



AGL UPSTREAM INVESTMENTS PTY LTD

GLOUCESTER GAS PROJECT

**June 2016 Monitoring Report:
Tiedman Irrigation Program
EPL 20358**

Reporting Period: May 2016

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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 2016
MONITORING BY	Parsons Brinckerhoff, on behalf of AGL
ANALYSIS BY	ALS Laboratory, Smithfield (Work orders: ES1611202 and ES1611290)
DATE AGL OBTAINED DATA	02 June 2016
REPORT DATE	10 June 2016
REPORT PREPARED BY	James Duggleby, Senior Hydrogeologist



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 will commence a comprehensive decommissioning and rehabilitation program for well sites and other infrastructure in the Gloucester region.

A dedicated water monitoring network is in place which has enabled the collection of baseline water level and water quality data for the different groundwater and surface water systems within the Gloucester Basin. There are currently more than 50 dedicated water monitoring locations and more than five years of baseline monitoring (water levels and water quality) across the Gloucester Basin.

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 quarterly water sampling event at the Tiedman Irrigation Program (24 - 25 May 2016).

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 are 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 surface water and 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).
- Micro-purge low-flow sample pump for groundwater monitoring bores S4MB01, TTMB02 and TCMB01 screened within material of relatively low permeability.
- Grab sample using a telescopic sampler for dam water samples.

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

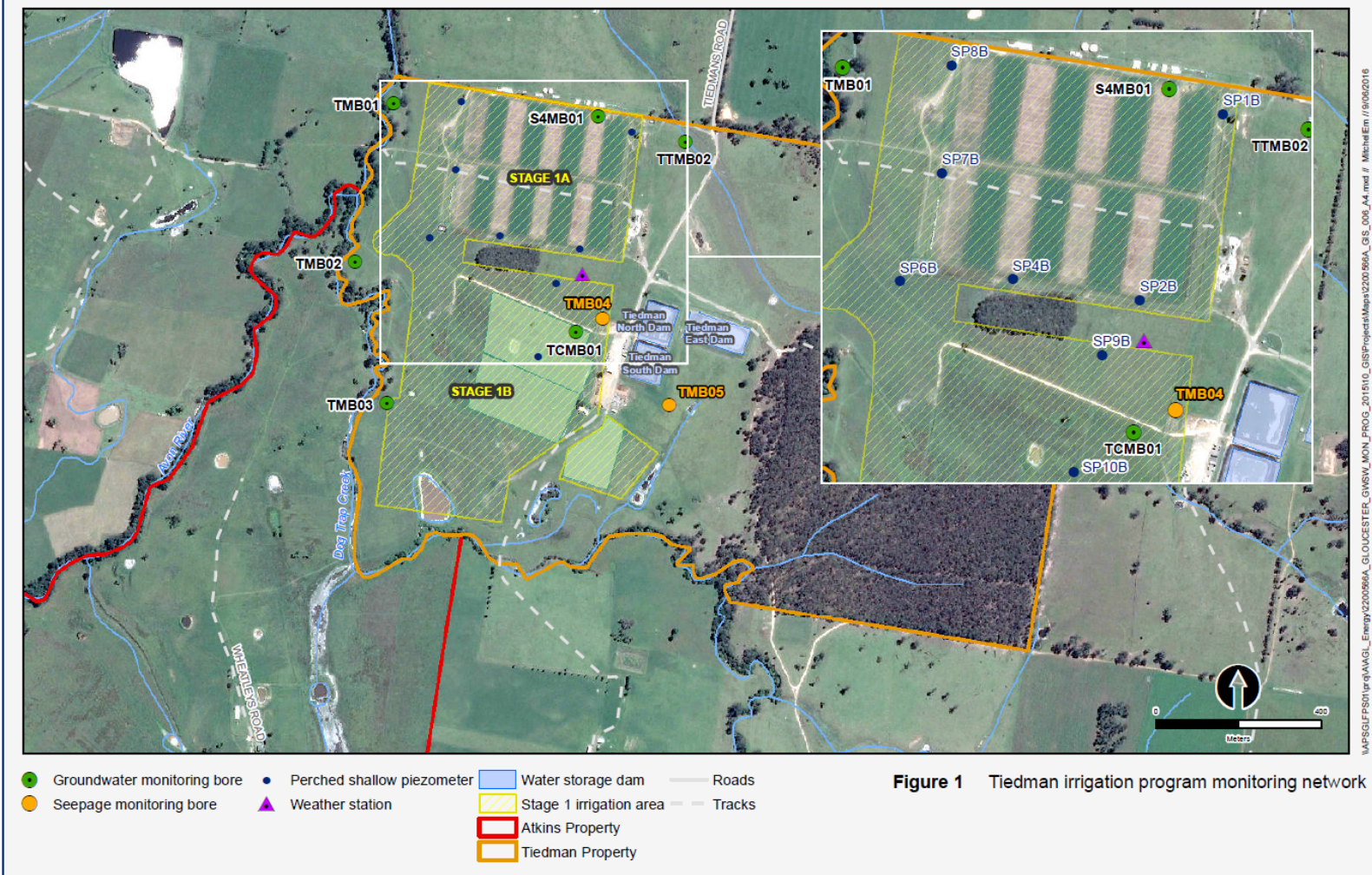
Table 1: Water quality monitoring points: Irrigation Program (as per EPL 20358)



