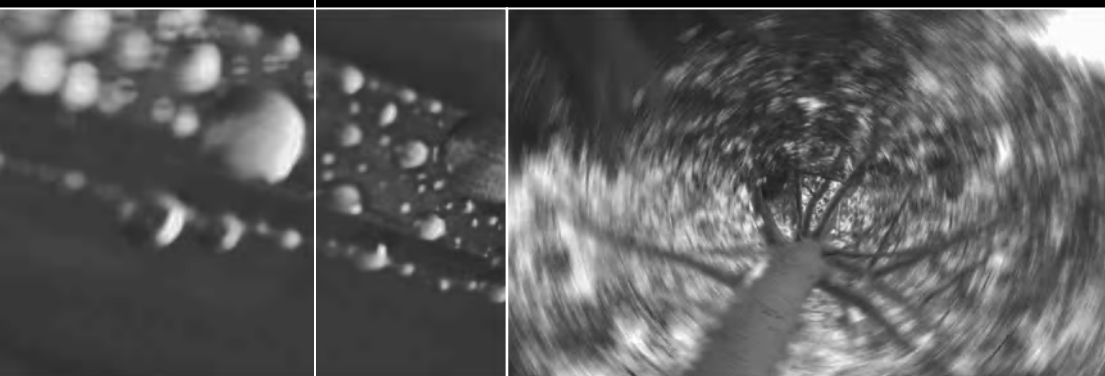


ENVIRONMENTAL ASSESSMENT

STAGE 2 CONCEPT AREA

SPRINGFARM PROJECT AREA

MENANGLE PARK PROJECT AREA



STAGE 2 CONCEPT AREA

Camden gas project

Expansion of Stage 2 of the Camden Gas Project Stage 2 Concept Area Spring Farm Project Area Menangle Park Project Area Environmental Assessment Volume 1

September 2007

Prepared for:
AGL Gas Production (Camden) Pty Ltd
72 Christie Street, St Leonards

CERTIFICATION

Submission of Environmental Assessment (EA)

prepared under the Environmental Planning and Assessment Act 1979
Section 75F

EA prepared by
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in respect of

Expansion of Stage 2 of the Camden Gas Project

project application
applicant name
applicant address

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Pty Ltd
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land to be developed
lot no., DP/MPS, vol/foi etc
proposed project

The proposed project is to be carried out on the land detailed in Table 2.1 of this EA. The proposed project involves a Concept Approval for the expansion of the Stage 2 area as well as Project Approval for Spring Farm and Menangle Park (see Figure 1.2 of this EA).

Map(s) attached

Environmental Assessment

an Environmental Assessment (EA) is attached

Certification

I certify that I have prepared the contents of this Environmental Assessment and to the best of my knowledge it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.


Signature
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Date 18/9/07


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APPENDICES

Appendix A: Record of Ministers Opinion

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Appendix C: Agency Responses to Consultation

Appendix D: Quantitative Risk Assessment, Coal Seam Methane Production Wells for Up to Six
Wellhead Configuration

Appendix E: Subsidence Report

Appendix F: Construction and Operational Noise Assessment

Appendix G: Ecological Assessment

Appendix H: Aboriginal Heritage Assessment



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GLOSSARY OF TERMS

Annual Average Daily Traffic	Traffic in both directions over a 24 hour period, averaged over one year
Applicant	The body proposing the development.
Camden Gas Project	A major coal seam methane project involving the extraction of gas located within the Southern Coalfields of the Sydney Basin. The Camden Gas Project is a Joint Venture between Sydney Gas (Camden) Operations Pty Limited (Sydney Gas) and AGL Gas Production (Camden) Pty Limited. AGL operates the Camden Gas Project on behalf of the JV.
Coal Seam Methane	A natural gas formed as a by-product during the coalification process whereby organic matter is turned into coal.
Cumulative Effect	Refers to the accumulation of impacts over time.
dB(A)	The most common measurement of sound level used to measure environmental noise, decibels, measured using a simple sound meter having an A-weighting filter to simulate the subjective response of the human ear.
Drilling	The perforation of the earth's surface crust by mechanical means, whether the hole caused by the perforation is vertical, inclined or horizontal (Surface to In Seam or SIS) or any future technology, and includes all operations for preventing collapse of the sides of any such hole or for preventing it from being filled with extraneous materials including water.
Ecologically Sustainable Development	Development that aims to meet the needs of the present community without compromising the ecological processes on which life depends for the benefit of future generations.
Emergency response	The reaction by emergency services such as Fire, Police, Ambulance, Industrial Fire Brigades, etc, to an emergency.
Emission	The release of constituents into the atmosphere (e.g. gas, steam or noise).
Endangered Species	Those plants and animal species likely to become extinct unless action is taken to remove or control the factors that threaten their survival.
Environment	The physical, biological, cultural, economic and social characteristics of an area, region or site.
Environmental Impact Assessment	The orderly and systematic evaluation of a proposal, including alternatives and objectives, and its effects on the environment, including the mitigation and management of those effects.
Environmental Management	That part of the overall management system which includes organisational structure, planning activities, responsibilities, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining environmental policy.
Environmental Management Plan	The control, training and monitoring measures to be implemented during the design, construction and operation phase of a project in order to avoid, minimise or ameliorate potentially adverse impacts (being socio-economic, cultural, physical, biological) identified during environmental assessments.
Fracture stimulation	A method of fracture stimulation of coal seams to improve the rate and total recovery of gas.

Gas Gathering Line	Pipelines used to collect and transport gas at low pressure.
Groundwater	Subsurface water contained within the saturated zone.
Habitat	The particular local environment occupied by an organism.
Hydrogeology	The study of subsurface water in its geological context.
Hydrology	Surface water and groundwater and their interaction with earth materials.
Inter-generational equity	The principle that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
L_{A10}, T	The A-weighted noise level exceeded for 10% of a time interval, T. This is commonly referred to as the average maximum noise level.
L_{A90}, T	The A-weighted noise level exceeded for 90% of a time interval, T. This is commonly referred to as background noise level.
L_{Aeq}, T	The equivalent continuous sound level in dB(A). The energy average A-weighted noise level over a time interval, T.
Native vegetation	A broad term for vegetation comprised of plant species which occur naturally in Australia (but which are not necessarily indigenous).
Occupational Health and Safety Management	Commitment of the workplace to safeguard the occupational health and safety of staff and contractors as an integral part of a business or operation and to ensure compliance with OH&S legislation.
Particulates	These include any solid material suspended in the atmosphere.
Petajoule	A measure of energy, equivalent to 1×10^{15} joules.
Petroleum Exploration Licence	A licence regulated under <i>the Petroleum (Onshore) Act 1991</i> .
Petroleum Production Lease	A lease regulated under <i>the Petroleum (Onshore) Act 1991</i> .
PM_{10}	Particulate matter less than $10\mu m$ in size, the respirable fraction.
Precautionary principle	The principle that if there are threats of serious or irreversible environmental damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Rehabilitation	The return of previously disturbed land to a stable land surface capable of useful purposes.
Revegetation	The process of re-establishing a vegetative cover.
Risk	Likelihood of a specific undesirable event occurring within specified period or in specified circumstances. Listed as frequency or probability.
Statutory Authority	An authority set up as a requirement of legislation.
Sustainable Use	Use of an organism, ecosystem or their renewable resource at a rate within its capacity for renewal.
Terrestrial	Of or pertaining to the land as distinct from the water.
Threatened Species	Animals and plants that are in danger of extinction or may now be considered extinct, but have been seen in the wild in the last 50 years.



