AGL UPSTREAM INVESTMENTS PTY LTD

GLOUCESTER GAS PROJECT

5 March 2015 Water Monitoring Report

Waukivory Pilot Project: Fracture Stimulation and Flow Test
EPL 20358

Reporting Period: November 2014 to January 2015

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Foreword

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, North Sydney, NSW 2060
MONITORING DATE(s)	19 November 2014 – 12 January 2015
MONITORING BY	Parsons Brinckerhoff, on behalf of AGL
DATE AGL OBTAINED DATA	16 February 2015
REPORT DATE	5 March 2015
REPORT PREPARED BY	James Duggleby, Senior Hydrogeologist

Introduction

AGL is proposing to build the Gloucester Gas Project (GGP) which comprises several stages of development facilitating the extraction of coal seam gas (CSG) from the Gloucester Basin. Concept plan and project approval (Part 3A Approval) for the Stage 1 Gas Field Development Area (GFDA) was granted on 22 February 2011 under Part 3A of the Environmental Planning and Assessment Act (1979) (EP&A Act). In addition the project received approval under the Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act) (EPBC Approval) on 11 February 2013.

The GGP will involve depressurising of deep groundwater and the extraction of gas from multiple coal seams within the Gloucester coal measures. Target coal seam depths will vary from site to site but are expected to range between 200 and 1,000 m below ground level (mbgl). The current GGP includes the construction, operation, and decommissioning of not more than 110 coal seam gas wells and associated infrastructure, including gas and water gathering lines within the Stage 1 GFDA. A comprehensive groundwater investigation (Phase 2 Groundwater Investigations) was completed in early 2012 to confirm the hydrogeological conceptual model across the Stage 1 GFDA (PB, 2012). Surface water and groundwater investigations are ongoing.

The Gloucester Coal Seam Gas Project has Environment Protection Licence (EPL) 20358 for coal seam gas activities. This Monitoring Report relates to the water monitoring activities specified in Part 5, Monitoring and Recording Conditions, of EPL 20358. This report relates specifically to the monitoring surrounding the Waukivory Pilot Project, and details:

- Monitoring results from continuous water level (piezometric level) monitoring at monitoring point 85 (WKMB05) between 19 November 2014 – 12 January 2015.

As per the EPL, 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 Appendix A. The monitoring results for monitoring point 85 (WKMB05) for this reporting period are shown in Table 2.

The monitoring point that is the subject of this report is part of the GGP surface water and groundwater monitoring network, as described in AGL's Surface Water and Groundwater Management Plan (SGMP) for the Waukivory Pilot Project (AGL, 2014).

Monitoring point 85 is a multizone monitoring well with six pressure transducers installed at six different horizons to measure the piezometric levels. Details of the individual monitored zones are included in Table 2: Continuous water level (piezometric level) monitoring results for monitoring point 85 for the period 19 November 2014 – 12 January 20152.

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: Waukivory Pilot Project water monitoring points (as per EPL 20358)

EPA Identification no.	Monitoring Point	Type of monitoring point	Easting (m)	Northing (m)
7	WKSW03	Stream gauge (surface water)	402486.36	6453090.65
8	WKSW02	Stream gauge (surface water)	402748.00	6452139.00
9	WKSW01	Stream gauge (surface water)	402069.00	6452241.00
10	WKMB01	Groundwater monitoring bore	402153.63	6452566.28
11	WKMB02	Groundwater monitoring bore	402575.54	6452572.49
12	WKMB03	Groundwater monitoring bore	402589.87	6452584.93
14	PL03	Vibrating wire piezometer (groundwater)	402633.90	6449898.67
85	WKMB05	Packer and piezometer completion: multizone monitoring well (groundwater)	402576.59	6452128.62
86	WK11	Gas well	402419.02	6452589.82
87	WK12	Gas well	402748.92	6452883.77
88	WK13	Gas well	402416.74	6452164.46
89	WK14	Gas well	402906.10	6452384.08
90	GR-P3	Private groundwater bore	402905.50	6452518.71
91	GW080487	Private groundwater bore	401226.00	6454020.00

Notes:

Coordinate reference system: Map Grid of Australia 1994

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

Table 2: Continuous water level (piezometric level) monitoring results for monitoring point 85 for the period 19 November 2014 – 12 January 2015

