

## CERTIFICATE OF ANALYSIS

**Work Order** : **ES1628176**  
**Amendment** : **(Preliminary Report)**  
**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** : AMNW1-H\_FB\_RP\_20160101  
**Sampler** : ----  
**Site** : Beetaloo  
**Quote number** : BNBQ/195/15  
**No. of samples received** : 4  
**No. of samples analysed** : 4

**Page** : 1 of 7  
**Laboratory** : Environmental Division Sydney  
**Contact** : EB ProjectManager  
**Address** : 277-289 Woodpark Road Smithfield NSW Australia 2164  
**Telephone** : [REDACTED]  
**Date Samples Received** : 09-Dec-2016 09:30  
**Date Analysis Commenced** : 09-Dec-2016  
**Issue Date** : 16-Dec-2016 17:06



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>
<span style="background-color: black; color: black;">[REDACTED]</span>	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
	Organic Coordinator	Sydney Organics, Smithfield, NSW

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## 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.

- EG020: Samples were diluted and rerun due to matrix interference and LOR's have been raised accordingly. (High Total Dissolved Solids)
- EG035: Poor matrix spike recovery was obtained for Mercury on sample ES1628176 # 3 due to high matrix interference. Confirmed by re-analysis.
- ED041G: LOR raised for Sulfate due to sample matrix.
- EK067G: LOR raised for Total P on various samples due to sample matrix.
- 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.

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## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_16.2	BET-PW001_FE_16.4	BET-PW001_Fe_16.5%	BET-PW001_FE_16.6%	----
Client sampling date / time					23-Nov-2016 12:00	26-Nov-2016 12:00	28-Nov-2016 12:00	30-Nov-2016 12:00	----
Compound	CAS Number	LOR	Unit		ES1628176-001	ES1628176-002	ES1628176-003	ES1628176-004	-----
				Result	Result	Result	Result	Result	---
EA005P: pH by PC Titrator									
pH Value	----	0.01	pH Unit		6.56	6.50	6.50	6.50	----
EA010P: Conductivity by PC Titrator									
Electrical Conductivity @ 25°C	----	1	µS/cm		51700	52300	52800	52300	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L		42000	44200	44800	44500	----
EA016: Calculated TDS (from Electrical Conductivity)									
Total Dissolved Solids (Calc.)	----	1	mg/L		33600	34000	34300	34000	----
EA065: Total Hardness as CaCO3									
Total Hardness as CaCO3	----	1	mg/L		5120	5280	5560	5560	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		377	371	367	384	----
Total Alkalinity as CaCO3	----	1	mg/L		377	371	367	384	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		<10	<10	<10	<10	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		22000	24000	21400	25400	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		1600	1650	1740	1740	----
Magnesium	7439-95-4	1	mg/L		272	283	295	295	----
Sodium	7440-23-5	1	mg/L		13100	13300	13900	13800	----
Potassium	7440-09-7	1	mg/L		68	67	70	70	----
EG020F: Dissolved Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		<0.010	<0.010	<0.010	<0.010	----
Boron	7440-42-8	0.05	mg/L		35.1	34.2	31.0	34.0	----
Barium	7440-39-3	0.001	mg/L		66.2	71.6	77.8	80.1	----
Beryllium	7440-41-7	0.001	mg/L		<0.010	<0.010	<0.010	<0.010	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	----
Cobalt	7440-48-4	0.001	mg/L		<0.010	<0.010	<0.010	<0.010	----
Chromium	7440-47-3	0.001	mg/L		0.025	0.028	0.031	0.029	----
Copper	7440-50-8	0.001	mg/L		<0.010	<0.010	<0.010	<0.010	----
Manganese	7439-96-5	0.001	mg/L		2.31	2.56	2.64	2.75	----
Nickel	7440-02-0	0.001	mg/L		0.021	0.017	<0.010	<0.010	----

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Project : Beetaloo Gr

## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_16.2	BET-PW001_FE_16.4	BET-PW001_Fe_16.5%	BET-PW001_FE_16.6%	----
Client sampling date / time				23-Nov-2016 12:00	26-Nov-2016 12:00	28-Nov-2016 12:00	30-Nov-2016 12:00	----	
Compound	CAS Number	LOR	Unit	ES1628176-001	ES1628176-002	ES1628176-003	ES1628176-004	-----	
				Result	Result	Result	Result	---	
EG020F: Dissolved Metals by ICP-MS - Continued									
Lead	7439-92-1	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	----	
Selenium	7782-49-2	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	----	
Vanadium	7440-62-2	0.01	mg/L	<0.10	<0.10	<0.10	<0.10	----	
Zinc	7440-66-6	0.005	mg/L	<0.050	<0.050	<0.050	<0.050	----	
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----	
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L	1.0	1.1	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	<0.01	<0.01	----	
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	58.0	60.0	61.5	62.1	----	
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L	58.0	60.0	61.5	62.1	----	
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L	<0.05	<0.05	0.10	<0.05	----	
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L	628	684	611	724	----	
Total Cations	----	0.01	meq/L	674	686	718	713	----	
Ionic Balance	----	0.01	%	3.51	0.10	8.02	0.77	----	
EP033: C1 - C4 Hydrocarbon Gases									
Methane	74-82-8	1	µg/L	7350	8370	7750	7720	----	
Ethene	74-85-1	1	µg/L	<1	<1	<1	<1	----	
Ethane	74-84-0	1	µg/L	798	781	614	467	----	
Propene	115-07-1	1	µg/L	<1	<1	<1	<1	----	
Propane	74-98-6	1	µg/L	23	23	18	18	----	
Butene	25167-67-3	1	µg/L	<1	<1	<1	<1	----	
Butane	106-97-8	1	µg/L	<1	<1	<1	<1	----	
EP041A: Nonionic Surfactants									
Nonionic Surfactants as CTAS	----	5	mg/L	<5	<5	<5	<5	----	
EP050: Anionic Surfactants as MBAS									
Anionic Surfactants as MBAS	----	0.1	mg/L	0.1	0.2	<0.1	0.2	----	
EP075(SIM)A: Phenolic Compounds									