Visibility	Measure of extent to which particular components of a development may be visible from surrounding areas.
Visual Absorption Capacity	An estimation of the capacity of the landscape to absorb development without creating a significant change in visual character or producing a reduction in scenic quality.
Vulnerable Species	Those that may soon become endangered unless action is taken.
Well	A hole made by drilling in connection with exploration for petroleum or operations for the recovery of petroleum.
Well Completion	Is a generic term used to describe the downhole and surface equipment required to enable safe and efficient production from a gas well.
Well Construction Compound	The total footprint for construction of a well comprises a construction footprint of up to 10,000 m ² which includes a level drill pad area of some 25 m x 25 m, drill pit(s) measuring up to 25 m x 25 m, site offices and equipment storage.
Well Stimulation	Refers to a treatment performed to restore or enhance the productivity of a well.
Well Surface Location	An area that may incorporate up to 6 co-located wells at one site or compound.



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EXECUTIVE SUMMARY

Introduction

The Camden Gas Project (CGP) is a major coal seam methane (CSM) project involving the extraction of CSM gas located within the Southern Coalfields of the Sydney Basin. Exploration and production titles associated with the CGP are issued under the *NSW Petroleum (Onshore) Act 1991*. Current CGP activities consist of approximately 100 existing coal seam gas wells, underground gas gathering pipes and gas treatment facilities.

HLA-Envirosciences Pty Limited (HLA ENSR) has prepared this Environmental Assessment (EA) on behalf of AGL Gas Production (Camden) Pty Limited (AGL) to assess the potential environmental impacts of the development of additional gas wells and associated infrastructure proposed to expand the CGP and its production capacity. This EA addresses the nature of proposed works and potential impacts for an area within the Camden, Campbelltown and Wollondilly Local Government Areas (LGAs) identified as Stage 2 of the CGP.

Concept Approval is also being sought for general works within Stage 2. In addition, concurrent Project Approval is being sought for specific works within Spring Farm and Menangle Park. HLA has prepared this EA in accordance with the provisions of Part 3A of the *Environmental Planning and Assessment (EP&A) Act 1979* and *EP&A Regulation (EP&A Regulation) 2000*, together with the Director-General's Environmental Assessment Requirements (EARs) which were issued to the Proponent in March 2007.

Site and Context

The proposed project which is the subject of the application for Concept Approval (further development within Stage 2), involves the construction of wells, gas gathering lines, other supporting infrastructure and post development activities to enable gas production within Stage 2 of the CGP. The Stage 2 area is situated within the Camden, Campbelltown and Wollondilly LGAs, south west of Sydney.

Concurrent Project Approval is being sought for the construction of wells and the installation of gas gathering and water pipelines within Spring Farm and Menangle Park. The area known as Spring Farm is located within the Camden LGA. The Spring Farm Project Area is located east of Camden and is situated south of the Camden by-pass. The Nepean River adjoins the south west boundary of the area, while the suburbs of Narellan and Mount Annan border the north/north eastern boundary of the area. Land in the area is allocated to support future urban development.

The Menangle Park Project Area falls within the Campbelltown LGA. The land is situated southeast of the proposed Spring Farm Project Area. The Menangle Park area is bounded by the Hume Highway to the east, with the exception of a small portion of the site which is situated east of the Hume Highway and north of Menangle Road. The Nepean River adjoins the western and southern boundaries of the area.

The study area is situated within land extending from Newcastle to Wollongong over which Petroleum Exploration Licence 2 (PEL 2) has been issued by the Minister for Mineral Resources (now the Minister for Primary Industries) under the *Petroleum (Onshore) Act 1991*.

Within PEL 2, four areas have been granted as Petroleum Production Leases (PPLs) under the *Petroleum (Onshore) Act 1991*. These areas are known as Petroleum Production Lease 1 (PPL 1), Petroleum Production Lease 2 (PPL 2), Petroleum Production Lease 4 (PPL 4) and

Petroleum Production Lease 5 (PPL 5) and enable the production, gathering and sale of petroleum gas.

Stage 1 of the CGP was approved in 2002, and initially comprised 22 wells, the Ray Beddoe Treatment Plant (RBTP) and an in-field compression gas gathering system in the Cawdor area. Stage 1 entered into gas production pursuant to PPL 1 and PPL 2.

Stage 2 of the CGP was originally approved in 2004, and initially comprised 43 wells, the Rosalind Park Gas Plant (RPGP) and gas gathering system in the Menangle and Menangle Park areas. Stage 2 entered into production pursuant to PPL 4 issued by the Minister for Mineral Resources in October 2004.

The two main areas remaining for development within the CGP Stage 2 area are Spring Farm and Menangle Park, however additional wells could be developed in other parts of the Stage 2 area.

An overview of the development history of the CGP is provided in **Table ES-1** below.

Table ES-1: Summary of Camden Gas Project

Relevant CGP Area	Brief Activity Description	Year
Stage 1	22 wells and the Ray Beddoe Treatment Plant (RBTP) and in-field gas gathering system in the Cawdor area.	2002
Stage 2	43 wells, Rosalind Park Gas Plant (RPGP) and gas gathering system in Menangle and Menangle Park	2004
Stage 2	Additional 15 wells at Mt Taurus and Harness Racing at Menangle Park	2004
Stage 2	Additional 6 wells at Glenlee and Elizabeth Macarthur Agricultural Institute (EMAI) Stage 1	2004
Stage 2	Additional 7 wells at Sugarloaf	2005
Stage 2	Extension of 10 wells on the El Bethel property	2006
Stage 1*	Extension of one well	2005
Stage 2*	Extension of 5 wells	2005
Stage 2	Glenlee modification	2006
Stage 2	Additional 14 wells on EMAI property	2006
Stage 2	Additional 10 wells in Razorback area	2006
Stages 1 & 2*	Additional 9 wells across the existing field	2007

* - these well extensions were part of a combined section 96 modifications

Approach to Environmental Assessment

The proponent is seeking Concept Approval for works and/or activities which may be implemented to enable further gas production within Stage 2 of the CGP. In addition, concurrent Project Approval is being sought, specifically in relation to the development of gas wells and associated infrastructure (gas gathering lines and access roads) within the Spring Farm and Menangle Park areas.

