

December 2017 Soil Monitoring Report

Gloucester Gas Project Tiedman
Irrigation Program EPL 20358

Reporting Period: November 2017





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Forward

PREMISES	Gloucester Coal Seam Gas Project Bucketts Way Gloucester NSW 2422
LICENCE DETAILS	Environment Protection Licence 20358
LICENCEE	AGL Upstream Investments Pty Limited (AGL)
LICENCEE'S ADDRESS	Locked Bag 1837, St Leonards, NSW 2065
MONITORING DATE	7 November 2017
MONITORING BY	EMM Consulting Pty Ltd (EMM), on behalf of AGL
ANALYSIS BY	East West Enviroag, Tamworth (Work order: EW173456)
DATE AGL OBTAINED DATA	12 December 2017
REPORT DATE	12 December 2017 Revision B (Addendum): 7 September 2018
REPORT PREPARED BY	James Duggleby, Principal Hydrogeologist, EMM, on behalf of AGL



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 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 soil sampling event at the Stage 1B area of the Tiedman Irrigation Program (7 November 2017). The soil sampling event is in compliance with Conditions M2.2 and M2.6 of EPL 20358 which requires soil sampling of the Stage 1B area at the conclusion of the irrigation program. The irrigation program was completed in October 2017.

As per EPL 20358, 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.

The monitoring points that are the subject of this report were part of the GGP soil monitoring network, as described in AGL's Soil Quality Monitoring and Management Program (FK, 2012). Soil monitoring results for the irrigation program are presented in a baseline water monitoring report (FK, 2013a) and six-monthly compliance reports (FK, 2013b, 2014a and 2014b; and Jacobs, 2015a, and 2015b) up to May 2015.

Samples were taken manually using a hand auger at 20 cm intervals until 120 cm depth, or until first refusal on rock.

The soil samples were analysed by East West Enviroag Pty Ltd, Tamworth, NSW, a National Association of Testing Authorities (NATA) and the Australasian Soil and Plant Analysis Council (ASPAC) accredited laboratory.

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

EPA ID no.	Monitoring Point	Type of monitoring point	Easting (m)	Northing (m)
100	CS17	Soil quality monitoring	402226.4	6448943.4
101	CS18	Soil quality monitoring	402202.8	6448877.5
102	CS19	Soil quality monitoring	402317.4	6448868.3
103	CS21	Soil quality monitoring	402390.9	6448791.5
104	CS22	Soil quality monitoring	402176.6	6448732.1
105	CS23	Soil quality monitoring	402190.3	6448810.1
106	CS24	Soil quality monitoring	402297.1	6448738.4
107	CS25	Soil quality monitoring	402379.8	6448753
108	CS26	Soil quality monitoring	402341.7	6448689.7
109	CS27	Soil quality monitoring	402510.5	6448662
110	CS28	Soil quality monitoring	402443.7	6448603.1
111	CS29	Soil quality monitoring	402481.8	6448564.1
113	CS20	Soil quality monitoring	402413.1	6448904.5

Coordinate reference system: Map Grid of Australia 1994

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



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



Analyte	Units of measure	Monitoring points	
		100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 113	
		Frequency	Sampling method
Aluminium	milligrams per kilogram	Special Frequency 5	Grab sample
Available phosphorus	milligrams per kilogram	Special Frequency 5	Grab sample
Boron	milligrams per kilogram	Special Frequency 5	Grab sample
Calcium	milligrams per kilogram	Special Frequency 5	Grab sample
Chloride	milligrams per kilogram	Special Frequency 5	Grab sample
Electrical conductivity	microsiemens per centimetre	Special Frequency 5	Grab sample
Exchangeable sodium percentage	percent	Special Frequency 5	Grab sample
Iron	milligrams per kilogram	Special Frequency 5	Grab sample
Magnesium	milligrams per kilogram	Special Frequency 5	Grab sample
Manganese	milligrams per kilogram	Special Frequency 5	Grab sample
Nitrogen (nitrate)	milligrams per kilogram	Special Frequency 5	Grab sample
Organic carbon	milligrams per kilogram	Special Frequency 5	Grab sample
pH	pH	Special Frequency 5	Grab sample
Phosphorus	milligrams per kilogram	Special Frequency 5	Grab sample
Potassium	milligrams per kilogram	Special Frequency 5	Grab sample
Sodium	milligrams per kilogram	Special Frequency 5	Grab sample
Sulfate	milligrams per kilogram	Special Frequency 5	Grab sample
Zinc	milligrams per kilogram	Special Frequency 5	Grab sample

Notes:

Special Frequency 5 = At the conclusion of the irrigation program samples will be collected at 20 cm intervals until 120 cm, or until refusal on rock.

