrifos	Chlorpyrifos-methyl	Demeton-S-methyl	Diazinon	Dichlorvos	Dimethoate	Ethion	Fenamiphos	Fenthion	Malathion	Methyl parathion	Monocrotophos	Parathion	Prirphos-ethyl	Prothiofos	Alkalinity (Carbonate as CaCO3)	Alkalinity (Hydroxide as CaCO3)	Alkalinity (total as CaCO3)	Bicarbonate Alkalinity as CaCO3	Sulfate as SO4 - Turbidimetric (Filtered)	Calcium (Filtered)	Chloride	Magnesium (Filtered)	Anions Total	Potassium (Filtered)	Sodium (Filtered)	Cations Total	Ionic Balance	Ammonia as N	Total Kjeldahl Nitrogen	Nitrate (as N)	Nitrite (as N)	Nitrite + Nitrate as N	Nitrogen (Total)	Phosphorus					
µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L				
LOR	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	2	2	2	0.5	0.5	1	1	1	1	1	1	1	1	1	1	0.01	1	1	0.01	0.01	0.01	0.01	0.1	0.01	0.01	0.01	0.01	0.01	0.01	
ANZECC 2000 FW Med-Low Reliability						4																																						
ANZECC 2000 FW Slight-Mod. Disturbed	0.1				0.01			0.01		0.15				0.05			0.004																			0.9		0.158						
ANZECC 2000 Irrigation - Long-term Trigger Values																																									5	0.05		
ANZECC 2000 Stock Watering																								1000																				
Morton Bay - Schedule 1 EPP (water) - Drinking Water																																												
Morton Bay - Schedule 1 EPP (water) - Wallum/Tannin Freshwater																																												

Location_Code	Sampled Date	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<1	<1	121	121	133	64	97	24	7.92	13	42	7.33	3.9	0.03	0.4	<0.01	<0.01	<0.01	0.4	0.04
GW1	14/06/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<1	<1	121	121	133	64	97	24	7.92	13	42	7.33	3.9	0.03	0.4	<0.01	<0.01	<0.01	0.4	0.04
GW3	14/06/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<1	<1	2	2	12	<1	14	2	0.68	1	10	0.62	-	0.04	5.8	0.69	<0.01	0.69	6.5	6.13

Statistical Summary		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Number of Results		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Minimum Concentration		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<1	<1	2	2	12	<1	14	2	0.68	1	10	0.62	3.9	0.03	0.4	<0.01	<0.01	<0.01	0.4	0.04			
Maximum Concentration		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	<2	<2	<0.5	<0.5	<1	<1	121	121	133	64	97	24	7.92	13	42	7.33	3.9	0.04	5.8	0.69	<0.01	0.69	6.5	6.13			



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CLIENT: **GHD Pty Ltd** TURNAROUND REQUIREMENTS: Standard TAT (List due date): Non Standard or urgent TAT (List due date): 5 Day TAT

OFFICE: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)

Location: **Coochiemudlo Island (Groundwater)** ALS QUOTE NO.: **EW-28713834**

JOB NUMBER: **4127018**

PROJECT MANAGER: **James Dowdeswell** CONTACT PH: **3316 3458**

SAMPLER: **MARY CARTER** SAMPLER MOBILE: RELINQUISHED BY: **M. Carter**

EDD FORMAT: **EXCEL ESDAT & PDF**

RELINQUISHED BY: RECEIVED BY: **[Signature]**

DATE/TIME: **14.6.17 1:10pm** DATE/TIME: **14.06.17 13:20**

Email Reports to: James.Dowdeswell@ghd.com / bernica.ng@ghd.com / jason.fowler2@ghd.com / sarah.whalan@ghd.com / vanessa.dear@ghd.com / mary.carter@ghd.com

Email Invoices to: AP-FSS@ghd.com / james.dowdeswell@ghd.com

Reference to ALS Quote No with Table / Suite No's...

FOR LABORATORY USE ONLY (Circle)

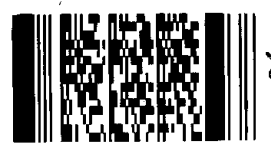
Customer Contacted	Yes	No	N/A
Pre-Instruction for Printer present upon receipt	Yes	No	N/A
Random Sample	C		
Temperature of Receipt			
Other comment:			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: Note Limited holding times on: Ammonia, Nitrate and Nitrite

ALS USE	SAMPLE DETAILS	CONTAINER INFORMATION	ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).												Additional Information							
			MAJOR CATIONS (Calcium, Magnesium, Sodium, Potassium)	MAJOR ANIONS (Chloride, Sulfate, Alkalinity)	AMMONIA as N, Nitrite, Nitrate, Total Nitrogen as N inc NOX & TKN, Total Phosphorus	DISSOLVED METALS: (Mn, Al, Fe, As, Cu, Pb, Zn, Ni, Cd, Cr, Hg)	TOTAL ORGANIC CARBON (TOC)	BOD	COD													
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL CONTAINERS	NT-1	NT-2	NT-8	W-2 EG020F	EP005	EP030	EP026SP										
													<i>bc for Pesticides</i>									
1	GW1-0617-1	14.6.17	WATER	ANZECC		X	X	X	X	X	X	X	Comments on likely contaminant levels, dilutions, or samples requiring specific GC analysis etc. GW3 Sample pH: 5.06 Sample Temp: 23.8°C GW1 6.2 21.0°C									
2	GW3-0617-1	14.6.17	WATER	ANZECC		X	X	X	X	X	X	X										
			WATER	ANZECC		X	X	X	X	X	X	X										

HT

Environmental Division
 Brisbane
 Work Order Reference
EB1712144



Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved CRC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Air/tight Unpreserved Plastic
 V = VOA Via HCl Preserved; VB = VOA Via Sodium Bisulphate Preserved; VS = VOA Via Sulfuric Preserved; AV = Air/tight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
 Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottle; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Solts; B = Unpreserved Bag.



SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : EB1712144

Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MR JAMES DOWDESWELL	Contact	: Vanessa Mattes
Address	: GPO BOX 668 BRISBANE QLD, AUSTRALIA 4001	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: james.dowdeswell@ghd.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3316 3000	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3316 3333	Facsimile	: +61-7-3243 7218
Project	: 4127018 Coochiemudlo Island (Groundwater)	Page	: 1 of 3
Order number	: ----	Quote number	: EB2013GHDSER0700 (BN/587/13 V4)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: Coochiemudlo Island (Groundwater)		
Sampler	: MARY CARTER		

Dates

Date Samples Received	: 14-Jun-2017 13:20	Issue Date	: 14-Jun-2017
Client Requested Due Date	: 21-Jun-2017	Scheduled Reporting Date	: 21-Jun-2017

Delivery Details

Mode of Delivery	: Client Drop Off	Security Seal	: Not Available
No. of coolers/boxes	: 1	Temperature	: 2.7°C - Ice present
Receipt Detail	: MEDIUM ESKY	No. of samples received / analysed	: 2 / 2

General Comments

- This report contains the following information:
 - Sample Container(s)/Preservation Non-Compliances
 - Summary of Sample(s) and Requested Analysis
 - Proactive Holding Time Report
 - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Sample(s) requiring volatile organic compound analysis received in airtight containers (ZHE).**
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**



Sample Container(s)/Preservation Non-Compliances

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

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

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

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

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EG020F Dissolved Metals by ICPMS	WATER - EN055 - PG Ionic Balance by ED037P, ED041G, ED045G &	WATER - EP026SP Chemical Oxygen Demand (COD)	WATER - EP030 BOD	WATER - NT-02 Major Anions (Chloride, Sulphate, Alkalinity)	WATER - NT-08 Total Nitrogen + NO2 + NO3 + NH3 + Total P	WATER - W-02 8 Metals
EB1712144-001	[14-Jun-2017]	GW1-0617-1	✓	✓	✓	✓	✓	✓	✓
EB1712144-002	[14-Jun-2017]	GW3-0617-1	✓	✓	✓	✓	✓	✓	

Matrix: **WATER**

Laboratory sample ID	Client sampling date / time	Client sample ID	WATER - EP005 Total Organic Carbon (TOC)	WATER - NT-01 Major Cations (Ca, Mg, Na, K)	WATER - W-12 OC/OP Pesticides
EB1712144-001	[14-Jun-2017]	GW1-0617-1	✓	✓	✓
EB1712144-002	[14-Jun-2017]	GW3-0617-1	✓	✓	✓

Proactive Holding Time Report

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



Requested Deliverables

ACCOUNTS PAYABLE (Brisbane)

- A4 - AU Tax Invoice (INV) Email ap-fss@ghd.com

BERNICE NG

- *AU Certificate of Analysis - NATA (COA) Email bernice.ng@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI) Email bernice.ng@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC) Email bernice.ng@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN) Email bernice.ng@ghd.com
- Chain of Custody (CoC) (COC) Email bernice.ng@ghd.com
- EDI Format - ENMRG (ENMRG) Email bernice.ng@ghd.com
- EDI Format - ESDAT (ESDAT) Email bernice.ng@ghd.com
- EDI Format - XTab (XTAB) Email bernice.ng@ghd.com

JAMES DOWDESWELL

- *AU Certificate of Analysis - NATA (COA) Email james.dowdeswell@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI) Email james.dowdeswell@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC) Email james.dowdeswell@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN) Email james.dowdeswell@ghd.com
- A4 - AU Tax Invoice (INV) Email james.dowdeswell@ghd.com
- Chain of Custody (CoC) (COC) Email james.dowdeswell@ghd.com
- EDI Format - ENMRG (ENMRG) Email james.dowdeswell@ghd.com
- EDI Format - ESDAT (ESDAT) Email james.dowdeswell@ghd.com
- EDI Format - XTab (XTAB) Email james.dowdeswell@ghd.com

JASON FOWLER

- *AU Certificate of Analysis - NATA (COA) Email jason.fowler2@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI) Email jason.fowler2@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC) Email jason.fowler2@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN) Email jason.fowler2@ghd.com
- Chain of Custody (CoC) (COC) Email jason.fowler2@ghd.com
- EDI Format - ENMRG (ENMRG) Email jason.fowler2@ghd.com
- EDI Format - ESDAT (ESDAT) Email jason.fowler2@ghd.com
- EDI Format - XTab (XTAB) Email jason.fowler2@ghd.com