Concept Approval provides for complex projects to be considered on the basis of a Concept Plan, with the assessment focussing on strategic issues rather than detailed information, and determining the broad requirements of a project up front. If a Concept Approval is granted,

further assessment and other forms of approval are generally required prior to commencement of work. More detailed information is provided at these later stages of assessment / approval.

This EA therefore provides different levels of detail in respect of the broader Stage 2 Concept Plan area and the Spring Farm and Menangle Park areas for which concurrent Project Approval is being sought.

The approach adopted for the EA involves describing the types of development and/or activities which may occur within the area and identifying the potential impacts associated with such development/activities.

Given the more strategic nature of the Concept Plan, locations for the proposed development activities are not identified, however locational guidelines/principles have been developed to assist with future siting of wells and associated infrastructure, or operational/maintenance activities. More detailed studies of the physical characteristics and potential impacts of proposed works identified in the Concept Plan would be provided in subsequent applications.

As indicated above, concurrent Project Approval is being sought for the proposed works within Spring Farm and Menangle Park, for which the Proponent has identified indicative locations for the proposed wells and gas gathering lines. Therefore, this EA includes more detailed baseline information and assessment of impacts for works proposed within the Spring Farm and Menangle Park areas based on the construction and operational footprint, together with a suite of mitigation measures and a Statement of Commitments to manage the potential impacts of works. Should Project Approval be granted for works within Spring Farm and Menangle Park, no further planning approvals would be required prior to commencement of works in these areas.

The Environmental Assessment has used an “envelope” approach to the impact assessment which means that the highest impact activities are assessed even when these activities are not the most likely. The assessment has been carried out on a wider area to allow the final well surface locations to be within an approximately 50 metre radius of the nominated location (in the case of Spring Farm) and an approximately 100 metre radius of the nominated location (in the case of Menangle Park). This approach would allow AGL to move infrastructure within the assessed parameters to enable flexibility with landowners and to accommodate future land uses.

Project Description

The works proposed under both the Concept and Project Approval involve the construction and subsequent operation of a number of gas wells, together with associated infrastructure and post development activities which deliver gas to gas plants.

Concept and concurrent Project Approval is being sought for a range of activities which can be divided into the following:

- Construction: The activities required to physically develop the wells and supporting infrastructure;
- Production: Production and delivery of gas from well surface locations to the gas plant via gas gathering lines for sale, including commissioning and maintenance activities;
- Post Development: Operational activities which may be needed to maintain production efficiency. These activities are proposed as part of the Concept Plan only and were generally not included as part of previous approvals in Stage 2. It is anticipated these activities may include the development of infill

wells, upgrade of gas gathering lines, re-fracture stimulation (if required) and installation of infield compression; and

- Closure and Final Rehabilitation.

Planning and Approvals

The construction and operation of the Project is subject to numerous statutory requirements. The primary relevant legislation is:

- *NSW Petroleum (Onshore) Act 1991*;
- *NSW Environmental Planning and Assessment (EP&A) Act 1979*;
- *Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999*; and
- *Protection of the Environment Operations Act 1997*.

The Spring Farm, Menangle Park and remaining Stage 2 Concept works comprise three different LGAs, being:

- Camden;
- Campbelltown; and
- Wollondilly.

Spring Farm Project Area is wholly situated within the Camden LGA, while Menangle Park Project Area is wholly situated within the Campbelltown LGA.

There are a variety of local Environmental Planning Instruments (EPIs) which apply to the land, the subject of the Stage 2 Concept works, which are identified in the following table.

Table ES-2: EPIs Applicable to Stage 2 Works

Local Government Area	Relevant EPIs
Camden	Camden Local Environmental Plan No. 121 – Spring Farm (LEP 121) Camden Local Environmental Plan No. 46 (LEP 46) Camden Local Environmental Plan No. 47 (LEP 47)
Campbelltown	Campbelltown Interim Development Order No. 15 (IDO 15) Campbelltown Local Environmental Plan (Urban Areas) 2002 (LEP 2002)
Wollondilly	Wollondilly Local Environmental Plan 1991 (LEP 1991)

Additionally, Stages 1 and 2 of the CGP are currently operated under separate premises-based Environment Protection Licences (EPLs) under the *NSW Protection of the Environment Operations Act 1997* to permit petroleum refining and waste generation activities. The proposed Spring Farm Project Area and Menangle Park Project Area gas wells and associated infrastructure form part of Stage 2 of the CGP and subject to approval, the new wells and infrastructure would be added to the existing EPL.

Consultation with Stakeholders

Statutory Authority Consultation

The Proponent has undertaken consultation with key local and State Government agencies as specified in the Environmental Assessment Requirements (EARs). The purpose of this consultation has been to provide an overview of the project, to seek local knowledge to assist with the preparation of the EA, and to seek input into matters they would like to see addressed in the EA.

In this regard, written comments were sought from relevant statutory agencies identified in the EARs to assist with the preparation of the EA.

Community Consultation

As part of the project planning for the proposed works, AGL undertook a program of community consultation targeting local landowners and stakeholders through a program of meetings and workshops. The approach adopted to distribute information to the local community involved the following:

- Discussions with landowners affected by the proposed works;
- Workshops for the CGP CCC and interested community and business groups; and
- Meetings to brief local council staff, Members of Parliament and government agencies.

The variety of consultation techniques implemented was designed to enable information about the project to effectively reach target audiences.

The Aboriginal Cultural Heritage Assessment undertaken as part of this EA also involved consultation with local Aboriginal groups. Results of this consultation are summarised in the Aboriginal Cultural Heritage Assessment.

Issues Prioritisation

A prioritisation analysis of the key issues identified was undertaken and was based on the need to recognise that the higher the potential severity of adverse environmental effects and the greater the potential consequence of those unmanaged effects, the higher the degree of environmental assessment required.

Where greater potential impacts were identified, the attribute or issue was allocated a higher priority for assessment.

The analysis assessed the potential risk on the basis of the potential severity of environmental effects and the likely consequences of those potential effects if unmanaged. Community views were also taken into account - where community concern regarding an issue was greater, a higher priority was assigned for the environmental assessment.

The analysis identified that the prioritisation of environmental issues and therefore the focus of environmental assessment for the proposed project should be as follows:

- High - Land use (compatibility with future land use); Hazard and risk (community perception);

- Medium – Air Quality (Odour); Soils and Geology; Noise and vibration; Social; Economic; and
- Low – Water management; Ecological; Visual Impacts; Cultural Heritage; and Traffic and Transportation.

These issues have been addressed accordingly within this EA.

Environmental Impact Assessment

Land Use

Consultation with landholders during the early project design phase ensured that wells and other infrastructure were sited to accommodate the relevant primary land uses. This has resulted in the relocation, removal or redesign of wells before the proposal is submitted for approval.

