

CERTIFICATE OF ANALYSIS

Work Order : **ES1623649**
Client : **ORIGIN ENERGY RESOURCES LTD**
Contact : [REDACTED]
Address : **ORIGIN ENERGY RESOURCES LIMITED GPO BOX 148**
BRISBANE QLD, AUSTRALIA 4001
Telephone : [REDACTED]
Project : **Beetaloo Groundwater Monitoring**
Order number : **16231417**
C-O-C number : **COC_AMNW1H_SU_TT_20161019**
Sampler : **----**
Site : **Betaloo**
Quote number : **----**
No. of samples received : **3**
No. of samples analysed : **3**

Page : 1 of 7
Laboratory : Environmental Division Sydney
Contact : [REDACTED]
Address : **277-289 Woodpark Road Smithfield NSW Australia 2164**
Telephone : [REDACTED]
Date Samples Received : **20-Oct-2016 13:45**
Date Analysis Commenced : **21-Oct-2016**
Issue Date : **27-Oct-2016 14:43**



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.

Signatories	Position	Accreditation Category
[REDACTED]	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
	Organic Coordinator	Sydney Organics, Smithfield, NSW
	Inorganics Coordinator	Sydney Inorganics, Smithfield, NSW



General Comments

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

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

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

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

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.

LOR = Limit of reporting

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

ø = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- EG020/ED093: LOR's have been raised for sample ID ES1623649 - #001 & #003 due to matrix interference. (High Total Dissolved Solids)
- ED041G: LOR raised for Sulfate for sample 1 due to sample matrix.
- ED041G: LOR raised for (Sulfate analysis) on sample no:3, due to sample matrix.
- EN055: Ionic Balance out of acceptable limits for sample 1 due to analytes not quantified in this report.
- EP050: The MBAS reported is calculated as LAS, mol wt ____342____.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- 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.



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_7x5	BET-PW001_Fe_8x5	BET-PW001_Fe_11x5	----	----
Client sampling date / time				19-Oct-2016 12:00	19-Oct-2016 12:00	19-Oct-2016 12:00	----	----	
Compound	CAS Number	LOR	Unit	ES1623649-001	ES1623649-002	ES1623649-003	-----	-----	
				Result	Result	Result	---	---	
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit	6.51	7.56	7.47	----	----	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm	41400	21100	26800	----	----	
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L	29900	14400	18100	----	----	
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	----	1	mg/L	26900	13700	17400	----	----	
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L	3340	1280	2080	----	----	
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----	
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----	----	
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	586	714	1020	----	----	
Total Alkalinity as CaCO3	----	1	mg/L	586	714	1020	----	----	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<10	46	<10	----	----	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	13300	6520	8010	----	----	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	1020	358	611	----	----	
Magnesium	7439-95-4	1	mg/L	192	95	135	----	----	
Sodium	7440-23-5	1	mg/L	9940	3950	5590	----	----	
Potassium	7440-09-7	1	mg/L	70	273	63	----	----	
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L	0.016	0.032	0.061	----	----	
Boron	7440-42-8	0.05	mg/L	62.9	38.2	66.0	----	----	
Barium	7440-39-3	0.001	mg/L	36.4	7.97	12.9	----	----	
Beryllium	7440-41-7	0.001	mg/L	<0.010	<0.001	<0.010	----	----	
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0001	<0.0010	----	----	
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.001	<0.010	----	----	
Chromium	7440-47-3	0.001	mg/L	0.031	0.044	0.055	----	----	
Copper	7440-50-8	0.001	mg/L	<0.010	<0.001	<0.010	----	----	
Manganese	7439-96-5	0.001	mg/L	2.24	0.906	1.39	----	----	
Nickel	7440-02-0	0.001	mg/L	0.016	0.016	0.028	----	----	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_7x5	BET-PW001_Fe_8x5	BET-PW001_Fe_11x5	----	----
Client sampling date / time				19-Oct-2016 12:00	19-Oct-2016 12:00	19-Oct-2016 12:00	----	----	
Compound	CAS Number	LOR	Unit	ES1623649-001	ES1623649-002	ES1623649-003	-----	-----	
				Result	Result	Result	---	---	
EG020F: Dissolved Metals by ICP-MS - Continued									
Lead	7439-92-1	0.001	mg/L	<0.010	<0.001	<0.010	----	----	
Selenium	7782-49-2	0.01	mg/L	<0.10	<0.01	<0.10	----	----	
Vanadium	7440-62-2	0.01	mg/L	<0.10	<0.01	<0.10	----	----	
Zinc	7440-66-6	0.005	mg/L	<0.050	<0.005	<0.050	----	----	
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	1.6	1.6	2.6	----	----	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L	0.02	0.03	0.02	----	----	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	88.0	69.6	72.8	----	----	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L	88.0	69.6	72.8	----	----	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	1.20	0.52	0.75	----	----	
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L	387	199	246	----	----	
Total Cations	----	0.01	meq/L	501	204	286	----	----	
Ionic Balance	----	0.01	%	12.8	1.32	7.51	----	----	
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	1	µg/L	2000	669	2080	----	----	
Ethene	74-85-1	1	µg/L	<1	<1	<1	----	----	
Ethane	74-84-0	1	µg/L	2	<1	<1	----	----	
Propene	115-07-1	1	µg/L	<1	<1	<1	----	----	
Propane	74-98-6	1	µg/L	<1	<1	<1	----	----	
Butene	25167-67-3	1	µg/L	<1	<1	<1	----	----	
Butane	106-97-8	1	µg/L	<1	<1	<1	----	----	
EP041A: Nonionic Surfactants									
Nonionic Surfactants as CTAS	----	5	mg/L	<5	<5	<5	----	----	
EP050: Anionic Surfactants as MBAS									
Anionic Surfactants as MBAS	----	0.1	mg/L	<0.1	<0.1	0.2	----	----	
EP075(SIM)A: Phenolic Compounds									