MARY CARTER

- *AU Certificate of Analysis - NATA (COA) Email mary.carter@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI) Email mary.carter@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC) Email mary.carter@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN) Email mary.carter@ghd.com
- Chain of Custody (CoC) (COC) Email mary.carter@ghd.com
- EDI Format - ENMRG (ENMRG) Email mary.carter@ghd.com
- EDI Format - ESDAT (ESDAT) Email mary.carter@ghd.com
- EDI Format - XTab (XTAB) Email mary.carter@ghd.com

SARAH WHALAN

- *AU Certificate of Analysis - NATA (COA) Email sarah.whalan@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI) Email sarah.whalan@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC) Email sarah.whalan@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN) Email sarah.whalan@ghd.com
- Chain of Custody (CoC) (COC) Email sarah.whalan@ghd.com
- EDI Format - ENMRG (ENMRG) Email sarah.whalan@ghd.com
- EDI Format - ESDAT (ESDAT) Email sarah.whalan@ghd.com
- EDI Format - XTab (XTAB) Email sarah.whalan@ghd.com

VANESSA DEAR

- *AU Certificate of Analysis - NATA (COA) Email vanessa.dear@ghd.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI) Email vanessa.dear@ghd.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC) Email vanessa.dear@ghd.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN) Email vanessa.dear@ghd.com
- Chain of Custody (CoC) (COC) Email vanessa.dear@ghd.com
- EDI Format - ENMRG (ENMRG) Email vanessa.dear@ghd.com
- EDI Format - ESDAT (ESDAT) Email vanessa.dear@ghd.com
- EDI Format - XTab (XTAB) Email vanessa.dear@ghd.com

CERTIFICATE OF ANALYSIS

Work Order	: EB1712144	Page	: 1 of 6
Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MR JAMES DOWDESWELL	Contact	: Vanessa Mattes
Address	: GPO BOX 668	Address	: 2 Byth Street Stafford QLD Australia 4053
	BRISBANE QLD, AUSTRALIA 4001		
Telephone	: +61 07 3316 3000	Telephone	: +61-7-3243 7222
Project	: 4127018 Coochiemudlo Island (Groundwater)	Date Samples Received	: 14-Jun-2017 13:20
Order number	: ----	Date Analysis Commenced	: 14-Jun-2017
C-O-C number	: ----	Issue Date	: 20-Jun-2017 16:50
Sampler	: MARY CARTER		
Site	: Coochiemudlo Island (Groundwater)		
Quote number	: BN/587/13 V4		
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
- Surrogate Control Limits

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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Greg Vogel	Laboratory Manager	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Tom Maloney	Nutrients Section Supervisor	Brisbane Inorganics, Stafford, QLD



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

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.

- EP005: Results for sample 'GW3-0617-1' may bias low due to large amounts of sediment. The sample was decanted before analysis.
- EP068 (Pesticides by GCMS): Sample EB1712144-001 (GW1-0617-1) shows poor matrix spike recovery due to matrix interference.



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)		Client sample ID		GW1-0617-1	GW3-0617-1	----	----	----
Client sampling date / time				[14-Jun-2017]	[14-Jun-2017]	----	----	----
Compound	CAS Number	LOR	Unit	EB1712144-001	EB1712144-002	-----	-----	-----
				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	121	2	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	121	2	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	133	12	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	97	14	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	64	<1	----	----	----
Magnesium	7439-95-4	1	mg/L	24	2	----	----	----
Sodium	7440-23-5	1	mg/L	42	10	----	----	----
Potassium	7440-09-7	1	mg/L	13	1	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.01	1.47	----	----	----
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	0.002	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	0.002	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	0.014	----	----	----
Manganese	7439-96-5	0.001	mg/L	0.016	0.007	----	----	----
Iron	7439-89-6	0.05	mg/L	0.16	0.59	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.04	----	----	----
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	0.69	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.69	----	----	----



