

The logo consists of the text "Energy in action.™" in a blue sans-serif font, positioned within a large, light brown rounded rectangle. Below this rectangle are three smaller, overlapping light brown rectangles of varying sizes and orientations, creating a stepped effect. At the bottom right of this graphic is the AGL logo, which is a blue square containing a white stylized sun icon and the letters "AGL" in white.The AGL logo is a blue square with a white stylized sun icon and the letters "AGL" in white.

AGL UPSTREAM INVESTMENTS PTY LTD

CAMDEN GAS PROJECT

Quarterly Produced Water Quality Monitoring Report

Reporting Period: 2nd Quarter – October / December 2013

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Foreword

PREMISES	Rosalind Park Gas Plant Lot 35 Medhurst Road GILEAD NSW 2560
LICENCE DETAILS	Environment Protection Licence 12003
LICENCEE	AGL Upstream Investments Pty Limited (AGL)
LICENCEE'S ADDRESS	Locked Bag 1837, North Sydney, NSW 2060
MONITORING DATE	2 nd Quarter – October / December 2013
MONITORING BY	AGL
ANALYSIS BY	ALS Laboratory, Smithfield (Work order number: ES1319191)
REPORT DATE	5 December 2013
REPORT PREPARED BY	Nicola Fry, Hydrogeologist

Introduction

The Camden Gas Project (CGP) is owned and operated by AGL and is located in the Macarthur region 65 km southwest of Sydney, in the Wollondilly, Camden and Campbelltown Local Government Areas (Figure 1). The CGP has been producing gas for the Sydney region since 2001 and currently consists of 144 gas wells, low-pressure underground gas gathering pipes and a gas plant facility. Not all production wells are currently operational. The production wells are licensed with Water Access Licences, Works Approvals and Use Approvals under the *Water Management Act 2000* (NSW), including an allocation of 30 ML per year for the existing CGP and associated dewatering activities from the coal seams. In the 2012-13 financial year, less than 4.7 megalitres of water was produced from the coal seams for the entire Camden Gas Project operating wellfield.

This Monitoring Report relates to the groundwater monitoring activities specified in Part 5, Monitoring and Recording Conditions, of the Environment Protection Licence. The Licence conditions stipulate groundwater monitoring is required to be carried out at the locations as shown in Table 1 and Figure 1. The specific analytes and frequency tested are shown in Table 2.

The monitoring points that are the subject of this report are part of the CGP groundwater monitoring network, as described in AGL's CGP Groundwater Management Plan (2012). Water samples are taken from each gas well at the separator. The deep groundwater (when brought to the surface) is known as produced water. 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*". Many of the operating wells within the Camden Gas Project produce very low volumes of water; frequently, there is not enough water present to allow for sampling at these monitoring points.

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

Table 3 displays the results of this quarter's monitoring.

Produced water from the coal seams at CGP ranges in quality, as a result of localised natural variations within the coal. Electrical conductivity (which is a measure of salinity) typically varies between about 7,000 and 15,000 $\mu\text{S}/\text{cm}$. However, it is not unusual to see values outside of this range. Low volume water producing wells frequently show very low electrical conductivity values as a result of evaporation and condensation processes occurring in the well bore (PB, 2013). These very low values are not representative of formation water samples. It is also not uncommon to observe

elevated levels of TPH (total petroleum hydrocarbons) after specific wells have undergone maintenance activities. These values are not representative of formation water samples.

More information on the hydrogeology and groundwater of the CGP is available in the Hydrogeological Summary (AGL, 2013) which can be viewed at the CGP website:

agl.com.au/Camden

Table 1- Groundwater quality monitoring points (as per EPL 12003)

EPA Identification no.	Location
8	EM40
9	SF08
10	RB10
11	MT05
12	MP12
13	MP30
14	RP12
15	SL03

Table 2 – Analytes monitored and frequency (as per EPL 12003)

Analyte	Units of measure	Frequency	Sampling Method
Aluminium	milligrams per litre	Quarterly	Grab sample
Ammonia	milligrams per litre	Yearly	Grab sample
Arsenic	milligrams per litre	Quarterly	Grab sample
Barium	milligrams per litre	Quarterly	Grab sample
Benzene	milligrams per litre	Yearly	Grab sample
Beryllium	milligrams per litre	Quarterly	Grab sample
Bicarbonate	milligrams per litre	Quarterly	Grab sample
Boron	milligrams per litre	Quarterly	Grab sample
Bromide	milligrams per litre	Quarterly	Grab sample
Cadmium	milligrams per litre	Quarterly	Grab sample
Calcium	milligrams per litre	Quarterly	Grab sample
Carbonate	milligrams per litre	Quarterly	Grab sample
Chloride	milligrams per litre	Quarterly	Grab sample
Chromium	milligrams per litre	Quarterly	Grab sample
Cobalt	milligrams per litre	Quarterly	Grab sample
Copper	milligrams per litre	Quarterly	Grab sample
Electrical conductivity	microsiemens per centimeter	Quarterly	Grab sample
Ethyl benzene	milligrams per litre	Yearly	Grab sample
Fluoride	milligrams per litre	Quarterly	Grab sample
Iron	milligrams per litre	Quarterly	Grab sample
Lead	milligrams per litre	Quarterly	Grab sample
Magnesium	milligrams per litre	Quarterly	Grab sample
Manganese	milligrams per litre	Quarterly	Grab sample
Mercury	milligrams per litre	Quarterly	Grab sample
Methane	milligrams per litre	Yearly	Grab sample
Molybdenum	milligrams per litre	Quarterly	Grab sample
Nickel	milligrams per litre	Quarterly	Grab sample
Nitrate	milligrams per litre	Yearly	Grab sample
Nitrite	milligrams per litre	Yearly	Grab sample