The use of drilling technology, co-location of wells and consultation with landowners has resulted in the Proponent significantly reducing the number of wells from around 45 to 16 and the overall footprint of the project. In Spring Farm, the proposal was originally for around 20 wells which has been reduced to four (4) well surface locations and in Menangle Park there were around 25 wells originally proposed, while now there are 12 well surface locations.

The proposal is a transient use of land to facilitate the extraction of a State significant resource. Land surrounding well surface locations would not be sterilised as a result of the proposed development following rehabilitation. The measures proposed within this EA to manage the environmental impacts of the proposed development will assist in managing land use impacts.

The identified impacts associated with the gas gathering lines and access roads, primarily relate to vehicles and equipment required during the construction phase. However, these impacts are temporary and through the implementation of identified mitigation measures are significantly reduced during the construction phase.

Identified impacts during the closure and final rehabilitation phase would be temporary and rehabilitated to either a pre-production land use or to a condition that landowners have agreed to through negotiations with AGL. With respect to wells located adjacent to parks and reserves, these well surface locations would be rehabilitated in accordance with the relevant Plans of Management in consultation with the relevant authorities.

Hazard and Risk

The potential impacts of the proposed Project in terms of hazard and risk are related to both the potential risk to human health and the potential risk to the environment. The potential impacts of CSM wells in this respect are generally well known and appropriate safeguards would be employed. They are generally related to flammable events which could occur due to a loss of containment of CSM coupled with an ignition event.

A quantitative risk analysis was undertaken for the level of risk associated with the proposed gas well surface locations (up to six well head configuration). The results state that the level of risk for the Project which is considered 'acceptable' for residential housing is three times lower than the risk of being killed by a falling object or being electrocuted in a non-industrial environment, and is about ten times lower than the risk of being killed in an aeroplane accident in Australia (or 145 times lower than being killed while travelling in a car).

Air Quality and Odour

Air quality in the locality has the potential to be impacted through the construction, operation and closure and rehabilitation phases of the project. Potential impacts relate to:

- Dust and exhaust emissions during the construction phase from vehicles, machinery and drilling operations;
- Odour generation as a result of drilling activities; and
- Exhaust emissions from operation of equipment, plant and machinery.

The potential impacts associated with the project are primarily associated with the construction phase of the development and are therefore generally short-term and temporary. Provided that the mitigation measures proposed are effectively implemented, significant adverse impacts on air quality of the region as a result of the proposed works are not expected.

The Spring Farm and Menangle Park Project Areas have been earmarked for future urban (residential, commercial and industrial) development, which would result in development being located in close proximity to the well surface locations. The construction of wells and associated infrastructure within these areas is expected to be completed prior to the land release of the area, thereby minimising the potential impacts on amenity resulting from minor air quality impacts during construction.

Based upon observation of existing well fields and AGL's previous experience, operational activities are expected to have minimal impacts on air quality. Mitigation measures, ongoing continuous improvement and notification would further minimise potential impacts throughout life cycle of the project.

Landform, Geology and Soils

Potential impacts resulting from the proposed project are primarily associated with:

- Disturbance of soils during construction which would temporarily increase potential erosion and sediment loads within the vicinity of the activity with the potential to impact on waterways and drainage lines near the sites;
- Potential contamination of soils through fuel, chemical and oils spillages from vehicles and machinery on site daily;
- Potential for geotechnical impacts to the surface land as a result of the drilling and fracture stimulation operations;
- Extraction and subsequent consumption of gas for commercial supply has the potential to impact on the natural coal resource and potential future coal mining; and
- Potential impacts in relation to subsidence.

It is not anticipated that the construction or operation of the wells would result in significant adverse effects on the landform, geology or soils within the Spring Farm or Menangle Park Project Areas. Potential impacts associated with the proposed works within the Stage 2 Concept area are expected to be largely the same. Minor impacts are expected during the construction and closure and rehabilitation stages however the safeguards proposed would considerably minimise the potential for these activities to significantly impact on the landform, geology and soils of the locality. The potential for subsidence to occur at the surface was assessed to be negligible.

Noise and Vibration

An assessment of noise and vibration impacts associated with the proposed works was undertaken by Wilkinson Murray (WM). The assessment considered the full range of potential noise impacts associated with the proposal including noise from construction of well surface locations, gas gathering systems, water drainage lines and access roads; operational noise and traffic noise.

In order to provide a conservative assessment of potential noise impacts, a worst case construction scenario has been assumed at each well surface location. This scenario assumed the drilling of up to six surface to in-seam (SIS) wells at each location over a period of twelve months, including 24 hour operation of drills, mud pumps and generators for the entire period. A site by site approach was used in the assessment to determine the design required at each well surface location to achieve allowable noise limits during the construction.

The most significant potential noise impacts of the project are related to the construction phase of the development and these would be temporary and transient in nature. Well surface locations also have the potential to impact upon parks and reserves, and design and mitigation measures have been incorporated with consideration of these areas to ensure compliance with relevant criteria.

Whilst construction noise has been assessed on the basis of a six to twelve month construction period, this is a worst-case scenario and is unlikely to be the case at most well surface locations. Further, given the nature of surrounding land use and development, residential receivers are few and site specific design measures have been incorporated into the well surface locations to ensure that the impacts upon these receivers are minimised and maintained within acceptable limits.

The character and density of surrounding land use is expected to change significantly from the construction to the operational phases of the Project with subsequent implications for background noise levels and potential noise impacts. It is demonstrated in the noise assessment that design measures have been incorporated that would be sufficient to reduce noise emissions from producing wells to within allowable limits such that residual impacts in terms of noise would be manageable. Detailed noise monitoring would be undertaken once wells have been commissioned to validate the site specific design measures of well surface locations and determine whether further mitigation is required. A similar approach would be taken to the decommissioning and rehabilitation phases of the project.

The potential noise impacts of the operational, decommissioning and rehabilitation phases of the project are expected to be manageable with the implementation of appropriate mitigation and would not result in significant adverse impacts upon the amenity of nearby residential development.

Based on the results of the noise assessment with regard to the project, the broader Stage 2 Concept Area impacts are expected to be manageable and maintainable within acceptable limits.

Social

The proposed Stage 2 Concept Area comprises Campbelltown, Camden and Wollondilly LGAs with the Menangle Park Project Area located wholly within Campbelltown LGA and the Spring Farm Project Area located wholly within the Camden LGA.

Wollondilly LGA is significantly larger in area than both Campbelltown and Camden and has a significantly lower population and population density.

Campbelltown LGA has a significantly larger population and population density than both Wollondilly LGA and Camden LGA. However, the sub-areas for the Menangle Park Project Area and the Spring Farm Project Area (rural residential and Elderslie/Spring Farm respectively) are relatively similar in population size with the Spring Farm Project Area located in a smaller sub-area with a lower population density.