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Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_16.2	BET-PW001_Fe_16.4	BET-PW001_Fe_16.5%	BET-PW001_Fe_16.6%	---
Client sampling date / time					23-Nov-2016 12:00	26-Nov-2016 12:00	28-Nov-2016 12:00	30-Nov-2016 12:00	---
Compound	CAS Number	LOR	Unit		ES1628176-001	ES1628176-002	ES1628176-003	ES1628176-004	-----
					Result	Result	Result	Result	---
EP075(SIM)A: Phenolic Compounds - Continued									
Phenol	108-95-2	1	µg/L		2.8	2.5	3.1	4.0	---
2-Chlorophenol	95-57-8	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
2-Methylphenol	95-48-7	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
3- & 4-Methylphenol	1319-77-3	2	µg/L		2.5	3.3	5.8	11.3	---
2-Nitrophenol	88-75-5	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
2,4-Dimethylphenol	105-67-9	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
2,4-Dichlorophenol	120-83-2	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
2,6-Dichlorophenol	87-65-0	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
4-Chloro-3-methylphenol	59-50-7	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
2,4,6-Trichlorophenol	88-06-2	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
2,4,5-Trichlorophenol	95-95-4	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Pentachlorophenol	87-86-5	2	µg/L		<2.0	<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	<1.0	---
Acenaphthylene	208-96-8	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Acenaphthene	83-32-9	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Fluorene	86-73-7	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Phenanthrene	85-01-8	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Anthracene	120-12-7	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Fluoranthene	206-44-0	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Pyrene	129-00-0	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Benz(a)anthracene	56-55-3	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Chrysene	218-01-9	1	µg/L		<1.0	<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	<1.0	---
Benzo(k)fluoranthene	207-08-9	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Benzo(a)pyrene	50-32-8	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	---
Indeno(1,2,3-cd)pyrene	193-39-5	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Dibenz(a,h)anthracene	53-70-3	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
Benzo(g,h,i)perylene	191-24-2	1	µg/L		<1.0	<1.0	<1.0	<1.0	---
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	---
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L		<0.5	<0.5	<0.5	<0.5	---
EP080/071: Total Petroleum Hydrocarbons									
C6 - C9 Fraction	----	20	µg/L		110	130	200	70	---
C10 - C14 Fraction	----	50	µg/L		<50	<50	<50	<50	---

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## Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	BET-PW001_Fe_16.2	BET-PW001_Fe_16.4	BET-PW001_Fe_16.5%	BET-PW001_Fe_16.6%	----
Client sampling date / time					23-Nov-2016 12:00	26-Nov-2016 12:00	28-Nov-2016 12:00	30-Nov-2016 12:00	----
Compound	CAS Number	LOR	Unit		ES1628176-001	ES1628176-002	ES1628176-003	ES1628176-004	-----
					Result	Result	Result	Result	---
EP080/071: Total Petroleum Hydrocarbons - Continued									
C15 - C28 Fraction	----	100	µg/L		490	470	450	610	----
C29 - C36 Fraction	----	50	µg/L		120	<50	70	90	----
^ C10 - C36 Fraction (sum)	----	50	µg/L		610	470	520	700	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions									
C6 - C10 Fraction	C6_C10	20	µg/L		110	130	200	70	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L		100	130	200	70	----
>C10 - C16 Fraction	----	100	µg/L		<100	<100	<100	<100	----
>C16 - C34 Fraction	----	100	µg/L		570	440	470	640	----
>C34 - C40 Fraction	----	100	µg/L		<100	<100	<100	<100	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L		570	440	470	640	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L		<100	<100	<100	<100	----
EP080: BTEXN									
Benzene	71-43-2	1	µg/L		3	2	2	2	----
Toluene	108-88-3	2	µg/L		2	<2	<2	<2	----
Ethylbenzene	100-41-4	2	µg/L		<2	<2	<2	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L		<2	<2	<2	<2	----
ortho-Xylene	95-47-6	2	µg/L		<2	<2	<2	<2	----
^ Total Xylenes	1330-20-7	2	µg/L		<2	<2	<2	<2	----
^ Sum of BTEX	----	1	µg/L		5	2	2	2	----
Naphthalene	91-20-3	5	µg/L		<5	<5	<5	<5	----
EP075(SIM)S: Phenolic Compound Surrogates									
Phenol-d6	13127-88-3	1	%		26.8	19.8	20.2	24.4	----
2-Chlorophenol-D4	93951-73-6	1	%		52.0	35.8	40.9	49.1	----
2,4,6-Tribromophenol	118-79-6	1	%		68.2	54.7	66.5	63.5	----
EP075(SIM)T: PAH Surrogates									
2-Fluorobiphenyl	321-60-8	1	%		68.0	51.1	59.8	64.6	----
Anthracene-d10	1719-06-8	1	%		87.4	74.9	82.2	85.0	----
4-Terphenyl-d14	1718-51-0	1	%		79.0	67.7	76.8	79.2	----
EP080S: TPH(V)/BTEX Surrogates									
1,2-Dichloroethane-D4	17060-07-0	2	%		109	110	114	104	----
Toluene-D8	2037-26-5	2	%		98.8	94.5	102	97.0	----
4-Bromofluorobenzene	460-00-4	2	%		106	105	106	103	----



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### Surrogate Control Limits

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