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW1-0617-1	GW3-0617-1	----	----	----
Client sampling date / time				[14-Jun-2017]	[14-Jun-2017]	----	----	----	
Compound	CAS Number	LOR	Unit	EB1712144-001	EB1712144-002	-----	-----	-----	
				Result	Result	----	----	----	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.4	5.8	----	----	----	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L	0.4	6.5	----	----	----	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	0.04	6.13	----	----	----	
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L	7.92	0.68	----	----	----	
Total Cations	----	0.01	meq/L	7.33	0.62	----	----	----	
Ionic Balance	----	0.01	%	3.90	----	----	----	----	
EP005: Total Organic Carbon (TOC)									
Total Organic Carbon	----	1	mg/L	3	8	----	----	----	
EP026SP: Chemical Oxygen Demand (Spectrophotometric)									
Chemical Oxygen Demand	----	10	mg/L	23	272	----	----	----	
EP030: Biochemical Oxygen Demand (BOD)									
Biochemical Oxygen Demand	----	2	mg/L	<2	<2	----	----	----	
EP068A: Organochlorine Pesticides (OC)									
alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	----	----	----	
Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	<0.5	----	----	----	
beta-BHC	319-85-7	0.5	µg/L	<0.5	<0.5	----	----	----	
gamma-BHC	58-89-9	0.5	µg/L	<0.5	<0.5	----	----	----	
delta-BHC	319-86-8	0.5	µg/L	<0.5	<0.5	----	----	----	
Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	----	----	----	
Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	----	----	----	
Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	<0.5	----	----	----	
trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	----	----	----	
alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	<0.5	----	----	----	
cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	----	----	----	
Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	----	----	----	
4,4`-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	----	----	----	
Endrin	72-20-8	0.5	µg/L	<0.5	<0.5	----	----	----	
beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	<0.5	----	----	----	
4,4`-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	----	----	----	
Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	<0.5	----	----	----	
Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	<0.5	----	----	----	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	GW1-0617-1	GW3-0617-1	----	----	----
Client sampling date / time				[14-Jun-2017]	[14-Jun-2017]	----	----	----	
Compound	CAS Number	LOR	Unit	EB1712144-001	EB1712144-002	-----	-----	-----	
				Result	Result	----	----	----	
EP068A: Organochlorine Pesticides (OC) - Continued									
4,4'-DDT	50-29-3	2	µg/L	<2.0	<2.0	----	----	----	
Endrin ketone	53494-70-5	0.5	µg/L	<0.5	<0.5	----	----	----	
Methoxychlor	72-43-5	2	µg/L	<2.0	<2.0	----	----	----	
^ Total Chlordane (sum)	----	0.5	µg/L	<0.5	<0.5	----	----	----	
^ Sum of DDD + DDE + DDT	72-54-8/72-55-9/5 0-2	0.5	µg/L	<0.5	<0.5	----	----	----	
^ Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	<0.5	----	----	----	
EP068B: Organophosphorus Pesticides (OP)									
Dichlorvos	62-73-7	0.5	µg/L	<0.5	<0.5	----	----	----	
Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	<0.5	----	----	----	
Monocrotophos	6923-22-4	2	µg/L	<2.0	<2.0	----	----	----	
Dimethoate	60-51-5	0.5	µg/L	<0.5	<0.5	----	----	----	
Diazinon	333-41-5	0.5	µg/L	<0.5	<0.5	----	----	----	
Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	<0.5	----	----	----	
Parathion-methyl	298-00-0	2	µg/L	<2.0	<2.0	----	----	----	
Malathion	121-75-5	0.5	µg/L	<0.5	<0.5	----	----	----	
Fenthion	55-38-9	0.5	µg/L	<0.5	<0.5	----	----	----	
Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	<0.5	----	----	----	
Parathion	56-38-2	2	µg/L	<2.0	<2.0	----	----	----	
Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	<0.5	----	----	----	
Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	<0.5	----	----	----	
Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	<0.5	----	----	----	
Fenamiphos	22224-92-6	0.5	µg/L	<0.5	<0.5	----	----	----	
Prothiofos	34643-46-4	0.5	µg/L	<0.5	<0.5	----	----	----	
Ethion	563-12-2	0.5	µg/L	<0.5	<0.5	----	----	----	
Carbophenothion	786-19-6	0.5	µg/L	<0.5	<0.5	----	----	----	
Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	<0.5	----	----	----	
EP068S: Organochlorine Pesticide Surrogate									
Dibromo-DDE	21655-73-2	0.5	%	92.0	72.7	----	----	----	
EP068T: Organophosphorus Pesticide Surrogate									
DEF	78-48-8	0.5	%	129	96.3	----	----	----	



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP068S: Organochlorine Pesticide Surrogate			
Dibromo-DDE	21655-73-2	40	134
EP068T: Organophosphorus Pesticide Surrogate			
DEF	78-48-8	42	143

QUALITY CONTROL REPORT

Work Order	: EB1712144	Page	: 1 of 9
Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MR JAMES DOWDESWELL	Contact	: Vanessa Mattes
Address	: GPO BOX 668 BRISBANE QLD, AUSTRALIA 4001	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3316 3000	Telephone	: +61-7-3243 7222
Project	: 4127018 Coochiemudlo Island (Groundwater)	Date Samples Received	: 14-Jun-2017
Order number	: ----	Date Analysis Commenced	: 14-Jun-2017
C-O-C number	: ----	Issue Date	: 20-Jun-2017
Sampler	: MARY CARTER		
Site	: Coochiemudlo Island (Groundwater)		
Quote number	: BN/587/13 V4		
No. of samples received	: 2		
No. of samples analysed	: 2		



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.

<i>Signatories</i>	<i>Position</i>	<i>Accreditation Category</i>
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Greg Vogel	Laboratory Manager	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Tom Maloney	Nutrients Section Supervisor	Brisbane Inorganics, Stafford, QLD



