

AGL UPSTREAM INVESTMENTS PTY LTD GLOUCESTER GAS PROJECT

June 2017 Monitoring Report

Tiedman Irrigation Program EPL 20358

Reporting Period: May 2017

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Foreword

PREMISES Gloucester Coal Seam Gas Project

Bucketts Way

Gloucester NSW 2422

LICENCE DETAILS <u>Environment Protection Licence 20358</u>

LICENCEE AGL Upstream Investments Pty Limited (AGL)

LICENCEE'S ADDRESS Locked Bag 1837, North Sydney, NSW 2060

MONITORING DATE 24, 25 May 2017

MONITORING BY EMM Consulting Pty Ltd (EMM), on behalf of AGL

ANALYSIS BY ALS Laboratory, Smithfield (Work order: ES1712752)

DATE AGL OBTAINED DATA 14 June 2017

REPORT DATE 14 June 2017

REPORT PREPARED BY Carolina Sardella, Senior Hydrogeologist, EMM, on behalf of AGL

GGP EPL 20358 Water Monitoring Report - Tiedman Irrigation Program: June 2017

Introduction

On 4 February 2016 AGL Upstream Investments Pty Ltd (AGL) announced that the GGP will not proceed to final investment stage. AGL will relinquish Petroleum Exploration Licence (PEL) 285 to the NSW Government and are completing a comprehensive decommissioning and rehabilitation program for well sites and other infrastructure in the Gloucester region.

This Monitoring Report relates to the water monitoring activities specified in Part 5, Monitoring and Recording Conditions, of the Environment Protection Licence 20358. This report relates specifically to the monitoring surrounding the Tiedman Irrigation Program, and details monitoring results from a quarterly water sampling event at the Tiedman Irrigation Program (24, 25 May 2017).

As per the Licence, the monitoring encompasses the monitoring points at the locations as shown in Table 1 and Figure 1. The specific analytes and frequency tested are shown in Table 2. The monitoring results for this reporting period are shown in Table 3, Table 4, and Table 5.

The monitoring points that are the subject of this report were part of the GGP groundwater monitoring network, as described in AGL's Water Management Plan for the Tiedman Irrigation Program (AGL, 2012a) and Soil Quality Monitoring and Management Program (AGL, 2012b)). Water monitoring results for the irrigation program are presented in a baseline water monitoring report (PB, 2013a) and six-monthly compliance reports (PB, 2013a, 2013b, 2014a, 2014b, 2015a, and 2015b).

The following sampling methods were used to obtain groundwater samples:

- Submersible 12V pump at the groundwater monitoring bores screened within relatively permeable geological materials: TMB01, TMB02 and TMB03. A minimum of three well volumes was purged prior to sampling.
- Submersible 12V pump at the seepage monitoring bores TMB04 and TMB05 which are screened within material of very low permeability. The physical parameters of the purged groundwater were initially tested, then the bores were purged dry and if any inflow was observed within 12 hours then physical parameters were tested again and a sample taken for analysis.
- Disposable bailer at the shallow perched soil water piezometers (with piezometers purged dry and if any inflow was observed within 12 hours then physical parameters were tested again and a sample taken for analysis). Note, all soil water piezometers were dry during the May 2017 sampling event.
- Micro-purge low-flow sample pump for groundwater monitoring bores S4MB01, TTMB02 and TCMB01 screened within material of relatively low permeability.

EC and pH were monitored during purging to ensure that they had stabilised prior to sample collection. The water quality samples are analysed by an external NATA certified laboratory (ALS Environmental, Smithfield), in accordance with the EPA Approved Methods Publication "Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales" (EPA, 2004), with the exception of calcium, which underwent filtration rather than acid extraction as a preliminary treatment prior to analysis.

This report is prepared in accordance with the *Requirements for Publishing Pollution Monitoring Data* (EPA, 2012) (Publication Requirements).

The remaining water and land monitoring points in EPL 20358 will be reported in subsequent reports when the requirement for monitoring is triggered.