The future development of these areas, particularly the Menangle Park Project Area and the Spring Farm Project Area, would significantly change the social characteristics of these sub-areas. Within the Stage 2 Concept Area, there is potential for approximately 8 000 new lots within these land release areas. The Elderslie/Spring Farm sub-area has the potential for around 4,083 lots and the Menangle Park sub-area has the potential for 4,200 lots.

The future development of urban release areas within the Menangle Park and Spring Farm Project areas would alter the social characteristics of these areas over the life of the proposed project. The assessment of potential social impacts as a result of the proposed project has taken this future development into account.

Due to the identification of potential social and amenity impacts with respect to visual, noise, traffic and hazard and risk, the design and planning of the Project would implement measures to ensure these impacts are minimised. Provided the recommended management and mitigation measures are implemented the potential social impacts of the proposed development are expected to be minimal.

In addition to the recommended mitigation measures, ongoing community consultation would keep the local community up-to-date and well informed regarding works in their area. A telephone hotline is also provided for the reporting of complaints or emergencies and any complaints are recorded and immediately addressed.

Economic

The proposed expansion of Stage 2 of the CGP provides economic benefits for the local, regional and State economies through taxes, charges and other indirect revenues as well as through the supply of a valuable energy resource for existing and predicted future demand. The supply of such a resource would ensure that prices remain stable for existing consumers and would support development in other important sectors including industry, manufacturing and construction.

Implementation of the proposal would generate approximately \$35 million in expenditure and approximately 70 temporary direct employees with indirect employment generated through demand for goods and services by staff and contractors associated with the CGP expansion. Based on studies multiplier values of around 2 can be considered relevant to the Camden operation. A multiplier of 2 means that for every \$1 of increased demand in one sector, another \$1 of demand is stimulated in the various sectors linked via production and consumption generated effects. The total impact of the Camden operations could be in the order of double the direct impacts.

The proposal would utilise the 35 existing contractor staff for the majority of the operational requirements of the CGP expansion. The anticipated employment increase for CGP, as a direct result of the operational stage of the project, is expected to be three new positions. The development of the project would help to secure these new positions into the future as well as securing the future of existing contractor positions.

The Camden Gas Project is providing a significant addition to economic activity in the region, and is an important source of employment, as well as demand for local goods and services.

This activity is consistent with the existing economic environment, and is a local source of value-adding which would contribute jobs and demand for goods and services, both directly and indirectly, to an area which has a demonstrated need for economic stimuli to match the population growth which is currently occurring.

The Project would contribute positively to Government initiatives such as the development of coal seam methane resources, the National Greenhouse Strategy, petroleum exploration in New South Wales, and the deregulation of energy markets in Australia.

The proposed development represents an economic benefit through the provision of gas to an already constrained NSW gas market. The extraction of gas as part of the CGP maintains the current supply and ensures security of supply to future urban (residential, commercial and industrial) development in the area, region and the State. Natural gas (including CSM) produces around 55% of greenhouse gas emission per gigajoule of energy relative to coal, making it the cleanest fossil fuel. A competitively priced gas supply from the CGP will reduce reliance on more greenhouse intensive fuels, which in accordance with the principles of BASIX for new developments.

Water

Potential impacts to water resulting from the proposed development were assessed with respect to surface water, flooding and groundwater. As the CGP has a history of extensive coal seam gas well development, previous assessments of impacts to surface and groundwater from previous well developments were reviewed, as well as existing operational management plans, for the purpose of this assessment.

All wells are cased-off and cemented for their entire length in accordance with the requirements of the Department of Primary Industries (DPI). The steel casing ensures that aquifers within the other geological formations would thus remain isolated and groundwater cross-contamination would not be likely to occur, which is in accordance with requirements from the NSW Government.

Design measures have been incorporated to ensure that in the event of flooding, operational processes would be set in place effectively isolating the meter run from the gathering system. The wellhead, separator and meter run would be safely submerged for an extended period of time with no risk to the environment or the infrastructure. Warning of significant flooding (namely, 1 in 100 year) events would be issued to enable operations on flood-prone land to be made secure.

Water use would be minimised through the recycling of drill and frac water for use at other well surface locations before being disposed of according to requirements of the DECC. As such, the issues identified are not considered to represent a significant constraint to the proposed development.

Flora and Fauna

An ecological assessment was undertaken relating to the proposed development activities within the Spring Farm and Menangle Park Project Areas. The assessment included field investigations which were undertaken in late October, early November 2006, early February 2007 and July 2007. The field investigations focussed on the proposed well surface locations, gas gathering lines and access road locations. For each well surface location, the assessment was undertaken over a 200 metre study area surrounding the indicative location (the Study Area) and 25 metres either side of the proposed locations of the gas gathering lines and access roads.

It is anticipated that the ecological impacts associated with the proposed works would be minimal provided that final well surface locations are chosen to avoid areas of significant vegetation. In order to manage the works to prevent further degradation to the remaining native vegetation and habitats within the Spring Farm and Menangle Park Project Areas, mitigation measures are recommended in the EA. As potential disturbance of the proposed development was found to be higher at certain Study Areas, additional mitigation measures would be implemented for these areas.

The ecological assessment undertaken in respect of the proposed works within Spring Farm and Menangle Park, for which Project Approval is being sought, indicates that provided that the recommended mitigation measures are implemented, it is unlikely that the proposed activities would result in further degradation to vegetation or habitats within both the Spring Farm and Menangle Park Project Areas. For ecological impacts associated with the Stage 2 Concept Area, the impacts on flora and fauna are generally the same as those identified in the Menangle Park and Spring Farm Project Areas. It is recommended location guidelines are used in consideration of the siting of wells. These guidelines would be further detailed in an ecological assessment undertaken as part of subsequent Project Applications within the Stage 2 Concept Area and provided this is undertaken the proposed activities within Stage 2 Concept Area are not likely to result in significant adverse impacts on flora and fauna within the Stage 2 Concept Area.

Landscape and Visual Amenity

The landscape and visual amenity assessment considered potential impacts of well surface locations in terms of:

- Visibility - a measure of the degree to which the construction activities and the final structure may be visible from the surrounding area, the relative number of viewers, the period of the view, the proximity of the view and the type of view;
- Visual Absorption Capacity - an estimation of the capacity of the landscape to absorb developments without its character being significantly changed or its scenic quality reduced.

The visibility assessment considered the visibility and visual absorption capacity of each well surface location and allocated each with a visual sensitivity rating of high, medium or low, where a high sensitivity rating indicated significant visibility of the proposed works and low indicated minimal to no visibility. In addition, as visual impacts to residents are considered to be highly significant, a proposal that is located in close proximity to residential development a higher sensitivity rating is therefore likely to apply.