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: 948110)									
EB1712132-005	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	65	63	2.89	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	65	63	2.89	0% - 20%
EB1712150-006	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	5	6	0.00	No Limit
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	5	6	0.00	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 944438)									
EB1712173-001	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: 944437)									
EB1712173-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	10	10	0.00	0% - 50%
ED093F: Dissolved Major Cations (QC Lot: 947797)									
EB1712100-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	14	14	0.00	0% - 50%
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	22	21	0.00	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.00	No Limit
ET1700744-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	374	376	0.730	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	249	253	1.66	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	356	358	0.684	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	2	2	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 947796)									
EB1712100-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	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 (%)
EG020F: Dissolved Metals by ICP-MS (QC Lot: 947796) - continued									
EB1712100-001	Anonymous	EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.009	0.009	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
ET1700744-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.020	0.021	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.266	0.271	1.99	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 947798)									
EB1712144-001	GW1-0617-1	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 943759)									
EB1712026-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	6.44	6.23	3.39	0% - 20%
EB1712144-002	GW3-0617-1	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.04	0.04	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 944436)									
EB1712143-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	0.01	0.01	0.00	No Limit
EB1712174-002	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: 943758)									
EB1712026-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.43	0.43	0.00	0% - 20%
EB1712144-002	GW3-0617-1	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.69	0.71	1.97	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 949338)									
EB1712110-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.3	0.3	0.00	No Limit
EB1712062-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	12.3	12.4	0.00	0% - 50%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 949337)									
EB1712110-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.01	0.02	0.00	No Limit
EB1712062-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	2.68	2.65	1.16	0% - 20%
EP005: Total Organic Carbon (TOC) (QC Lot: 945228)									
EB1712062-001	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	594	585	1.56	0% - 20%
EB1712174-005	Anonymous	EP005: Total Organic Carbon	----	1	mg/L	4	5	0.00	No Limit
EP026SP: Chemical Oxygen Demand (Spectrophotometric) (QC Lot: 951015)									

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 Work Order : EB1712144
 Client : GHD PTY LTD
 Project : 4127018 Coochiemudlo Island (Groundwater)



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 (%)
EP026SP: Chemical Oxygen Demand (Spectrophotometric) (QC Lot: 951015) - continued									
EB1712000-001	Anonymous	EP026SP: Chemical Oxygen Demand	----	10	mg/L	84	83	0.00	No Limit
EB1712103-002	Anonymous	EP026SP: Chemical Oxygen Demand	----	10	mg/L	35	37	4.17	No Limit
EP030: Biochemical Oxygen Demand (BOD) (QC Lot: 944651)									
EB1712137-001	Anonymous	EP030: Biochemical Oxygen Demand	----	2	mg/L	<2	<2	0.00	No Limit
EB1712150-022	Anonymous	EP030: Biochemical Oxygen Demand	----	2	mg/L	3	7	85.1	No Limit
EP068A: Organochlorine Pesticides (OC) (QC Lot: 948798)									
EB1712144-002	GW3-0617-1	EP068: alpha-BHC	319-84-6	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: beta-BHC	319-85-7	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: gamma-BHC	58-89-9	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: delta-BHC	319-86-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Heptachlor	76-44-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Aldrin	309-00-2	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Dieldrin	60-57-1	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: 4,4'-DDE	72-55-9	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Endrin	72-20-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: 4,4'-DDD	72-54-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Endrin ketone	53494-70-5	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: 4,4'-DDT	50-29-3	2	µg/L	<2.0	<2.0	0.00	No Limit
EP068: Methoxychlor	72-43-5	2	µg/L	<2.0	<2.0	0.00	No Limit		
EP068B: Organophosphorus Pesticides (OP) (QC Lot: 948798)									
EB1712144-002	GW3-0617-1	EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Malathion	121-75-5	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	<0.5	0.00	No Limit

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 Work Order : EB1712144
 Client : GHD PTY LTD
 Project : 4127018 Coochiemudlo Island (Groundwater)



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 (%)
EP068B: Organophosphorus Pesticides (OP) (QC Lot: 948798) - continued									
EB1712144-002	GW3-0617-1	EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Ethion	563-12-2	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	<0.5	0.00	No Limit
		EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	<2.0	0.00	No Limit
		EP068: Parathion	56-38-2	2	µg/L	<2.0	<2.0	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: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike Concentration	Spike Recovery (%)		Recovery Limits (%)	
						LCS	Low	High	
ED037P: Alkalinity by PC Titrator (QCLot: 948110)									
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	102	80	120	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 944438)									
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	112	85	118	
				<1	100 mg/L	99.4	85	118	
ED045G: Chloride by Discrete Analyser (QCLot: 944437)									
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	93.2	90	115	
				<1	1000 mg/L	98.0	90	115	
ED093F: Dissolved Major Cations (QCLot: 947797)									
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----	
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----	
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----	
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----	
EG020F: Dissolved Metals by ICP-MS (QCLot: 947796)									
EG020A-F: Aluminium	7429-90-5	0.01	mg/L	<0.01	0.5 mg/L	101	79	118	
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100	88	116	
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	97.1	88	108	
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	99.2	87	113	
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	100.0	88	114	
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	96.2	89	110	
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	108	89	120	
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	102	89	113	
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	97.6	87	113	
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	98.8	82	114	
EG035F: Dissolved Mercury by FIMS (QCLot: 947798)									
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	102	84	118	
EK055G: Ammonia as N by Discrete Analyser (QCLot: 943759)									
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	1 mg/L	101	86	112	
EK057G: Nitrite as N by Discrete Analyser (QCLot: 944436)									
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	104	90	110	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 943758)									
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	98.4	89	115	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 949338)									
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	80.5	70	111	