Phenols	milligrams per litre	Yearly	Grab sample
Polycyclic aromatic	milligrams per litre	Yearly	Grab sample
Potassium	milligrams per litre	Quarterly	Grab sample
Reactive Phosphorus	milligrams per litre	Yearly	Grab sample
Selenium	milligrams per litre	Quarterly	Grab sample
Silica	milligrams per litre	Quarterly	Grab sample
Sodium	milligrams per litre	Quarterly	Grab sample
Strontium (dissolved)	milligrams per litre	Quarterly	Grab sample
Sulfate	milligrams per litre	Quarterly	Grab sample
Toluene	milligrams per litre	Yearly	Grab sample
Total dissolved solids	milligrams per litre	Quarterly	Grab sample
Total petroleum hydrocarbons	milligrams per litre	Yearly	Grab sample
Uranium	milligrams per litre	Quarterly	Grab sample
Vanadium	milligrams per litre	Quarterly	Grab sample
Xylene	milligrams per litre	Yearly	Grab sample
Zinc	milligrams per litre	Quarterly	Grab sample



Groundwater Monitoring Results

Table 3 - Produced water monitoring results for 2nd Quarter - October/December 2013

Monitoring point	8	9	10	11	12	13	14	15
Location	EM40	SF08	RB10	MT05	MP12	MP30	RP12	SL03
Sampled Date	Not enough water to sample (19/11/2013)	Not enough water to sample (19/11/2013)	Not enough water to sample (19/11/2013)	Not enough water to sample (19/11/2013)	Not enough water to sample (19/11/2013)	Not enough water to sample (19/11/2013)	Not enough water to sample (19/11/2013)	Not enough water to sample (19/11/2013)

	Analyte	Units	Limit of reporting								
Physical	Electrical conductivity * (lab)	µS/cm	1	-	-	-	-	-	-	-	-
	Total Dissolved Solids (measured)	mg/L	10	-	-	-	-	-	-	-	-
	TSS	mg/L	5	-	-	-	-	-	-	-	-
Major Cations	Calcium (Filtered)	mg/L	1	-	-	-	-	-	-	-	-
	Magnesium (Filtered)	mg/L	1	-	-	-	-	-	-	-	-
	Potassium (Filtered)	mg/L	1	-	-	-	-	-	-	-	-
	Sodium (Filtered)	mg/L	1	-	-	-	-	-	-	-	-
	Cations Total	meq/L	0.01	-	-	-	-	-	-	-	-
Major Anions	Alkalinity (Bicarbonate as CaCO ₃)	mg/L	1	-	-	-	-	-	-	-	-
	Alkalinity (Carbonate as CaCO ₃)	mg/L	1	-	-	-	-	-	-	-	-
	Alkalinity (Hydroxide) as CaCO ₃	mg/L	1	-	-	-	-	-	-	-	-



	Alkalinity (total) as CaCO3	mg/L	1	-	-	-	-	-	-	-	-
	Chloride	mg/L	1	-	-	-	-	-	-	-	-
	Anions Total	meq/L	0.01	-	-	-	-	-	-	-	-
	Ionic Balance	%	0.01	-	-	-	-	-	-	-	-
Dissolved Metals	Aluminium (Filtered)	mg/L	0.01	-	-	-	-	-	-	-	-
	Arsenic (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Barium (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Beryllium (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Boron (Filtered)	mg/L	0.05	-	-	-	-	-	-	-	-
	Cadmium (Filtered)	mg/L	0.0001	-	-	-	-	-	-	-	-
	Chromium (III + VI) (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Cobalt (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Copper (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Iron (Filtered)	mg/L	0.05	-	-	-	-	-	-	-	-
	Lead (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Manganese (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Mercury (Filtered)	mg/L	0.0001	-	-	-	-	-	-	-	-
	Molybdenum (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
Nickel (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-	
Selenium (Filtered)	mg/L	0.01	-	-	-	-	-	-	-	-	