EPA ID no.	Monitoring Point	Type of monitoring point	Easting (m)	Northing (m)
27	TND	Produced water storage dam	Tiedman property	
28	TSD	Produced water storage dam	Tiedman property	
29	TED	Produced water storage dam	Tiedman property	
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

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)



Groundwater and surface water monitoring results

Table 3: Water monitoring results for May 2016 quarterly water sampling round

		Monitoring points	27	28	29	30	31	39	40	41	42	43	44
		Location	TND	TSD	TED	TMB04	TMB05	TMB01	TMB02	TMB03	S4MB01	TCMB01	TTMB02
		Sampled date	24/05/2016	24/05/2016	24/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016
		Date ACL obtained data	2/06/2016	2/06/2016	2/06/2016	2/06/2016	2/06/2016	2/06/2016	2/06/2016	2/06/2016	2/06/2016	2/06/2016	2/06/2016
Analyte	Units of measure	Limit of reporting											
Aluminium	mg/L	0.01	0.02	0.02	0.02	0.01	1.21	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ammonia	mg/L	0.01	<0.01	2.55	0.02	0.15	0.6	0.15	0.3	0.17	1.69	1.2	0.56
Arsenic	mg/L	0.001	0.002	0.005	0.001	<0.001	<0.001	0.001	0.003	0.004	<0.001	<0.001	<0.001
Barium	mg/L	0.001	0.108	0.185	0.130	0.179	0.078	0.195	0.792	0.188	4.040	8.020	0.639
Benzene	ug/L	1				<1	<1	<1	<1	<1	<1	<1	<1
Beryllium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.007	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bicarbonate	mg/L	1	80	197	184	169	35						
Boron	mg/L	0.05	0.08	0.07	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	0.15	<0.05	<0.05
Cadmium	mg/L	0.0001	0.0001	<0.0001	<0.0001	0.0002	0.0026	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L	1	19	23	13	90	42	218	151	259	336	256	179
Chloride	mg/L	0.1	83.8	55.9	135	2000	2070						
Chromium	mg/L	0.001						<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	<0.001	<0.001	<0.001	0.058	0.273	<0.001	0.002	0.002	<0.001	<0.001	<0.001
Copper	mg/L	0.001	<0.001	0.001	0.002	0.002	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved oxygen ^a	mg/L	0.01	6.50	7.83	7.26	4.97	2.75	2.08	1.5	4.28	0.55	7.69	0.51
Electrical conductivity	µS/cm	1	768	629	884	7080	6990	7740	3870	5940	4720	2990	2410
Ethyl benzene	ug/L	2				<2	<2	<2	<2	<2	<2	<2	<2
Iron	mg/L	0.05	<0.05	<0.05	<0.05	9.22	7.13	2.56	6.10	3.83	0.42	1.90	2.38
Lead	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L	1	9	4	4	202	221	198	87	138	52	67	50
Manganese	mg/L	0.001	0.002	<0.001	0.026	8.440	14.700	0.783	1.030	1.430	0.134	0.037	0.091
Mercury	mg/L	0.0001						<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	0.002	0.005	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.001	<0.001	0.002	<0.001	0.028	0.139	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate	mg/L	0.01	<0.01	0.12	0.02	0.05	0.38	0.02	0.02	0.03	0.02	0.03	0.03
Nitrite	mg/L	0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
pH ^a	pH	0.01	8.79	9.18	8.36	7.02	5.42	6.37	6.25	6.33	7.1	6.8	6.44
Phosphorus (total)	mg/L	0.01	0.18	0.46	0.47	0.12	0.04	0.32	0.06	0.05	0.05	<0.01	0.24
Potassium	mg/L	1	41	36	39	18	15	2	3	3	6	4	4
Reactive Phosphorus	mg/L	0.01	<0.01	0.38	<0.01	<0.01	<0.01						
Redox potential ^a	mV	0.1	-17.4	-11.5	-27.1	43.5	-14.6	-69.8	-46.0	-26.0	-197.4	-157.2	-121.5
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silica	mg/L	0.05						38.90	37.00	35.50	28.10	23.10	37.00
Sodium	mg/L	1	100	75	155	990	942	1050	442	724	624	266	243
Sodium Adsorption Ratio	ratio	0.01		3.79									
Standing water level	m AHD	-				Refer to Table 5	Refer to Table 5	Refer to Table 5	Refer to Table 5	Refer to Table 5	Refer to Table 5	Refer to Table 5	Refer to Table 5
Strontium (dissolved)	mg/L	0.001	0.266	0.291	0.185	0.968	0.609	5.160	3.240	5.660	22.000	13.700	2.920
Sulfate	mg/L	1	119	29	7	658	215	80	29	201	36	<1	66
Toluene	ug/L	2				<2	<2	<2	<2	<2	<2	<2	<2
Total alkalinity	mg/L	1						531	175	491	434	290	370
Total dissolved solids	mg/L	10	428	442	500	4280	3970	4590	2300	3480	2380	1910	1520
Total organic carbon	mg/L	1	21	15	55	5	6						
Total suspended solids	mg/L	5											
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	0.002	<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	<0.01	<0.01	<0.01
Xylene	ug/L	2				<2	<2	<2	<2	<2	<2	<2	<2
Zinc	mg/L	0.005				0.131	1.02	0.011	0.009	0.013	<0.005	0.011	0.018

Key:

Shaded grey = not required to be analysed

^a measured with calibrated field meter



Groundwater and surface water monitoring results

Table 4: May 2016 water monitoring results for monitoring points 45 – 52

Analyte	Units of measure	Monitoring points	45	46	47	48	49	50	51	52
		Location	SP1B ^a	SP2B ^a	SP4B ^a	SP6B ^a	SP7B ^a	SP8B ^a	SP9B ^a	SP10B ^a
Sampled date		25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016
Date AGL obtained data		na	na	na	na	na	na	na	na	na
Limit of reporting										
Aluminium	mg/L	0.01	na	na	na	na	na	na	na	na
Ammonia	mg/L	0.01	na	na	na	na	na	na	na	na
Arsenic	mg/L	0.001	na	na	na	na	na	na	na	na
Barium	mg/L	0.001	na	na	na	na	na	na	na	na
Benzene	µg/L	1	na	na	na	na	na	na	na	na
Beryllium	mg/L	0.001	na	na	na	na	na	na	na	na
Bicarbonate	mg/L	1								
Boron	mg/L	0.05	na	na	na	na	na	na	na	na
Cadmium	mg/L	0.0001	na	na	na	na	na	na	na	na
Calcium	mg/L	1	na	na	na	na	na	na	na	na
Chloride	mg/L	0.1								
Chromium	mg/L	0.001	na	na	na	na	na	na	na	na
Cobalt	mg/L	0.001	na	na	na	na	na	na	na	na
Copper	mg/L	0.001	na	na	na	na	na	na	na	na
Dissolved oxygen ^a	mg/L	0.01	na	na	na	na	na	na	na	na
Electrical conductivity	µS/cm	1	na	na	na	na	na	na	na	na
Ethyl benzene	µg/L	2	na	na	na	na	na	na	na	na
Iron	mg/L	0.05	na	na	na	na	na	na	na	na
Lead	mg/L	0.001	na	na	na	na	na	na	na	na
Magnesium	mg/L	1	na	na	na	na	na	na	na	na
Manganese	mg/L	0.001	na	na	na	na	na	na	na	na
Mercury	mg/L	0.0001	na	na	na	na	na	na	na	na
Molybdenum	mg/L	0.001	na	na	na	na	na	na	na	na
Nickel	mg/L	0.001	na	na	na	na	na	na	na	na
Nitrate	mg/L	0.01	na	na	na	na	na	na	na	na
Nitrite	mg/L	0.01	na	na	na	na	na	na	na	na
pH ^a	pH	0.01	na	na	na	na	na	na	na	na
Phosphorus (total)	mg/L	0.01	na	na	na	na	na	na	na	na
Potassium	mg/L	1	na	na	na	na	na	na	na	na
Reactive Phosphorus	mg/L	0.01								
Redox potential ^a	mV	0.1	na	na	na	na	na	na	na	na
Selenium	mg/L	0.01	na	na	na	na	na	na	na	na
Silica	mg/L	0.05	na	na	na	na	na	na	na	na
Sodium	mg/L	1	na	na	na	na	na	na	na	na