Sub-Matrix: WATER

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report				
				Result	Spike	Spike Recovery (%)		Recovery Limits (%)	
					Concentration	LCS	Low	High	
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 949337)									
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	88.8	77	109	
EP005: Total Organic Carbon (TOC) (QCLot: 945228)									
EP005: Total Organic Carbon	----	1	mg/L	<1	10 mg/L	86.1	79	113	
				<1	100 mg/L	94.0	79	113	
EP026SP: Chemical Oxygen Demand (Spectrophotometric) (QCLot: 951015)									
EP026SP: Chemical Oxygen Demand	----	10	mg/L	<10	50 mg/L	97.5	86	112	
				<10	500 mg/L	100	86	112	
EP030: Biochemical Oxygen Demand (BOD) (QCLot: 944651)									
EP030: Biochemical Oxygen Demand	----	2	mg/L	<2	198 mg/L	97.8	77	109	
EP068A: Organochlorine Pesticides (OC) (QCLot: 948798)									
EP068: alpha-BHC	319-84-6	0.5	µg/L	<0.5	5 µg/L	104	45	125	
EP068: Hexachlorobenzene (HCB)	118-74-1	0.5	µg/L	<0.5	5 µg/L	89.0	41	121	
EP068: beta-BHC	319-85-7	0.5	µg/L	<0.5	5 µg/L	97.4	39	122	
EP068: gamma-BHC	58-89-9	0.5	µg/L	<0.5	5 µg/L	93.4	42	119	
EP068: delta-BHC	319-86-8	0.5	µg/L	<0.5	5 µg/L	83.6	53	112	
EP068: Heptachlor	76-44-8	0.5	µg/L	<0.5	5 µg/L	97.4	45	118	
EP068: Aldrin	309-00-2	0.5	µg/L	<0.5	5 µg/L	88.6	52	123	
EP068: Heptachlor epoxide	1024-57-3	0.5	µg/L	<0.5	5 µg/L	95.4	52	124	
EP068: trans-Chlordane	5103-74-2	0.5	µg/L	<0.5	5 µg/L	89.4	48	125	
EP068: alpha-Endosulfan	959-98-8	0.5	µg/L	<0.5	5 µg/L	84.6	54	128	
EP068: cis-Chlordane	5103-71-9	0.5	µg/L	<0.5	5 µg/L	89.2	51	125	
EP068: Dieldrin	60-57-1	0.5	µg/L	<0.5	5 µg/L	92.6	50	124	
EP068: 4,4'-DDE	72-55-9	0.5	µg/L	<0.5	5 µg/L	85.9	56	122	
EP068: Endrin	72-20-8	0.5	µg/L	<0.5	5 µg/L	99.8	47	129	
EP068: beta-Endosulfan	33213-65-9	0.5	µg/L	<0.5	5 µg/L	81.7	50	126	
EP068: 4,4'-DDD	72-54-8	0.5	µg/L	<0.5	5 µg/L	83.1	52	124	
EP068: Endrin aldehyde	7421-93-4	0.5	µg/L	<0.5	5 µg/L	94.4	49	131	
EP068: Endosulfan sulfate	1031-07-8	0.5	µg/L	<0.5	5 µg/L	74.5	37	124	
EP068: 4,4'-DDT	50-29-3	2	µg/L	<2.0	5 µg/L	91.8	35	131	
EP068: Endrin ketone	53494-70-5	0.5	µg/L	<0.5	5 µg/L	103	45	129	
EP068: Methoxychlor	72-43-5	2	µg/L	<2.0	5 µg/L	93.7	32	135	
EP068: Total Chlordane (sum)	----	0.5	µg/L	<0.5	----	----	----	----	
EP068: Sum of DDD + DDE + DDT	72-54-8/72-55-9/50-29-3	0.5	µg/L	<0.5	----	----	----	----	
EP068: Sum of Aldrin + Dieldrin	309-00-2/60-57-1	0.5	µg/L	<0.5	----	----	----	----	
EP068B: Organophosphorus Pesticides (OP) (QCLot: 948798)									
EP068: Dichlorvos	62-73-7	0.5	µg/L	<0.5	5 µg/L	87.6	49	115	



Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report Result	Laboratory Control Spike (LCS) Report			
					Spike Concentration	Spike Recovery (%)	Recovery Limits (%)	
						LCS	Low	High
EP068B: Organophosphorus Pesticides (OP) (QCLot: 948798) - continued								
EP068: Demeton-S-methyl	919-86-8	0.5	µg/L	<0.5	5 µg/L	72.4	44	118
EP068: Monocrotophos	6923-22-4	2	µg/L	<2.0	5 µg/L	# 2.53	16	49
EP068: Dimethoate	60-51-5	0.5	µg/L	<0.5	5 µg/L	70.9	41	111
EP068: Diazinon	333-41-5	0.5	µg/L	<0.5	5 µg/L	100	44	129
EP068: Chlorpyrifos-methyl	5598-13-0	0.5	µg/L	<0.5	5 µg/L	97.7	50	118
EP068: Parathion-methyl	298-00-0	----	µg/L	----	5 µg/L	103	50	118
EP068: Malathion	121-75-5	0.5	µg/L	<0.5	5 µg/L	106	51	122
EP068: Fenthion	55-38-9	0.5	µg/L	<0.5	5 µg/L	94.8	49	121
EP068: Chlorpyrifos	2921-88-2	0.5	µg/L	<0.5	5 µg/L	97.7	54	119
EP068: Parathion	56-38-2	2	µg/L	<2.0	5 µg/L	89.9	43	123
EP068: Pirimphos-ethyl	23505-41-1	0.5	µg/L	<0.5	5 µg/L	91.5	52	126
EP068: Chlorfenvinphos	470-90-6	0.5	µg/L	<0.5	5 µg/L	71.8	50	127
EP068: Bromophos-ethyl	4824-78-6	0.5	µg/L	<0.5	5 µg/L	99.3	52	124
EP068: Fenamiphos	22224-92-6	0.5	µg/L	<0.5	5 µg/L	80.2	43	121
EP068: Prothiofos	34643-46-4	0.5	µg/L	<0.5	5 µg/L	95.5	53	126
EP068: Ethion	563-12-2	0.5	µg/L	<0.5	5 µg/L	99.5	50	127
EP068: Carbophenothion	786-19-6	0.5	µg/L	<0.5	5 µg/L	91.3	48	128
EP068: Azinphos Methyl	86-50-0	0.5	µg/L	<0.5	5 µg/L	50.9	44	130

