

CERTIFICATE OF ANALYSIS

Work Order : **ES1624547**
Client : **ORIGIN ENERGY RESOURCES LTD**
Contact : [REDACTED]
Address : PO BOX 443
 CHINCHILLA QLD, AUSTRALIA 4413
Telephone : [REDACTED]
Project : BEETALOO GROUNDWATER MONITORING
Order number : 16231417
C-O-C number : AMNW1H_FB_RP_20161027
Sampler : ----
Site : Beetaloo
Quote number : ----
No. of samples received : 2
No. of samples analysed : 2

Page : 1 of 8
Laboratory : Environmental Division Sydney
Contact : [REDACTED]
Address : 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone : [REDACTED]
Date Samples Received : 01-Nov-2016 12:45
Date Analysis Commenced : 01-Nov-2016
Issue Date : 09-Nov-2016 11:51



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.

Signatories	Position	Accreditation Category
[REDACTED]	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
		Sydney Inorganics, Smithfield, NSW
	Organic Coordinator	Sydney Organics, Smithfield, NSW
	Metals Teamleader	Radionuclides, Fyshwick, ACT
	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

∅ = ALS is not NATA accredited for these tests.

~ = Indicates an estimated value.

- MBAS is calculated as LAS, molecular weight 342
- EG035: Poor matrix spike recovery was obtained for Mercury on sample ES1624547# 1 due to high matrix interference. Confirmed by re-analysis
- EG020A-T/EG020A-F: Some samples were rerun (X10) due to matrix interference and LOR's have been raised accordingly.
- Gross Alpha and Beta Activity analyses are performed by ALS Fyshwick (NATA Accreditation number 992).
- EP041A, Invalidated duplicate/ Spike for NIS due to insufficient volume.
- EK067G: LOR raised for Total P on sample No 1 due to sample matrix.
- EA016: Calculated TDS is determined from Electrical conductivity using a conversion factor of 0.65.
- EA250 LSC : LOR for Gross Alpha and Beta raised due to high solid content
- 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_13%	BET-PW001_Fe_13.5%	---	---	---
Client sampling date / time				[22-Oct-2016]	[25-Oct-2016]	---	---	---	
Compound	CAS Number	LOR	Unit	ES1624547-001	ES1624547-002	-----	-----	-----	
				Result	Result	---	---	---	
EA005P: pH by PC Titrator									
pH Value	---	0.01	pH Unit	6.51	6.55	---	---	---	
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	---	1	µS/cm	52600	53500	---	---	---	
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	---	10	mg/L	37700	31800	---	---	---	
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	---	1	mg/L	34200	34800	---	---	---	
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	---	1	mg/L	3960	3990	---	---	---	
EA250: Gross Alpha and Beta Activity									
Gross alpha	---	0.05	Bq/L	8.57	12.4	---	---	---	
Gross beta activity - 40K	---	0.1	Bq/L	9.76	12.7	---	---	---	
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	566	556	---	---	---	
Total Alkalinity as CaCO3	---	1	mg/L	566	556	---	---	---	
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	---	---	---	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L	19300	20000	---	---	---	
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L	1200	1210	---	---	---	
Magnesium	7439-95-4	1	mg/L	233	235	---	---	---	
Sodium	7440-23-5	1	mg/L	10900	10800	---	---	---	
Potassium	7440-09-7	1	mg/L	64	65	---	---	---	
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L	<0.010	<0.010	---	---	---	
Boron	7440-42-8	0.05	mg/L	40.0	41.1	---	---	---	
Barium	7440-39-3	0.001	mg/L	63.5	68.4	---	---	---	
Beryllium	7440-41-7	0.001	mg/L	<0.010	<0.010	---	---	---	
Cadmium	7440-43-9	0.0001	mg/L	<0.0010	<0.0010	---	---	---	
Cobalt	7440-48-4	0.001	mg/L	<0.010	<0.010	---	---	---	



Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_13%	BET-PW001_Fe_13.5%	---	---	---
Client sampling date / time				[22-Oct-2016]	[25-Oct-2016]	---	---	---	
Compound	CAS Number	LOR	Unit	ES1624547-001	ES1624547-002	-----	-----	-----	
				Result	Result	---	---	---	
EG020F: Dissolved Metals by ICP-MS - Continued									
Chromium	7440-47-3	0.001	mg/L	0.032	0.030	---	---	---	
Copper	7440-50-8	0.001	mg/L	<0.010	<0.010	---	---	---	
Manganese	7439-96-5	0.001	mg/L	2.34	2.44	---	---	---	
Nickel	7440-02-0	0.001	mg/L	0.014	0.018	---	---	---	
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	---	---	---	
Selenium	7782-49-2	0.01	mg/L	<0.10	<0.10	---	---	---	
Vanadium	7440-62-2	0.01	mg/L	<0.10	<0.10	---	---	---	
Zinc	7440-66-6	0.005	mg/L	<0.050	<0.050	---	---	---	
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	---	---	---	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	1.1	1.1	---	---	---	
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	---	0.01	mg/L	<0.01	<0.01	---	---	---	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	---	0.1	mg/L	61.3	59.4	---	---	---	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	---	0.1	mg/L	61.3	59.4	---	---	---	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	---	0.01	mg/L	<0.10	0.15	---	---	---	
EN055: Ionic Balance									
Total Anions	---	0.01	meq/L	556	575	---	---	---	
Total Cations	---	0.01	meq/L	555	551	---	---	---	
Ionic Balance	---	0.01	%	0.08	2.14	---	---	---	
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	1	µg/L	6500	6490	---	---	---	
Ethene	74-85-1	1	µg/L	<1	<1	---	---	---	
Ethane	74-84-0	1	µg/L	925	757	---	---	---	
Propene	115-07-1	1	µg/L	<1	<1	---	---	---	
Propane	74-98-6	1	µg/L	33	20	---	---	---	
Butene	25167-67-3	1	µg/L	<1	<1	---	---	---	
Butane	106-97-8	1	µg/L	2	<1	---	---	---	
EP041A: Nonionic Surfactants									
Nonionic Surfactants as CTAS	---	5	mg/L	<5	<5	---	---	---	



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Client sampling date / time				[22-Oct-2016]	[25-Oct-2016]	---	---	---	
Compound	CAS Number	LOR	Unit	ES1624547-001	ES1624547-002	-----	-----	-----	
				Result	Result	---	---	---	
EP050: Anionic Surfactants as MBAS									
Anionic Surfactants as MBAS	---	0.1	mg/L	<0.1	<0.1	---	---	---	
EP075(SIM)A: Phenolic Compounds									
Phenol	108-95-2	1	µg/L	1.6	1.7	---	---	---	
2-Chlorophenol	95-57-8	1	µg/L	<1.0	<1.0	---	---	---	
2-Methylphenol	95-48-7	1	µg/L	<1.0	<1.0	---	---	---	
3- & 4-Methylphenol	1319-77-3	2	µg/L	2.7	7.0	---	---	---	
2-Nitrophenol	88-75-5	1	µg/L	<1.0	<1.0	---	---	---	
2,4-Dimethylphenol	105-67-9	1	µg/L	<1.0	<1.0	---	---	---	
2,4-Dichlorophenol	120-83-2	1	µg/L	<1.0	<1.0	---	---	---	
2,6-Dichlorophenol	87-65-0	1	µg/L	<1.0	<1.0	---	---	---	
4-Chloro-3-methylphenol	59-50-7	1	µg/L	<1.0	<1.0	---	---	---	
2,4,6-Trichlorophenol	88-06-2	1	µg/L	<1.0	<1.0	---	---	---	
2,4,5-Trichlorophenol	95-95-4	1	µg/L	<1.0	<1.0	---	---	---	
Pentachlorophenol	87-86-5	2	µg/L	<2.0	<2.0	---	---	---	
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons									
Naphthalene	91-20-3	1	µg/L	<1.0	<1.0	---	---	---	
Acenaphthylene	208-96-8	1	µg/L	<1.0	<1.0	---	---	---	
Acenaphthene	83-32-9	1	µg/L	<1.0	<1.0	---	---	---	
Fluorene	86-73-7	1	µg/L	<1.0	<1.0	---	---	---	
Phenanthrene	85-01-8	1	µg/L	<1.0	<1.0	---	---	---	
Anthracene	120-12-7	1	µg/L	<1.0	<1.0	---	---	---	
Fluoranthene	206-44-0	1	µg/L	<1.0	<1.0	---	---	---	
Pyrene	129-00-0	1	µg/L	<1.0	<1.0	---	---	---	
Benz(a)anthracene	56-55-3	1	µg/L	<1.0	<1.0	---	---	---	
Chrysene	218-01-9	1	µg/L	<1.0	<1.0	---	---	---	
Benzo(b+)fluoranthene	205-99-2 205-82-3	1	µg/L	<1.0	<1.0	---	---	---	
Benzo(k)fluoranthene	207-08-9	1	µg/L	<1.0	<1.0	---	---	---	
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	---	---	---	
Indeno(1.2.3.cd)pyrene	193-39-5	1	µg/L	<1.0	<1.0	---	---	---	
Dibenz(a,h)anthracene	53-70-3	1	µg/L	<1.0	<1.0	---	---	---	
Benzo(g,h,i)perylene	191-24-2	1	µg/L	<1.0	<1.0	---	---	---	
^ Sum of polycyclic aromatic hydrocarbons	---	0.5	µg/L	<0.5	<0.5	---	---	---	
^ Benzo(a)pyrene TEQ (zero)	---	0.5	µg/L	<0.5	<0.5	---	---	---	
EP080/071: Total Petroleum Hydrocarbons									