More information on the groundwater monitoring of the GGP is available on the project website: agl.com.au/Gloucester

MAGL

Table 1: Water quality monitoring points: Irrigation Program (as per EPL ■ MAGL 20358)

EPA ID no.	Monitoring Point	Type of monitoring point	Easting (m)	Northing (m)	
30	TMB04	Groundwater quality monitoring	402558.1	6448921.7	
31	TMB05	Groundwater quality monitoring	402650.1	6448725.3	
39	TMB01	Groundwater quality monitoring	401996.98	6449419.7	
40	TMB02	Groundwater quality monitoring	401905.11	6449100.6	
41	TMB03	Groundwater quality monitoring	401969.53	6448755	
42	S4MB01	Groundwater quality monitoring	402581.88	6449409.7	
43	TCMB01	Groundwater quality monitoring	402501.7	6448899	
44	TTMB02	Groundwater quality monitoring	402699	6449358	
45	SP1B	Soil water quality monitoring	402570.3	6449381.3	
46	SP2B	Soil water quality monitoring	402444.2	6449100.1	
47	SP4B	Soil water quality monitoring	402252	6449131.3	
48	SP6B	Soil water quality monitoring	402103.5	6449178.6	
49	SP7B	Soil water quality monitoring	402144.8	6449292.1	
50	SP8B	Soil water quality monitoring	402159.1	6449454.8	
51	SP9B	Soil water quality monitoring	402387.5	6449016.9	
52	SP10B	Soil water quality monitoring	402344.2	6448840.6	
91	Tiedman Dams Irrigation Discharge	Discharge point of blended water	Tiedman South Dam		

Coordinate reference system: Map Grid of Australia 1994

Figure 1: Location of groundwater and surface water quality monitoring points: Irrigation Program (as per EPL 20358)

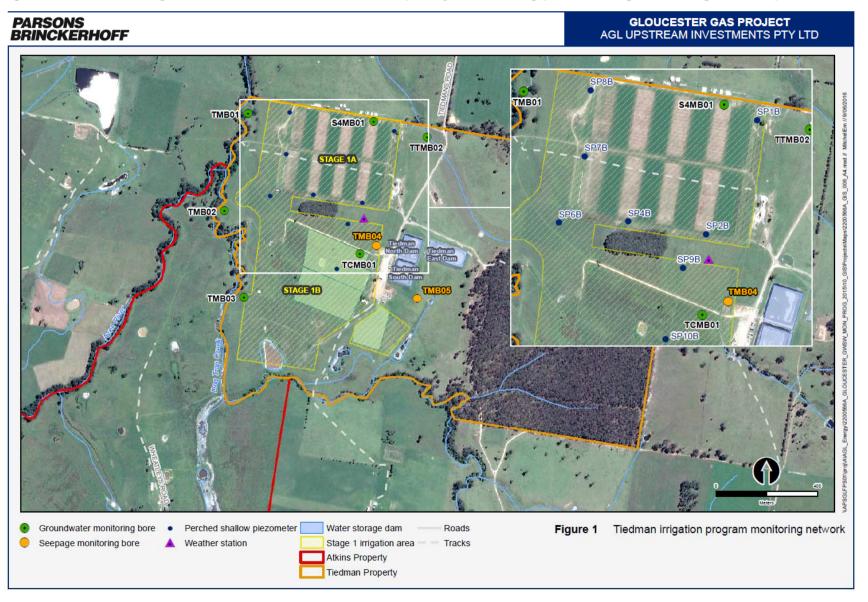




Table 2: Analytes monitored and frequency - monitoring points 30 – 52, as per the EPL 20358 version valid at the time of sampling (version 5 January 2017)