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**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report			
				Spike Concentration	Spike Recovery(%)	Recovery Limits (%)	
					MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 944438)							
EB1712144-002	GW3-0617-1	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	79.0	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 944437)							
EB1712144-002	GW3-0617-1	ED045G: Chloride	16887-00-6	400 mg/L	110	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 947796)							
EB1712100-002	Anonymous	EG020A-F: Aluminium	7429-90-5	0.5 mg/L	92.2	70	130
		EG020A-F: Arsenic	7440-38-2	0.1 mg/L	100	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	92.1	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	92.6	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	87.5	70	130
		EG020A-F: Lead	7439-92-1	0.1 mg/L	85.7	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	92.2	70	130



Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	Spike Recovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 947796) - continued							
EB1712100-002	Anonymous	EG020A-F: Nickel	7440-02-0	0.1 mg/L	88.8	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	84.9	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 947798)							
EB1712144-002	GW3-0617-1	EG035F: Mercury	7439-97-6	0.01 mg/L	95.7	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 943759)							
EB1712026-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	93.3	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 944436)							
EB1712143-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	97.6	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 943758)							
EB1712026-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	# Not Determined	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 949338)							
EB1712062-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	91.4	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 949337)							
EB1712062-002	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	112	70	130
EP005: Total Organic Carbon (TOC) (QCLot: 945228)							
EB1712062-002	Anonymous	EP005: Total Organic Carbon	----	100 mg/L	94.5	70	130
EP026SP: Chemical Oxygen Demand (Spectrophotometric) (QCLot: 951015)							
EB1712017-001	Anonymous	EP026SP: Chemical Oxygen Demand	----	291 mg/L	104	70	130
EP068A: Organochlorine Pesticides (OC) (QCLot: 948798)							
EB1712144-001	GW1-0617-1	EP068: gamma-BHC	58-89-9	10 µg/L	98.0	70	130
		EP068: Heptachlor	76-44-8	10 µg/L	116	70	130
		EP068: Aldrin	309-00-2	10 µg/L	110	70	130
		EP068: Dieldrin	60-57-1	10 µg/L	106	70	130
		EP068: Endrin	72-20-8	40 µg/L	97.2	70	130
		EP068: 4,4'-DDT	50-29-3	40 µg/L	# 34.8	70	130
EP068B: Organophosphorus Pesticides (OP) (QCLot: 948798)							
EB1712144-001	GW1-0617-1	EP068: Diazinon	333-41-5	10 µg/L	111	70	130
		EP068: Chlorpyrifos-methyl	5598-13-0	10 µg/L	97.9	70	130
		EP068: Pirimphos-ethyl	23505-41-1	10 µg/L	103	70	130
		EP068: Bromophos-ethyl	4824-78-6	10 µg/L	116	70	130
		EP068: Prothiofos	34643-46-4	10 µg/L	128	70	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB1712144	Page	: 1 of 7
Client	: GHD PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MR JAMES DOWDESWELL	Telephone	: +61-7-3243 7222
Project	: 4127018 Coochiemudlo Island (Groundwater)	Date Samples Received	: 14-Jun-2017
Site	: Coochiemudlo Island (Groundwater)	Issue Date	: 20-Jun-2017
Sampler	: MARY CARTER	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.
- Laboratory Control outliers exist - please see following pages for full details.
- Matrix Spike outliers exist - please see following pages for full details.
- For all regular sample matrices, **NO** surrogate recovery outliers occur.

Outliers : Analysis Holding Time Compliance

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

Outliers : Frequency of Quality Control Samples

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



Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Laboratory Control Spike (LCS) Recoveries							
EP068B: Organophosphorus Pesticides (OP)	QC-948798-002	----	Monocrotophos	6923-22-4	2.53 %	16-49%	Recovery less than lower control limit
Matrix Spike (MS) Recoveries							
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Ar	EB1712026--002	Anonymous	Nitrite + Nitrate as N	----	Not Determined	----	MS recovery not determined, background level greater than or equal to 4x spike level.
EP068A: Organochlorine Pesticides (OC)	EB1712144--001	GW1-0617-1	4.4'-DDT	50-29-3	34.8 %	70-130%	Recovery less than lower data quality objective