Table 2: Analytes monitored and frequency - soil monitoring points 100 - 111 and 113, as per EPL 20358 (version 5 January 2017)

Soil Monitoring Results

Table 3: November 2017 soil monitoring results for monitoring points 100-111 and 113 (soil monitoring points)

Monitoring point	100												101												102												103											
	CS17												CS18												CS19												CS21											
	7/11/2017												7/11/2017												7/11/2017												7/11/2017											
	12/12/2017												12/12/2017												12/12/2017												12/12/2017											
Location	100												101												102												103											
Depth increment (cm bgl)	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120																								
Sample date	7/11/2017												7/11/2017												7/11/2017												7/11/2017											
Date AGL obtained data	12/12/2017												12/12/2017												12/12/2017												12/12/2017											
Unit of measure	Lowest obtainable reading												Lowest obtainable reading												Lowest obtainable reading												Lowest obtainable reading											
Aluminium	mg/kg	1	10.8	9.22	193	203	167	89.4	10.1	17.5	<1	<1	<1	5.94	34.4	28.2	19.1	17.9	15.9	<1	171	229	235	196	174																							
Available phosphorus	mg/kg	40	206	65.9	40.2	<40	<40	<40	167	42.2	48.9	<40	41.4	<40	185	63.8	58.5	<40	<40	<40	284	<40	<40	<40	<40																							
Boron	mg/kg	0.2	0.32	0.23	0.28	<0.20	<0.20	<0.20	0.32	<0.20	<0.20	<0.20	<0.20	0.44	0.23	<0.20	<0.20	<0.20	<0.20	0.42	0.36	0.37	0.37	0.31																								
Calcium	mg/kg	20	334	209	206	97.7	55.9	82.5	319	248	176	169	205	262	368	242	186	116	102	91.6	1356	484	358	216	196	139																						
Chloride	mg/kg	2	10.0	246	57.3	129	174	148	46.5	97.0	223	645	1040	1210	41.2	85.5	135	167	144	119	28.1	42.4	50.1	88.0	143	197																						
Electrical conductivity	µS/cm	10	40	30	140	210	220	190	80	120	280	600	890	730	97	160	220	260	230	190	80	90	110	140	160	180																						
Exchangeable sodium percentage	%	na	17.4	25.5	18.4	21.6	24.0	25.6	10.9	14.7	23.0	32.6	35.6	34.0	15.5	16.3	20.1	21.8	20.2	13.4	7.96	13.4	14.3	15.2	16.7	17.6																						
Iron	mg/kg	0.5	507	209	26.4	23.6	19.3	36.3	479	99.2	25.7	20.5	19.1	15.0	373	48.9	33.3	30.5	26.3	25.0	366	75.5	60.3	67.9	108	116																						
Magnesium	mg/kg	10	112	85.5	1275	1159	1103	786	466	1060	1245	1279	1452	2123	377	1177	1010	992	1383	1300	481	666	899	1119	1145	1047																						
Manganese	mg/kg	0.5	5.99	2.02	<0.5	<0.5	<0.5	<0.5	37.9	1.49	2.50	1.32	0.61	<0.5	26.4	2.34	1.10	0.88	0.59	0.52	24.2	4.96	0.83	<0.5	0.98	0.72																						
Nitrogen (nitrate)	mg/kg	0.5	2.10	2.24	1.21	1.45	0.88	0.84	2.34	0.98	0.67	1.68	1.02	1.82	3.04	0.74	1.31	2.01	1.07	0.60	2.56	<0.5	0.67	4.32	0.69	<0.5																						
Organic carbon	%	0.05	0.37	0.32	0.42	0.15	0.10	1.04	0.36	0.22	0.17	0.16	0.06	<0.05	0.37	0.26	0.20	0.14	0.14	0.07	1.67	0.51	0.36	0.42	0.25	0.15																						
pH	pH units	na	4.57	4.54	4.22	4.15	4.23	4.16	4.77	4.67	5.56	6.05	7.60	7.00	4.64	7.93	4.51	4.45	4.44	4.43	5.39	4.05	3.96	3.96	3.98	3.94																						
Phosphorus	mg/kg	1	45.4	15.5	2.13	4.55	1.27	2.78	25.1	8.39	39.3	3.44	1.70	3.22	28.3	4.55	5.44	9.08	2.78	5.21	49.3	4.55	2.35	<1	10.7	<1																						
Potassium	mg/kg	10	79.8	32.2	93.6	88.0	86.9	115	210	94.8	107	124	155	194	245	170	208	245	112	120	375	210	195	208	233	212																						
Sodium	mg/kg	10	141	153	729	800	856	654	173	417	793	1325	1722	2321	240	532	588	621	728	686	234	370	473	558	613	586																						
Sulfate	mg/kg	3	7.44	9.01	18.2	21.5	13.4	9.60	10.4	7.17	10.5	16.1	23.8	21.8	14.3	16.2	34.3	44.8	36.4	29.5	10.3	17.0	18.0	17.9	15.7	14.9																						
Zinc	mg/kg	0.2	0.65	0.26	<0.2	<0.2	<0.2	<0.2	1.18	<0.2	<0.2	<0.2	<0.2	<0.2	0.91	<0.2	<0.2	0.29	0.56	0.69	3.99	0.38	5.62	0.25	0.51	0.82																						