		Monitoring points							
Analyte	Units of measure	30,31		39,40,41,42,43,44		45,46,47,	48,49,50,51, 52		91 ^b
		Frequency	sampling method	Frequency	sampling method	Frequency	sampling method	Frequency	sampling meth
lluminium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
mmonia	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Arsenic	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Barium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Benzene	micrograms per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Beryllium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Bicarbonate	milligrams per litre	Special Frequency 1	Grab sample	Quarterry	Grab sample	quarterly	Grab sample	Monthly	Grab sample
Boron	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Cadmium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Calcium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample		Grab sample
Chloride		· · · · · · · · · · · · · · · · · · ·	Grab sample	Quarterry	Grab sample	Quarterly	Grab sample	Monthly Monthly	Grab sample
	milligrams per litre	Special Frequency 1	Grab Sample	Quartarly	Crob comple	Ougstorly	Crob comple		
Chromium	milligrams per litre	Consist Formula 1	Cook commute	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Cobalt	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Copper	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Dissolved oxygen	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample		
lectrical conductivity	microsiemens per centimetre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Fortnightly	Probe
thyl benzene	micrograms per litre ^a	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
luoride	milligrams per litre							Monthly	Grab sample
ron	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
.ead	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
/lagnesium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Manganese	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Mercury	milligrams per litre			Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Nolybdenum	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Nickel	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
litrate	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
litrite	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
litrogen (total)	milligrams per litre		·					Monthly	Grab sample
Н	pH			Quarterly	Grab sample	Quarterly	Grab sample	Fortnightly	Probe
Phosphorus (total)	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
			· ·	Quartoriy	Grab sample	Qualitoriy	Grab sample	incriting .	Grab sample
Reactive Phosphorus	milligrams per litre	Special Frequency 1	Grab sample						
Redox potential	millivolts	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Fortnightly	Probe
Selenium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
	milligrams per litre			Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
Sodium Adsorption Ratio	milligrams per litre ^c							Monthly	Grab sample ^c
standing water level	meters (Australian Height Datum)	Special frequency 8	Special method 5	Special frequency 8	Special method 5	Quarterly	Special method 1		
trontium (dissolved)	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
ulfate	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
emperature	degrees Celcius							Fornightly	Probe
oluene	micrograms per litre ^a	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
otal alkalinity	milligrams per litre			Quarterly	Grab sample			Monthly	Grab sample
otal dissolved solids	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Fornightly	Probe
otal organic carbon	milligrams per litre	Special Frequency 1	Grab sample					Monthly	Grab sample
otal suspended olids	milligrams per litre							Monthly	Grab sample
Iranium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
/anadium	milligrams per litre	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
(ylene	micrograms per litre ^a	Special Frequency 1	Grab sample	Quarterly	Grab sample	Quarterly	Grab sample	Monthly	Grab sample
			· · · · · · · · · · · · · · · · · · ·	1	· · · · · · · · · · · · · · · · · · ·	,	· · · · · · · · · · · · · · · · · · ·	+ <u> </u>	+

Notes:

Special Frequency 1 - Quarterly if inflow within 12 hours of purging dry.

Special Frequency 8 - Every 6 hours. Note these monitoring points may form part of AGL's rehabilitation work, and should a monitoring point be rehabilitated, than monitoring will no longer be required from that point.

Special Method 1 - Manual dip Special Method 4 - By calculation Special Method 5 - Automated datalogger

Shaded grey - not required to be analysed

^aEPL20358 (issued 5 January 2017) contains inconsistancies in the required Units of Measure for Toluene, Ethyl Benzene and Xylene. For consistency with laboratory data BTEX concentrations are reported here in micrograms per litre.

^bMonitoring Point 91 is only required during periods when the Licensee is utilising the water irrigation or stock use.

^c Unit of measure is incorrectly referenced as 'miligrams per litre' - should be 'ratio'. And sampling method is incorrectly assigned as 'grab sample' in EPL - should be 'Special Method 4 - By calculation'