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) GW1-0617-1,	GW3-0617-1	14-Jun-2017	----	----	----	16-Jun-2017	28-Jun-2017	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G) GW1-0617-1,	GW3-0617-1	14-Jun-2017	----	----	----	14-Jun-2017	12-Jul-2017	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G) GW1-0617-1,	GW3-0617-1	14-Jun-2017	----	----	----	14-Jun-2017	12-Jul-2017	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) GW1-0617-1,	GW3-0617-1	14-Jun-2017	----	----	----	16-Jun-2017	12-Jul-2017	✓
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) GW1-0617-1,	GW3-0617-1	14-Jun-2017	----	----	----	16-Jun-2017	11-Dec-2017	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) GW1-0617-1,	GW3-0617-1	14-Jun-2017	----	----	----	16-Jun-2017	12-Jul-2017	✓



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
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) GW1-0617-1, GW3-0617-1	14-Jun-2017	----	----	----	15-Jun-2017	12-Jul-2017	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) GW1-0617-1, GW3-0617-1	14-Jun-2017	----	----	----	14-Jun-2017	16-Jun-2017	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) GW1-0617-1, GW3-0617-1	14-Jun-2017	----	----	----	15-Jun-2017	12-Jul-2017	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) GW1-0617-1, GW3-0617-1	14-Jun-2017	17-Jun-2017	12-Jul-2017	✓	17-Jun-2017	12-Jul-2017	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) GW1-0617-1, GW3-0617-1	14-Jun-2017	17-Jun-2017	12-Jul-2017	✓	17-Jun-2017	12-Jul-2017	✓
EP005: Total Organic Carbon (TOC)							
Amber TOC Vial - Sulfuric Acid (EP005) GW1-0617-1, GW3-0617-1	14-Jun-2017	----	----	----	15-Jun-2017	12-Jul-2017	✓
EP026SP: Chemical Oxygen Demand (Spectrophotometric)							
Clear Plastic Bottle - Sulfuric Acid (EP026SP) GW1-0617-1, GW3-0617-1	14-Jun-2017	----	----	----	19-Jun-2017	12-Jul-2017	✓
EP030: Biochemical Oxygen Demand (BOD)							
Clear Plastic Bottle - Natural (EP030) GW1-0617-1, GW3-0617-1	14-Jun-2017	----	----	----	14-Jun-2017	16-Jun-2017	✓
EP068A: Organochlorine Pesticides (OC)							
Amber Glass Bottle - Unpreserved (EP068) GW1-0617-1, GW3-0617-1	14-Jun-2017	16-Jun-2017	21-Jun-2017	✓	19-Jun-2017	26-Jul-2017	✓
EP068B: Organophosphorus Pesticides (OP)							
Amber Glass Bottle - Unpreserved (EP068) GW1-0617-1, GW3-0617-1	14-Jun-2017	16-Jun-2017	21-Jun-2017	✓	19-Jun-2017	26-Jul-2017	✓



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	Method	Count		Rate (%)			Quality Control Specification
		QC	Reaular	Actual	Expected	Evaluation	
Analytical Methods							
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	15	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Biochemical Oxygen Demand (BOD)	EP030	2	15	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	5	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	16.67	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	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	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	2	50.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	5	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	14	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Biochemical Oxygen Demand (BOD)	EP030	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	2	18	11.11	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	5	40.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	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	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	5	40.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	2	13	15.38	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Biochemical Oxygen Demand (BOD)	EP030	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard



Matrix: **WATER**

Evaluation: * = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type	Method	Count		Rate (%)			Quality Control Specification
		QC	Regular	Actual	Expected	Evaluation	
Analytical Methods							
Method Blanks (MB) - Continued							
Dissolved Metals by ICP-MS - Suite A	EG020A-F	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	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	6	16.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	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	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Pesticides by GCMS	EP068	1	2	50.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Organic Carbon	EP005	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	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 SO ₄ ²⁻ by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO ₄ . 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 BaSO ₄ suspension is measured by a photometer and the SO ₄ 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 liberated thiocyanate forms highly-coloured ferric thiocyanate 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)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl ₂)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl ₂ which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH ₃ 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-NO ₂ - 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-NO ₃ - F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined separately 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)



Analytical Methods	Method	Matrix	Method Descriptions
Nitrite and Nitrate as N (NO _x) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO ₃ - F. Combined oxidised Nitrogen (NO ₂ +NO ₃) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + No _x) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO ₃ -. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO ₄ 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)
Chemical Oxygen Demand (COD) (Spectrophotometric)	EP026SP	WATER	In house: Referenced to APHA 5220 D. Samples are digested with a known excess of an acidic potassium dichromate solution using silver sulfate as a catalyst. The chromium is reduced from the Cr (VI) oxidation state to the Cr (III) state by the oxygen present in the organic material. Both of these chromium species are coloured and absorb in the visible region of (400nm & 600nm) the spectrum. The oxidisable organic matter can be calculated in terms of oxygen equivalents.
Biochemical Oxygen Demand (BOD)	EP030	WATER	In house: Referenced to APHA 5210 B. The 5-Day BOD test provides an empirical measure of the oxygen consumption capacity of a given water. A portion of the sample is diluted into oxygenated, nutrient rich water, and a seed added to begin biological decay. The initial dissolved oxygen content is measured, then the bottle is sealed and incubated for five days. The remaining dissolved oxygen is measured, and from the difference, the demand for oxygen, by biological decay, is determined. This method is compliant with NEPM (2013) Schedule B(3)
Pesticides by GCMS	EP068	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.