Monitoring point	104												105												106												107											
	CS22												CS23												CS24												CS25											
	7/11/2017												7/11/2017												7/11/2017												7/11/2017											
	12/12/2017												12/12/2017												12/12/2017												12/12/2017											
Location	104												105												106												107											
Depth increment (cm bgl)	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120																								
Sample date	7/11/2017												7/11/2017												7/11/2017												7/11/2017											
Date AGL obtained data	12/12/2017												12/12/2017												12/12/2017												12/12/2017											
Unit of measure	Lowest obtainable reading												Lowest obtainable reading												Lowest obtainable reading												Lowest obtainable reading											
Aluminium	mg/kg	1	21.4	48.7	138	97.7	35.2	7.08	1.44	19.3	54.2	92.2	70.4	41.3	4.06	26.0	4.87	<1	<1	<1	1.03	56.4	176	71.0	71.4	58.5																						
Available phosphorus	mg/kg	40	393	121	77.6	50.2	<40	40.5	511	149	154	80.7	61.5	69.0	287	103	52.1	47.2	<40	<40	303	137	64.5	52.0	<40	40.3																						
Boron	mg/kg	0.2	0.56	0.34	0.27	<0.20	<0.20	<0.20	0.54	0.36	0.34	0.23	<0.20	<0.20	0.41	0.39	0.27	<0.20	<0.20	<0.20	0.48	0.36	<0.20	0.20	<0.20	<0.20																						
Calcium	mg/kg	20	849	566	453	424	376	357	1175	2862	1150	677	501	572	463	357	274	139	102	113	1030	456	343	167	60.3	110																						
Chloride ^b	mg/kg	2	65.5	59.5	77.5	146	253	387	70	28.8	39.2	71.5	118	248	36.3	66.5	175	317	610	710	19.6	26.1	74.0	115	146	210																						
Electrical conductivity	µS/cm	10	110	80	100	150	230	300	110	60	70	90	180	310	100	150	260	410	690	780	100	90	160	210	190	250																						
Exchangeable sodium percentage	%	na	10.2	11.3	10.4	14.9	19.2	22.3	8.16	6.62	9.17	8.32	12.4	17.4	11.9	13.3	15.8	19.7	25.9	26.0	7.96	13.9	15.0	15.1	15.3	16.4																						
Iron	mg/kg	0.5	552	328	117	127	61.6	32.6	64.0	107	129	105	77.6	42.4	473	115	43.5	19.5	9.80	10.2	543	214	92.5	90.7	50.7	68.8																						
Magnesium	mg/kg	10	584	544	1125	1250	1135	1041	726	2485	1118	747	595	667	374	1170	1542	1533	1499	1802	388	507	1045	1372	621	982																						
Manganese	mg/kg	0.5	19.5	33.5	3.35	1.15	0.72	0.66	35.4	13.2	5.23	2.12	1.00	0.80	27.1	3.48	0.94	2.13	0.71	0.77	21.3	14.0	3.10	1.86	0.51	1.53																						
Nitrogen (nitrate)	mg/kg	0.5	4.24	<0.5	<0.5	<0.5	0.63	<0.5	5.93	<0.5	0.69	0.69	<0.5	0.56	<0.5	0.56	<0.5	1.18	<0.5	2.74	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5																						
Organic carbon ^a	%	0.05	1.53	0.74	0.65	0.36	0.20	0.11	1.97	0.85	0.73	0.39	0.22	0.22	1.13	0.49	0.34	0.20	0.12	0.13	1.96	0.85	0.37	0.32	0.15	0.13																						
pH	pH units	na	4.43	4.28	4.13	4.25	4.37	4.71	4.84	4.57	4.34	4.21	4.14	4.20	4.85	4.74	4.84	5.48	5.92	6.26	5.13	4.41	4.24	4.26	4.25	4.26																						
Phosphorus	mg/kg	1	76.2	16.5	6.56	7.20	8.49	6.78	10.8	9.10	8.23	7.88	8.75	7.20	36.6	13.5	10.7	7.54	8.75	25.5	39.4	15.2	9.45	6.69	5.86	6.03																						
Potassium	mg/kg	10	163	119	377	142	151	123	229	367	187	95.5	59.2	69.3	54.7	50.5	53.9	52.5	67.6	93.5	218	125	128	170	78.6	105																						
Sodium	mg/kg	10	256	241	363	562	663	716	256	590	375	227	273	440	174	423	620	768	1058	1278	176	277	516	550	338	436																						
Sulfate	mg/kg	3	13.6	15.4	11.7	14.9	16.1	19.1	12.9	8.62	8.84	10.3	13.7	19.7	9.03	9.66	14.3	26.1	45.4	56.4	15.5	11.3	20.4	15.8	13.7	15.8																						
Zinc	mg/kg	0.2	3.25	1.29	<0.2	<0.2	<0.2	<0.2	5.03	0.46	0.29	0.49	0.29	0.39	1.11	0.19	<0.2	<0.2	<0.2	<0.2	2.35	0.70	0.23	0.29	0.35	0.53																						