Of the sixteen proposed well surface locations four of the well surface locations were identified with a low-medium visual sensitivity rating with the remainder of the well surface locations identified as low. Potential visual impacts would be most significant at the construction phase of the proposed development due to the size of the construction footprint and scale of plant and equipment required. As the footprint and scale of plant and equipment reduces in later phases, the potential visual impacts are also reduced. Once construction is completed for the gas gathering system, it would be below ground surface and the surface land returned to its original state, therefore removing the visual impact. Given the existing access roads within the general area and that they are at ground level, visual impacts associated with the access roads are considered minor. Provided the recommended mitigation measures are implemented, significant adverse visual impacts are not expected to result from the proposed development.

Indigenous Heritage

An archaeological field investigation was undertaken within the Stage 2 Concept Area in October, November 2006, February 2007 and July 2007. The survey revealed 25 archaeological sites, of which four were probably recorded during earlier surveys. Discounting these four sites, the survey collected information on 21 previously unrecorded Aboriginal sites – 13 in the Spring Farm Project Area and eight (8) in the Menangle Park Project Area.

While the well surface locations within the Spring Farm and Menangle Park Project Areas were investigated in detail, the wider Stage 2 Concept Area was also considered during the field investigation to consider the types of landforms and areas archaeological sites may occur. Based on existing environmental information and the physical inspection, it was considered that sites routinely occurred upon elevated areas and major creek lines (typically second order or higher), with other low relief areas and lower order creeks having a lesser potential.

Given numerous archaeological sites are located in the Project Areas with some located on the periphery of the proposed well surface locations, the potential for subsequent activities to impact archaeological sites through works were considered in the design and approach to each phase of the development. These considerations included activities beyond the nominated well surface locations, access roads and drill sites, such as vehicle turning circles, equipment storage, spoil heap locations, and earthworks.

Although the proposed activities of the CGP are anticipated to result in some disturbance to Aboriginal heritage within the locality, potential impacts would be minimised through the implementation of environmental safeguards and management options for Aboriginal heritage sites and artefacts. These environmental safeguards and management options would be developed in consultation with local Aboriginal Groups in a Cultural Heritage Management Plan. Upon implementation of environmental safeguards and management measures identified, the impacts associated with Aboriginal heritage are not expected to represent a significant environmental impact.

Non-Indigenous Heritage

The Stage 2 Concept Area has been subject to considerable land disturbance from previous agricultural, recreational and industrial land uses that occurred in the region, together with more recent residential/urban development which has occurred in certain locations within the area. Sand and soil extraction within the areas of Spring Farm and Menangle Park has resulted in significant land disturbance.

A search of the State Heritage Inventory was conducted to identify items of heritage significance. Given the relatively large area covered by Stage 2 of the CGP, several items were identified, particularly of local heritage significance. The majority of these items are listed in the relevant LEPs as having heritage significance, and include old homesteads and cottages.

The siting of the wells and infrastructure would be designed in consideration of the identified heritage items within the Stage 2 Concept Area, including the proposed Menangle Park Project Area and Spring Farm Project Area. These items would be avoided in order to ensure the potential impacts on these items from the development is minimised. For the Spring Farm and Menangle Park Project Areas, provided the recommended mitigation measures above are implemented, significant adverse environmental impacts on non-indigenous heritage items resulting from the proposed development are not anticipated.

With regard to the Stage 2 Concept Area, it is considered that potential impacts on non-indigenous heritage items would be minimised through the careful planning of the siting of the wells with consideration of heritage items. Locational Guidelines for the siting of wells within the

Stage 2 Concept Area have been developed and would assist in minimising impacts on identified non-heritage items.

Traffic and Transportation

The proposal would result in additional vehicles, including heavy vehicles, transport machinery and personnel to and from areas proposed for well surface locations and ancillary development with the most significant impact predicted to occur during the construction phase of the project. The production and post development phases of the project would result in minor and intermittent vehicle activity associated with maintenance and testing, and installation of in-field compression and re-fracture stimulation of wells. Similarly, the closure and rehabilitation phase of the project would result in some additional vehicle movements over a relatively short period of time.

Mitigation measures would be implemented to minimise potential impacts on traffic and transport networks of the Stage 2 Concept Area and the Spring Farm and Menangle Park Project Areas. A greater level of detail regarding site establishment, site constraints and site specific mitigations measures for the Stage 2 Concept Area would be detailed in future Project Applications.

The traffic and transport impacts associated with the proposed development are considered to be negligible in light of the existing and future traffic environment, with respect to the relatively minor increase in additional vehicles, and the temporary and relatively short term duration of vehicle related activities.

Waste Management

The proposed development involves a number of activities that would result in the generation of waste materials. Wastes generated within the Stage 2 Concept Area and the Spring Farm and Menangle Park Project Areas would largely be similar. Waste would predominantly be generated during the construction and rehabilitation phases of work from activities including:

- Civil works associated with the construction and preparation well surface locations and drill pads;
- Drilling activities;
- Fracture stimulation (fracture stimulation and re-fracture stimulation); and
- Rehabilitation of construction areas.

During the phases of the project, management measures would be implemented in order to ensure that waste generation is minimised, and that waste suitable for reuse or recycling would be handled appropriately. Wastes requiring disposal would be removed from the site and disposed of at a licensed waste facility.

This EA has identified the potential for the generation of waste during the various phases of the proposed development, however it is likely that a majority of the waste generated would be during the construction period, and would be temporary in nature. Furthermore, the waste generated requiring offsite disposal is not expected to be substantial, as much of the waste including excess topsoil, mulched vegetation and formation waters generated during fracture stimulation would be reused for various activities associated with operation as well as rehabilitation.

The implementation of waste management measures and environmental safeguards would further minimise and effectively manage waste generated, thus minimising residual impacts.

The generation of waste from the proposed development is therefore considered to be manageable and does not represent a significant constraint to the project.

Rehabilitation and Final Landform

The overall objective of undertaking final rehabilitation at each of the well surface locations is to return the land to pre-operational land use and condition. Rehabilitation of well surface locations would also minimise residual impacts of the proposed development on land use within the Stage 2 Concept Area and Spring Farm and Menangle Park Project Areas. Rehabilitation of well surface locations would be undertaken in two stages. These include:

- Initial rehabilitation of surplus construction footprint following completion of drilling; and
- Final rehabilitation of well surface locations following closure of the wells.

During each stage of final rehabilitation, mitigation measures and environmental safeguards would be implemented to minimise potential impacts.

The final rehabilitation works would be undertaken with maximum regard to environmental protection including training operators in the principles of least possible disturbance and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation.

The rehabilitation of the subject areas would ultimately return the land to pre-operational land uses. Rehabilitation activities would occur in two discrete phases; namely initial rehabilitation and the closure and final rehabilitation. The assessment identified potential impacts associated with each of these stages. However, the development and implementation of appropriate environmental management measures and the Rehabilitation Management Plan would ensure the minimisation of impacts associated with rehabilitation activities.

Statement of Commitments

In accordance with the EARs issued under Part 3A of the EP&A Act, Statements of Commitment (SoC) are provided. As the Project comprises two separate components – a Concept Application and a Project Application, two separate Statements of Commitment have been developed in recognition of the different approvals paths.