Analytical Results

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Client sampling date / time				[22-Oct-2016]	[25-Oct-2016]	---	---	---	
Compound	CAS Number	LOR	Unit	ES1624547-001	ES1624547-002	-----	-----	-----	
				Result	Result	---	---	---	
EP080/071: Total Petroleum Hydrocarbons - Continued									
C6 - C9 Fraction	---	20	µg/L	90	80	---	---	---	
C10 - C14 Fraction	---	50	µg/L	270	190	---	---	---	
C15 - C28 Fraction	---	100	µg/L	170	180	---	---	---	
C29 - C36 Fraction	---	50	µg/L	<50	150	---	---	---	
^ C10 - C36 Fraction (sum)	---	50	µg/L	440	520	---	---	---	
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L	90	80	---	---	---	
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	80	80	---	---	---	
>C10 - C16 Fraction	---	100	µg/L	240	140	---	---	---	
>C16 - C34 Fraction	---	100	µg/L	210	280	---	---	---	
>C34 - C40 Fraction	---	100	µg/L	<100	130	---	---	---	
^ >C10 - C40 Fraction (sum)	---	100	µg/L	450	550	---	---	---	
^ >C10 - C16 Fraction minus Naphthalene (F2)	---	100	µg/L	240	140	---	---	---	
EP080: BTEXN									
Benzene	71-43-2	1	µg/L	4	3	---	---	---	
Toluene	108-88-3	2	µg/L	3	2	---	---	---	
Ethylbenzene	100-41-4	2	µg/L	<2	<2	---	---	---	
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	---	---	---	
ortho-Xylene	95-47-6	2	µg/L	<2	<2	---	---	---	
^ Total Xylenes	1330-20-7	2	µg/L	<2	<2	---	---	---	
^ Sum of BTEX	---	1	µg/L	7	5	---	---	---	
Naphthalene	91-20-3	5	µg/L	<5	<5	---	---	---	
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%	21.7	21.7	---	---	---	
2-Chlorophenol-D4	93951-73-6	1	%	43.4	40.6	---	---	---	
2,4,6-Tribromophenol	118-79-6	1	%	57.6	54.8	---	---	---	
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%	79.4	82.5	---	---	---	
Anthracene-d10	1719-06-8	1	%	82.8	78.5	---	---	---	
4-Terphenyl-d14	1718-51-0	1	%	103	97.4	---	---	---	
EP080S: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	2	%	113	118	---	---	---	



Analytical Results

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Client sampling date / time				[22-Oct-2016]	[25-Oct-2016]	---	---	---	
Compound	CAS Number	LOR	Unit	ES1624547-001	ES1624547-002	-----	-----	-----	
				Result	Result	---	---	---	
EP080S: TPH(V)/BTEX Surrogates - Continued									
Toluene-D8	2037-26-5	2	%	104	105	---	---	---	
4-Bromofluorobenzene	460-00-4	2	%	113	115	---	---	---	



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