Monitoring point	108												109												110												111												113											
	CS26												CS27												CS28												CS29												CS20											
	7/11/2017												7/11/2017												7/11/2017												7/11/2017												7/11/2017											
	12/12/2017												12/12/2017												12/12/2017												12/12/2017												12/12/2017											
Location	108												109												110												111												113											
Depth increment (cm bgl)	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120	0-20	20-40	40-60	60-80	80-100	100-120																														
Sample date	7/11/2017												7/11/2017												7/11/2017												7/11/2017												7/11/2017											
Date AGL obtained data	12/12/2017												12/12/2017												12/12/2017												12/12/2017												12/12/2017											
Unit of measure	Lowest obtainable reading												Lowest obtainable reading												Lowest obtainable reading												Lowest obtainable reading												Lowest obtainable reading											
Aluminium	mg/kg	1	103	196	147	72.4	40.5	24.2	<1	94.6	163	84.7	22.5	20	<1	<1	36.0	125	100	81.9	104	287	166	69.2	47.0	<1	156	183	116	59.2	61.2																													
Available phosphorus	mg/kg	40	188	66.9	51.5	45.1	83.6	333	63.8	61.7	<40	<40	18.7	2828	898	326	130	90.3	43.2	175	46.6	<40	84.3	75.0	234	50.7	<40	<40	&																															



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