	Strontium (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Uranium (Filtered)	mg/L	0.001	-	-	-	-	-	-	-	-
	Vanadium (Filtered)	mg/L	0.01	-	-	-	-	-	-	-	-
	Zinc (Filtered)	mg/L	0.005	-	-	-	-	-	-	-	-
Other	Bromine (dissolved) (Filtered)	mg/L	0.1	-	-	-	-	-	-	-	-
	Fluoride	mg/L	0.1	-	-	-	-	-	-	-	-
	Iodine (dissolved) (Filtered)	mg/L	0.1	-	-	-	-	-	-	-	-
	Silica	mg/L	0.1	-	-	-	-	-	-	-	-
	Sulfate (Filtered)	mg/L	1	-	-	-	-	-	-	-	-

- not analysed

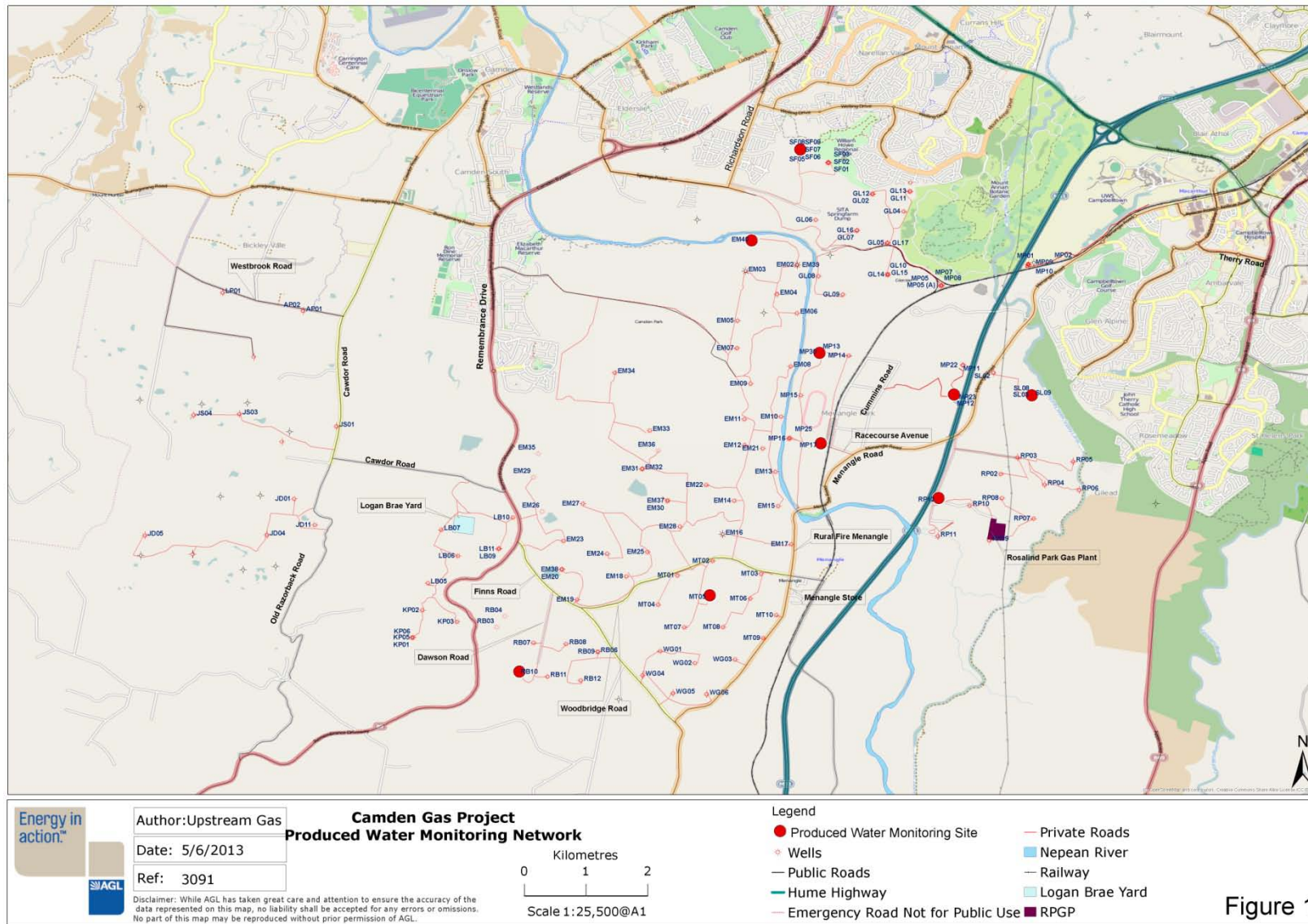


Figure 1- CGP and produced water monitoring locations as listed in EPL12003 (CSG wells)

References

AGL, 2012. Groundwater Management Plan. AGL document. Last revised November 2012. Available online:

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