The SoCs state the Proponent's environmental commitments and detail the environmental management and monitoring of the proposed Project along with further investigations/studies which the Proponent would carry out (particularly in relation to the Stage 2 Concept Area).

The Proponent is committed to ensuring the preparation and implementation of the environmental management and monitoring plans, further investigations and studies and environmental mitigation measures detailed in the SoCs for the proposed Project.

The SoCs, prepared in respect of the proposed Project, have been compiled on an issues basis and are informed by the environmental risk analysis and impact assessment undertaken as part of this EA. The SoCs have been written in a format which can be incorporated into subsequent project or concept approvals issued, to act as the conditions of that approval.

Residual Risk

The Residual Environmental Risk Analysis for the proposed Project is based on a process adapted from Australian Standard AS 4369:1999 Risk Management, as well as environmental

risk tools developed by other organisations. Residual Environmental Risk is assessed on the basis of the significance of environmental effects of the proposed project and the ability to confidently manage those effects to minimise harm to the environment.

The analysis of residual environmental risk for issues related to the proposed Project is shown in **Table ES-3**. This analysis indicates the environmental risk profile for the proposed Project based on the assessment of environmental effects, the identification of appropriate safeguards, and the SoC included in this EA.

Table ES-3: Risk Profile

Issue	Significance	Manageability	Residual Risk
Hazard and Risk	2	2	4 (Low/Medium)
Land Use	2	3	5 (Low/Medium)
Noise and Vibration	2	3	5 (Low/Medium)
Air Quality	2	1	3 (Low)
Water Management	2	1	3 (Low)
Visual Impacts	2	2	4 (Low/Medium)
Soils and Geology	2	2	4 (Low/Medium)
Ecology	2	2	4 (Low/Medium)
Cultural Heritage	2	2	4 (Low/Medium)
Transport and Traffic	1	1	2 (Low)
Social	3	2	5 (Low/Medium)
Economic	2	1	3 (Low)
Resource Implications	2	1	3 (Low)

The above residual risk analysis indicates that the proposed Project presents an overall low/medium risk in relation to each of the identified environmental issues provided that the recommended mitigation measures are implemented.

Project Justification

The proposed expansion of Stage 2 of the CGP would provide benefits for the local, regional and State economy in terms of the provision of a valuable, indigenous energy resource to supply the growing NSW economy.

The importance of securing an indigenous, cost-effective energy supply, with lower greenhouse emissions is considered vital to the social and economic growth of the project area and the State. The Project represents a significant investment in the region and provides the local community with the impetus to plan for future business and service opportunities in the area.

The Proponent has developed the application of CSM technology locally, and based on the history of existing local CGP operations. The CGP presents a viable application to use this resulting in an increase in gas production in NSW to meet the projected increase in demand for this resource. Furthermore, the development of this local resource locally reduces the need to transport gas from elsewhere (including interstate), improving efficiency.

Substantial benefits would result from the proposed expansion, including environmental benefits associated with the provision of an alternative and cleaner fuel to that provided by coal. Natural gas is widely considered to be the cleanest and most environmentally acceptable fossil fuel, producing only 55% of the greenhouse gas emissions when burned (including carbon dioxide and sulphur compounds) compared to the burning of coal. The Project would also provide wider economic benefits including the facilitation of further development in the Spring Farm and Menangle Park Project Areas and the provision of an important energy resource for commercial and industrial users.

The proposal stands to provide significant public benefit in terms of the provision of a vital source of energy for projected future demand as well as allowing for the future urban (residential, commercial and industrial) development of the area. The proposal would therefore have resultant benefits for the local and wider community and the environment, as well as for present and future generations.

1 BACKGROUND

1.1 Introduction

The Camden Gas Project (CGP) is a major coal seam methane (CSM) project involving the extraction of gas located within the Southern Coalfields of the Sydney Basin. Exploration and production titles associated with the CGP are issued under the New South Wales (NSW) *Petroleum (Onshore) Act 1991*.

Current CGP operations consist of approximately 100 existing coal seam gas wells, access roads, underground gas gathering pipes and gas treatment facilities.

HLA-Envirosciences Pty Limited (HLA ENSR) has prepared this Environmental Assessment (EA) on behalf of AGL Gas Production (Camden) Pty Limited (AGL) to assess the potential environmental impacts of the development of additional gas wells and associated infrastructure proposed to expand the CGP and its production capacity. This EA addresses the nature of proposed works and potential impacts for an area within the Camden, Campbelltown and Wollondilly Local Government Areas (LGAs) identified as Stage 2 of the CGP.

Concept Approval is being sought for general works within Stage 2. In addition, concurrent Project Approval is being sought for specific works within Spring Farm and Menangle Park. HLA ENSR has prepared this EA in accordance with the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979 (EP&A Act)* and *Environmental Planning and Assessment Regulation 2000 (EP&A Regulation)*, together with the Director-General's Environmental Assessment Requirements (EARs) which were issued to the Proponent in March 2007 by the NSW Department of Planning (DoP).

1.2 Overview of the Camden Gas Project

The CGP is located approximately 65 kilometres (km) south west of Sydney, and is being developed to continue and grow NSW gas production.

The project is situated within land extending from Newcastle to Wollongong over which Petroleum Exploration Licence 2 (PEL 2) has been issued by the Minister for Mineral Resources under the *NSW Petroleum (Onshore) Act 1991* (see **Figure 1.1**).

Within PEL 2, four areas have been granted as Petroleum Production Leases (PPLs) under the *NSW Petroleum (Onshore) Act 1991*. These areas are known as Petroleum Production Lease 1 (PPL 1), Petroleum Production Lease 2 (PPL 2), Petroleum Production Lease 4 (PPL 4) and Petroleum Production Lease 5 (PPL 5) and enable the production, gathering and sale of petroleum gas.

Stage 1 of the CGP was approved in 2002, and initially comprised 22 wells, the Ray Beddoe Treatment Plant (RBTP) and an in-field compression gas gathering system in the Cawdor area. Stage 1 entered into gas production pursuant to PPL 1 and PPL 2.

Stage 2 of the CGP was originally approved in 2004, and initially comprised 43 wells, the Rosalind Park Gas Plant (RPGP) and gas gathering system in the Menangle and Menangle Park areas

Stage 2 entered into production pursuant to PPL 4 issued by the Minister for Mineral Resources in October 2004.

The two main areas remaining for development within the CGP Stage 2 area are Spring Farm and Menangle Park, however additional wells could be developed in other parts of the Stage 2 area.

An overview of the development history of the CGP is provided in **Table 1-1** below.