Sodium Adsorption Ratio	ratio	0.01								
Standing water level	m AHD	-	na	na	na	na	na	na	na	na
Strontium (dissolved)	mg/L	0.001	na	na	na	na	na	na	na	na
Sulfate	mg/L	1	na	na	na	na	na	na	na	na
Toluene	µg/L	2	na	na	na	na	na	na	na	na
Total alkalinity	mg/L	1								
Total dissolved solids	mg/L	10	na	na	na	na	na	na	na	na
Total organic carbon	mg/L	1								
Total suspended solids	mg/L	5								
Uranium	mg/L	0.001	na	na	na	na	na	na	na	na
Vanadium	mg/L	0.01	na	na	na	na	na	na	na	na
Xylene	µg/L	2	na	na	na	na	na	na	na	na
Zinc	mg/L	0.005	na	na	na	na	na	na	na	na

Shaded grey = not required to be analysed

^a measured with calibrated field meter

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

na - not analysed as no sample collected





Table 5: Continuous electrical conductivity monitoring results for monitoring points 30, 31, 33, 34, 39 - 44 for the period 6 January 2016 – 24 February 2016

Monitoring point	30	31	39	40	41	42	43	44
Location	TMB04	TMB05	TMB01	TMB02	TMB03	S4MB01	TCMB01	TTMB02
Data type	Standing water level							
Units	mAHD							
Data date range	23/02/2016 – 24/05/2016		24/2/2016 - 25/5/2016			24/2/2016 - 25/05/2016		
Date data downloaded	24/05/2016	24/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016	25/05/2016
Date data supplied to AGL	9/06/2016	9/06/2016	9/06/2016	9/06/2016	9/06/2016	9/06/2016	9/06/2016	9/06/2016
Monitoring frequency required by EPL 20358	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours	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	Every 6 hours	Every 6 hours	Every 6 hours	Every 6 hours
No. of times measured during monitoring period	366	368	367	367	368	367	368	368
Min. value	112.22	110.52	102.66	102.69	103.61	113.04	113.75	113.93
Mean value	113.29	113.25	102.84	102.87	103.76	113.09	113.78	113.97
Median value	113.29	113.24	102.83	102.84	103.75	113.09	113.78	113.97
Max. value	113.35	113.39	103.08	103.10	103.93	113.16	113.81	114.03

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