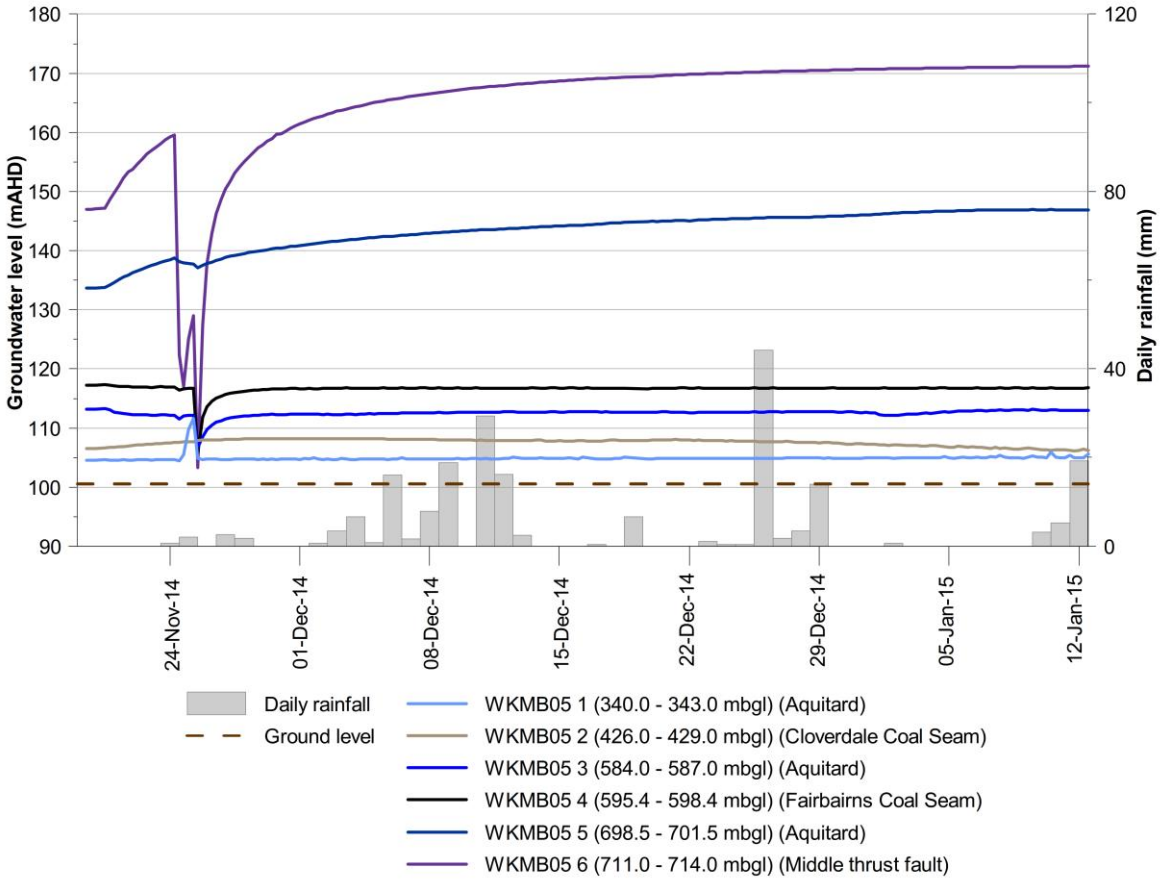
Monitoring point	85					
Location	WKMB05					
	Sensor 1	Sensor 2	Sensor 3	Sensor 4	Sensor 5	Sensor 6
Monitored interval (mbgl)	340.0 - 343.0	426.0-429.0	584.0-587.0	595.4-598.4	698.5-701.5	711.0-714.0
Formation	Aquitard	Cloverdale Coal Seam	Aquitard	Fairbairns Coal Seam	Aquitard	Middle trust fault
Data type	Standing Water Level					
Units	mAHD (metres (Australian Height Datum))					
Data date range	19/11/2014 - 16/01/2015					
Date data downloaded	12/01/2015					
Date data supplied to AGL	16/02/2015					
Monitoring frequency required by licence	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	212	212	212	212	212	212
Water level (piezometric level) (mAHD)						
Min. value	104.4	106.1	106.7	105.7	133.6	103.3
Mean value	104.9	107.6	112.5	116.6	143.4	164.8
Median value	104.9	107.8	112.7	116.7	144.3	168.9
Max. value	111.6	108.2	113.3	117.4	147.0	171.2

Notes:

mbgl - elevation in metres below ground level

mAHD – elevation in metres above Australian Height Datum

Figure 2: Continuous water level monitoring results for monitoring point 85 for the period 19 November 2014 – 12 January 2015



Note: The rapid changes in the piezometric levels measured at all sensors on 25 November 2014 occurred during the commissioning of the packer system. Piezometric levels have since begun to re-equilibrate to that of the monitored formations. Sensors 1, 2 and 4 show relatively stable trends within 2 to 3 days of installation on 25 November 2014. The time required for the piezometric pressure at the sensor to equilibrate to that of the surrounding formation is typically longer for lower permeability formations.

References

AGL, 2014. Surface Water and Groundwater Management Plan for the Waukivory Pilot Program – Gloucester Gas Project. Available online: http://www.resourcesandenergy.nsw.gov.au/__data/assets/pdf_file/0007/532942/FinalversionoftheSGMPfortheWaukivoryPilot-Oct2014.pdf

APHA, 2012. Standard Methods for the Examination of Water and Wastewater: 22nd Edition.