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_7x5	BET-PW001_Fe_8x5	BET-PW001_Fe_11x5	----	----
Client sampling date / time				19-Oct-2016 12:00	19-Oct-2016 12:00	19-Oct-2016 12:00	----	----	
Compound	CAS Number	LOR	Unit	ES1623649-001	ES1623649-002	ES1623649-003	-----	-----	
				Result	Result	Result	---	---	
EP075(SIM)A: Phenolic Compounds - Continued									
Phenol	108-95-2	1	µg/L	18.5	5.2	13.2	----	----	
2-Chlorophenol	95-57-8	1	µg/L	<1.0	<1.0	<1.0	----	----	
2-Methylphenol	95-48-7	1	µg/L	<1.0	<1.0	<1.0	----	----	
3- & 4-Methylphenol	1319-77-3	2	µg/L	91.2	31.5	762	----	----	
2-Nitrophenol	88-75-5	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,4-Dimethylphenol	105-67-9	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,4-Dichlorophenol	120-83-2	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,6-Dichlorophenol	87-65-0	1	µg/L	<1.0	<1.0	<1.0	----	----	
4-Chloro-3-methylphenol	59-50-7	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,4,6-Trichlorophenol	88-06-2	1	µg/L	<1.0	<1.0	<1.0	----	----	
2,4,5-Trichlorophenol	95-95-4	1	µg/L	<1.0	<1.0	<1.0	----	----	
Pentachlorophenol	87-86-5	2	µg/L	<2.0	<2.0	<2.0	----	----	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1	µg/L	<1.0	<1.0	<1.0	----	----	
Acenaphthylene	208-96-8	1	µg/L	<1.0	<1.0	<1.0	----	----	
Acenaphthene	83-32-9	1	µg/L	<1.0	<1.0	<1.0	----	----	
Fluorene	86-73-7	1	µg/L	<1.0	<1.0	<1.0	----	----	
Phenanthrene	85-01-8	1	µg/L	<1.0	<1.0	<1.0	----	----	
Anthracene	120-12-7	1	µg/L	<1.0	<1.0	<1.0	----	----	
Fluoranthene	206-44-0	1	µg/L	<1.0	<1.0	<1.0	----	----	
Pyrene	129-00-0	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benz(a)anthracene	56-55-3	1	µg/L	<1.0	<1.0	<1.0	----	----	
Chrysene	218-01-9	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	----	----	
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	<1.0	<1.0	----	----	
Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	<1.0	<1.0	----	----	
Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	<1.0	<1.0	----	----	
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----	
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	----	----	
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L	50	<20	<20	----	----	
C10 - C14 Fraction	----	50	µg/L	330	120	360	----	----	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_7x5	BET-PW001_Fe_8x5	BET-PW001_Fe_11x5	----	----
Client sampling date / time				19-Oct-2016 12:00	19-Oct-2016 12:00	19-Oct-2016 12:00	----	----	
Compound	CAS Number	LOR	Unit	ES1623649-001	ES1623649-002	ES1623649-003	-----	-----	
				Result	Result	Result	---	---	
EP080/071: Total Petroleum Hydrocarbons - Continued									
C15 - C28 Fraction	----	100	µg/L	250	370	370	----	----	
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	----	----	
^ C10 - C36 Fraction (sum)	----	50	µg/L	580	490	730	----	----	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L	40	<20	<20	----	----	
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	40	<20	<20	----	----	
>C10 - C16 Fraction	----	100	µg/L	370	200	490	----	----	
>C16 - C34 Fraction	----	100	µg/L	210	350	290	----	----	
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	----	----	
^ >C10 - C40 Fraction (sum)	----	100	µg/L	580	550	780	----	----	
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	370	200	490	----	----	
EP080: BTEXN									
Benzene	71-43-2	1	µg/L	<1	<1	<1	----	----	
Toluene	108-88-3	2	µg/L	<2	<2	<2	----	----	
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	----	----	
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	----	----	
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	----	----	
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	<2	----	----	
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	----	----	
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	----	----	
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%	23.8	23.2	24.2	----	----	
2-Chlorophenol-D4	93951-73-6	1	%	49.2	51.7	54.7	----	----	
2,4,6-Tribromophenol	118-79-6	1	%	81.3	83.6	80.1	----	----	
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%	67.5	68.9	56.6	----	----	
Anthracene-d10	1719-06-8	1	%	66.5	67.6	68.0	----	----	
4-Terphenyl-d14	1718-51-0	1	%	86.6	94.0	85.1	----	----	
EP080S: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	2	%	94.1	96.5	95.3	----	----	
Toluene-D8	2037-26-5	2	%	123	115	112	----	----	
4-Bromofluorobenzene	460-00-4	2	%	123	115	110	----	----	



Surrogate Control Limits

Sub-Matrix: WATER		Recovery Limits (%)	
Compound	CAS Number	Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	44
2-Chlorophenol-D4	93951-73-6	14	94
2,4,6-Tribromophenol	118-79-6	17	125
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	20	104
Anthracene-d10	1719-06-8	27	113
4-Terphenyl-d14	1718-51-0	32	112
EP080S: TPH(V)/BTEX Surrogates			
1,2-Dichloroethane-D4	17060-07-0	71	137
Toluene-D8	2037-26-5	79	131
4-Bromofluorobenzene	460-00-4	70	128