Groundwater and surface water monitoring results

Table 3: May 2017 water monitoring results for monitoring points 30-44

		Monitoring points	30	31	39	40	41	42	43	44
		Location	TMB04	TMB05	TMB01	TMB02	TMB03	S4MB01	TCMB01	TTMB02
		Sampled date	24/05/2017	24/05/2017	24/05/2017	24/05/2017	24/05/2017	24/05/2017	24/05/2017	24/05/2017
		Date AGL obtained	14/06/2017	14/06/2017	14/06/2017	14/06/2017	14/06/2017	14/06/2017	14/06/2017	14/06/2017
	Units of	data	14/00/2017	14/00/2017	14/00/2017	1470072017	14/00/2017	14/00/2017	14/00/2017	14/00/2017
Analyte	measure	Limit of reporting								
Aluminium	mg/L	0.01	<0.01	0.05	< 0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia	mg/L	0.01	0.16	1.4	0.29	0.30	0.58	1.97	1.2	0.64
Arsenic	mg/L	0.001	0.003	0.002	<0.001	0.01	0.005	<0.001	< 0.001	< 0.001
Barium	mg/L	0.001	0.058	0.09	0.172	0.631	0.164	3.7	7.79	0.629
Benzene	ug/L	1	<1	<1	<1	<1	<1	<1	<1	<1
Beryllium	mg/L	0.001	0.01	0.006	<0.001	0.016	0.006	<0.001	< 0.001	<0.001
Bicarbonate	mg/L	1	127	100						
Boron	mg/L	0.05	<0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.15	<0.05	< 0.05
Cadmium	mg/L	0.0001	0.0005	0.0004	<0.0001	0.0001	<0.0001	<0.0001 284	<0.0001	<0.0001
	mg/L	·		49	189	135	161	284	228	173
Chloride Chromium	mg/L mg/L	0.1	1630	1800	<0.001	0.006	0.003	<0.001	< 0.001	<0.001
Chromium	mg/L mg/L	0.001	0.076	0.203	<0.001	0.006	0.003	<0.001	<0.001	<0.001
	mg/L mg/L	0.001	0.076	0.203	<0.001	< 0.003	< 0.003	<0.001	< 0.002	<0.001
Copper	-	0.001	2.53	1.84	<0.001	<0.001	<0.001 1.87	<0.001 0.56	<0.001	<0.001
Dissolved oxygen ^b Electrical conductivity ^b	mg/L μS/cm	0.01	7334	6531	7681	4022	5474	4459	2974	2458
Ethyl benzene	ug/L	2	<2	<2	<2	4022 <2	<2	<2	<2	<2
Fluoride	mg/L	0.1	<2	<2	<2	<2	<2	<2	< 2	< 2
	mg/L	0.05	1.18	25.6	<0.05	1.6	<0.05	<0.05	0.32	0.32
Iron Lead	mg/L	0.001	< 0.001	<0.001	<0.001	< 0.001	<0.001	<0.001	< 0.001	< 0.001
Magnesium	mg/L	1	217	232	188	82	113	48	64	49
Manganese	mg/L	0.001	9.18	17.1	0.730	1.06	1.3	0.108	0.178	0.11
Mercury	mg/L	0.0001	9.16	17.1	<0.0001	<0.0001	<0.0001	< 0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.0001	< 0.001	<0.001	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	mg/L	0.001	0.033	0.102	< 0.002	<0.001	<0.001	0.001	0.003	<0.001
Nitrate	mg/L	0.01	0.09	0.22	0.06	0.06	0.08	0.04	0.003	0.02
Nitrite	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	< 0.01
Nitrogen (total)	mg/L	0.1	C0.01	Ç0.01	(0.01	(0.01	C0.01	(0.01	(0.01	V0:01
pH ^b	pH	0.01			6.57	6.48	6.53	7.14	6.92	6.70
Phosphorus (total)	mg/L	0.01	0.08	0.09	0.06	0.05	0.06	0.05	0.01	0.32
Potassium	mg/L	1	18	15	2	3	2	5	4	4
Reactive Phosphorus	mg/L	0.01	< 0.01	< 0.01						
Redox potential ^b	mV	0.1	-8.4	-84.1	-120.8	-56.3	-147.3	-199.9	-137.2	-108.7
Selenium	mg/L	0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Silica	mg/L	0.05			34.70	33.80	31.20	25.70	20.40	33.60
Sodium	mg/L	1	1050	964	1090	528	835	618	277	256
Sodium Adsorption Ratio	ratio	0.01								
Standing water level	m AHD	-	Refer to Table 5	Refer to Table 5	Refer to Table 5	Refer to Table				
Strontium (dissolved)	mg/L	0.001	0.746	0.663	5.08	2.77	3.52	20.5	12.6	2.74
Sulfate	mg/L	1	558	142	70	44	201	10	<1	64
Temperature ^b	*C	0.1								
Toluene	ug/L	2	<2	7	<2	<2	19	<2	<2	<2
Total alkalinity	mg/L	1			510	191	523	396	272	372
Total dissolved solids	mg/L	10	4690	4720	4640	2170	3060	2680	1910	1510
Total organic carbon	mg/L	1	6	7						
Total suspended solids	mg/L	5								
Uranium	mg/L	0.001	< 0.001	<0.001	0.003	< 0.001	0.01	< 0.001	< 0.001	< 0.001
Vanadium	mg/L	0.01	<0.01	<0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	цg/L	2	<2	<2	<2	<2	<2	<2	<2	<2
Zinc	mg/L	0.005	0.1	0.495	< 0.005	< 0.005	< 0.005	<0.005	0.012	0.006
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Kev:

Shaded grey = not required to be analysed na - not analysed as no sample collected

^bmeasured with calibrated field meter

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Groundwater and surface water monitoring results

Table 4: May 2017 water monitoring results for monitoring points 45-52

		Monitoring points	45	46	47	48	49	50	51	52
		Location	SP1B ^b	SP2B ^b	SP4B ^b	SP6B ^b	SP7B ^b	SP8B ^b	SP9B ^b	SP10B ^b
		Sampled date	25/05/2017	25/05/2017	25/05/2017	25/05/2017	25/05/2017	25/05/2017	25/05/2017	25/05/2017
		Date AGL	na							
	Units of	obtained data Limit of	na	nu	nu	Hu	nu	i la	Hu	Ha
Analyte	measure	reporting								
Aluminium	mg/L	0.01	na							
Ammonia	mg/L	0.01	na							
Arsenic	mg/L	0.001	na							
Barium	mg/L	0.001	na							
Benzene	чg/L	1	na							
Beryllium	mg/L	0.001	na							
Bicarbonate	mg/L	1								
Boron	mg/L	0.05	na							
Cadmium	mg/L	0.0001	na							
Calcium	mg/L	1	na							
Chloride	mg/L	0.1								
Chromium	mg/L	0.001	na							
Cobalt	mg/L	0.001	na							
Copper	mg/L	0.001	na							
Dissolved oxygen ^a	mg/L	0.01	na							
Electrical conductivity ^a	μS/cm	1	na							
Ethyl benzene	цg/L	2	na							
Fluoride	mg/L	0.1								
Iron	mg/L	0.05	na							
Lead	mg/L	0.001	na							
Magnesium	mg/L	1	na							
Manganese	mg/L	0.001	na							
Mercury	mg/L	0.0001	na							
Molybdenum	mg/L	0.001	na							
Nickel	mg/L	0.001	na							
Nitrate	mg/L	0.01	na							
Nitrite	mg/L	0.01	na							
Nitrogen (total)	mg/L	0.1								
pH ^a	pН	0.01	na							
Phosphorus (total)	mg/L	0.01	na							
Potassium	mg/L	1	na							
Reactive Phosphorus	mg/L	0.01								
Redox potential ^a	mV	0.1	na							
Selenium	mg/L	0.01	na							
Silica	mg/L	0.05	na							
Sodium	mg/L	1	na							
Sodium Adsorption Ratio	ratio	0.01								
Standing water level	m AHD	-	na							
Strontium (dissolved)	mg/L	0.001	na							
Sulfate	mg/L	1	na							
Temperature ^a	°C	0.1								
Toluene	yg/L	2	na							
Total alkalinity	mg/L	1								
Total dissolved solids	mg/L	10	na							
Total organic carbon	mg/L	1								
Total suspended solids	mg/L	5								
Uranium	mg/L	0.001	na							
Vanadium	mg/L	0.01	na							
Xylene	ug/L	2	na							
Zinc	mg/L	0.005	na							
~	mg/L	0.000	i id	110	ila	ıш	ila	iia	110	1 i a

Shaded grey = not required to be analysed

na - not analysed as no sample collected



^a measured with calibrated field meter

^b No water present at this location at the time of sampling



Monitoring point	30	31	39	40	41	42	43	44		
Location	TMB04	TMB05	TMB01	TMB02	TMB03	S4MB01	TCMB01	TTMB02		
Data type				Standing v	vater level					
Units				mA	HD					
Data date range		2017 – 5/2017		2017 – 5/2017	6/02/2017 - 24/05/2017		017 – 24/0	5/2017		
Date data downloaded		24/05/2017								
Date data supplied to AGL		14/6/2017								
Monitoring frequency required by EPL 20358	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours						
Actual monitoring frequency	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours						
No. of times measured during monitoring period	427	427	425	425	428	425	425	425		
Min. value	111.88	110.54	102.39	102.55	103.59	113.14	113.80	114.04		
Mean value	113.44	113.22	102.89	102.92	103.85	113.31	113.90	114.13		
Median value	113.45	113.30	102.92	103.02	103.93	113.31	113.91	114.14		
Max. value	113.56	113.38	104.06	103.28	104.21	113.40	113.94	114.20		



References

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