Environment Protection Authority (EPA), 2004. Approved Methods for the Sampling and Analysis of Water Pollutants in New South Wales, The Department of Environment and Conservation, Sydney, Australia. Available online: http://www.environment.nsw.gov.au/resources/water/approvedmethods-water.pdf

Parsons Brinckerhoff (PB), 2012. Phase 2 Groundwater Investigations – Stage 1 Gas Field Development Area, Gloucester Gas Project. Report dated January 2012, PR_5630. Available online: http://www.agl.com.au/~/media/AGL/About%20AGL/Documents/How%20We%20Source%20Energy/CSG%20and%20the%20Environment/Gloucester/Assessments%20and%20Reports/2012/January/PB%20Gloucester%20Groundwater%20Report%20Phase%202%20Appendices%20E-P.pdf

The State of NSW and Environment Protection Authority (EPA), 2012. Requirements for publishing pollution monitoring data. Environment Protection Authority, Sydney, Australia. Available online: http://www.epa.nsw.gov.au/resources/licensing/130742reqpubpmdata.pdf

Appendix A: Analytes monitored and frequency required for monitoring points in Table 1 (as per EPL 20358)

Pollutant	Units of measure	Monitoring points											
		7,8,9		10,11,12		14,85		86,87,88,89		90		91	
		Frequency	Sampling method	Frequency	Sampling method	Frequency	Sampling method	Frequency	Sampling method	Frequency	Sampling method	Frequency	Sampling method
Aluminium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Ammonia	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Arsenic	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Barium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Beryllium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Bicarbonate	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Boron	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Cadmium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Calcium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Carbonate	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Chloride	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Chromium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Cobalt	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Copper	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Electrical conductivity	microsiemens per centimetre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Fluoride	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Iron	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Lead	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Magnesium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Manganese	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Mercury	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Methane	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Molybdenum	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Monoethanolamine Borate	micrograms per litre	Special Frequency 5	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority			Special Frequency 4	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority
Nickel	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Nitrate	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Nitrite	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
pH	pH	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Phosphorus (total)	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Potassium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Reactive Phosphorus	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Selenium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Silica	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Sodium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Sodium Hypochlorite	milligrams per litre	Special Frequency 5	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority			Special Frequency 4	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority	Special Frequency 3	Method approved in writing by the Authority
Standing water level	meters (Australian Height Datum)			Special Frequency 8	Special Method 5	Special Frequency 8	Special Method 5	Special Frequency 9	Special Method 3	Special Frequency 8	Special Method 5	Special Frequency 6	Special Method 1
Strontium (dissolved)	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Sulfate	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
THPS (Phosphonium, Tetrakis (Hydroxymethyl-sulfate)	micrograms per litre	Special Frequency 5	Method approved in writing by the Authority (after the data was received for this report)	Special Frequency 3	Method approved in writing by the Authority (after the data was received for this report)			Special Frequency 4	Method approved in writing by the Authority (after the data was received for this report)	Special Frequency 3	Method approved in writing by the Authority (after the data was received for this report)	Special Frequency 3	Method approved in writing by the Authority (after the data was received for this report)
Total dissolved solids	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Total organic carbon	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Total suspended solids	milligrams per litre			Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Uranium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Vanadium	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample
Zinc	milligrams per litre	Special Frequency 5	Grab sample	Special Frequency 3	Grab sample			Special Frequency 4	Grab sample	Special Frequency 3	Grab sample	Special Frequency 3	Grab sample

Notes:

Special Frequency 3 – One sampling event before the Waukivory Pilot Project fracture stimulation commences, one sampling event within 24 hours of the completion of the fracture stimulation of each well, and one sample at week 2 and week 4 after the completion of the Waukivory Pilot Project fracture stimulation.

Special Frequency 4 – Every fortnight for 8 weeks from the commencement of the Waukivory pilot flow testing, then every 2 months thereafter until the cessation of the Waukivory pilot flow testing.

Special Frequency 5 – One sampling event within 24 hours of the completion of the fracture stimulation of each well, and one sampling event one week after the completion of the fracture stimulation of each well, and one sampling event every 6 months thereafter until the cessation of the Waukivory pilot flow testing.

Special Frequency 6 – One monitoring event to determine water level prior to the Waukivory Pilot Project fracture stimulation.

Special Frequency 8 – Every 6 hours

Special Frequency 9 – Every 6 hours when using an automated datalogger, or, once every fortnight using a Sonolog in the event of failure of an automated datalogger.

Special method 1 - manual dip

Special method 3 - Use of an automated datalogger. As a back up contingency, by use of Sonolog in the event of an automated datalogger.

Special method 5 - Automated datalogger

Shaded grey = not required to be analysed