Table 1-1: Summary of Camden Gas Project

Relevant CGP Area	Brief Activity Description	Year
Stage 1	22 wells and the Ray Beddoe Treatment Plant (RBTP) and in-field gas gathering system in the Cawdor area.	2002
Stage 2	43 wells, Rosalind Park Gas Plant (RPGP) and gas gathering system in Menangle and Menangle Park	2004
Stage 2	Additional 15 wells at Mt Taurus and Harness Racing at Menangle Park	2004
Stage 2	Additional 6 wells at Glenlee and Elizabeth Macarthur Agricultural Institute (EMAI) Stage 1	2004
Stage 2	Additional 7 wells at Sugarloaf	2005
Stage 2	Extension of 10 wells on the El Bethel property	2006
Stage 1*	Extension of one well	2005
Stage 2*	Extension of 5 wells	2005
Stage 2	Glenlee modification	2006
Stage 2	Additional 14 wells on EMAI property	2006
Stage 2	Additional 10 wells in Razorback area	2006
Stages 1 & 2*	Additional 9 wells across the existing field	2007

* - these well extensions were part of a combined section 96 modifications

Figure 1.3 displays the existing and proposed wells within the Camden Gas Project.

1.3 Location

The proposed project which is the subject of the application for Concept Approval (further development within Stage 2), involves the construction of wells, gas gathering lines, other supporting infrastructure and post development activities to enable gas production within Stage 2 of the CGP. The Stage 2 area is situated within the Camden, Campbelltown and Wollondilly LGAs, south west of Sydney.

The Nepean River runs through the project area, from the south to the north western corner of the Stage 2 area. The area extends from the suburbs of Narellan and Currans Hill in the north to south of Menangle, extending across to Glen Alpine and Ambervale in the east, and Camden in the west (see **Figure 1.2**), and incorporates the areas of Spring Farm and Menangle Park.

Concurrent Project approval is being sought for the construction of wells and access roads, the installation of gas gathering and water pipelines within Spring Farm and Menangle Park (see **Figure 1.2**).

The area known as Spring Farm is located within the Camden LGA. The Spring Farm area is located east of Camden and is situated south of the Camden by-pass. The Nepean River adjoins the south west boundary of the area, while the suburbs of Spring Farm border the north/north eastern boundary of the area. Land in the area is allocated to support future urban (residential, commercial and industrial) development.

The Spring Farm area is located between the existing well fields of Glenlee (to the south east) and EMAI (to the south).

The Menangle Park area falls within the Campbelltown LGA. The land is situated south east of the proposed Spring Farm well field. The Menangle Park area is bounded by the Hume Highway to the east, with the exception of a small portion of the site which is situated east of the Hume Highway and north of Menangle Road. The Nepean River adjoins the western and southern boundaries of the area.

1.4 The Proponent

The Proponent of the project outlined in this EA is AGL Gas Production (Camden) Pty Limited (AGL), as the operator of the Camden Gas Project, through a Joint Venture with Sydney Gas (Camden) Operations Pty Limited (Sydney Gas).

AGL believes that coal seam methane provides a safe and superior alternative energy supply for the New South Wales market that is clean, efficient and environmentally friendly when compared with other fossil fuel energy options.

AGL Gas Production (Camden) Pty Limited is a wholly owned subsidiary of AGL Energy Limited, an Australian public company listed on the Australian Stock Exchange. AGL currently operates four Petroleum Production Leases (PPL1, 2, 4 and 5) in New South Wales.

As the operator of the Camden Gas Project, AGL is responsible for the delivery of the proposal in accordance with all regulatory requirements, the Project's Environment, Health and Safety Management Plans (EHSMPs), and industry best practice.

1.5 Environmental Assessment Process

The EP&A Act 1979 and the EP&A Regulation 2000 provide a framework for environmental planning in NSW.

Prior to any decision to proceed with a proposal that may have an impact on the environment, a detailed assessment of the likely impacts of the project must be undertaken. The proposed project has been declared by the Minister as a major project under the provisions of the EP&A Act and *State Environmental Planning Policy (Major Projects) 2005* (SEPP 2005), and is therefore subject to the provisions of Part 3A of the EP&A Act (see **Appendix A** for record of Minister's opinion).

Part 3A of the EP&A Act establishes the processes and matters for consideration by the approval authority when determining the impact of a project and whether the project should be approved.

1.5.1 Major Projects

The proposal involves the recovery of coal seam methane which requires the drilling and operation of petroleum wells, associated gas gathering lines and ancillary works. The proposal falls under the definition of a 'major project' under Group 6 of Schedule 1 of SEPP 2005.

Group 6 of Schedule 1 to SEPP 2005 identifies classes of development which are defined as 'major projects' and includes projects related to petroleum (oil, gas and coal seam methane), being:

'Development for the purpose of drilling and operation of petroleum wells (including associated pipelines) that:

- c) *Is in the local government areas of Camden, Wollondilly, Campbelltown City, Wollongong City, Wingecarribee, Gosford City, Wyong, Lake Macquarie City, Newcastle City, Maitland City, Cessnock City, Singleton or Muswellbrook, but only if the principle resource sought is coal seam methane.*

The recovery of coal seam methane involves the drilling and operation of well surface locations associated gas gathering lines and ancillary works. The proposal involves well site development for coal seam methane extraction within Stage 2 of the CGP which is situated in the Camden, Campbelltown and Wollondilly LGAs. Therefore the proposal falls within the definition under Group 6 of Schedule 1 of SEPP (Major Projects) 2005.

The Proponent will therefore be seeking the following approvals pursuant to Part 3A of the EP&A Act:

- Concept Approval for the development of wells and associated infrastructure and post development activities within the Stage 2 area; and
- Concurrent Project Approval for the proposed well surface locations, access roads gas gathering and water lines at Spring Farm and Menangle Park Project Areas.

This EA has been prepared to support the works proposed as part of the Concept and concurrent Project Approval.

1.5.2 Environmental Assessment Requirements

Section 75F of the EP&A Act requires an EA to be prepared in accordance with the requirements of the Director-General of the Department of Planning (DoP). A request for these requirements was made in October 2006.

The Director-General's EARs were issued in March 2007, a copy of which is enclosed as **Appendix B** to this EA.

1.5.3 Planning Focus Meeting

Having regard to the history of the CGP, the DoP in this instance advised that a formal Planning Focus Meeting (PFM) was not required. However, DoP, on behalf of the Director-General, sought the views of relevant statutory authorities on issues to be included in his EARs, by referring a copy of the Preliminary Project Application and Environmental Assessment Scoping Report (EASR). This process provided opportunity for key statutory authorities to establish the requirements for the form and content of the EA. These requirements are outlined in **Section 5** of this EA.

1.5.4 EA Exhibition

This EA has been prepared under Part 3A of the EP&A Act which specifically lists the matters to be addressed in an EA.

The EP&A Act requires that the EA be placed on exhibition for public review for a minimum period of 30 days.

1.6 Context of this Proposal

On 13 June 2003, the Minister declared the CGP as State Significant development, and the existing Stage 2 works of the CGP were considered pursuant to Part 4 of the EP&A Act.

On 1 August 2005, planning reforms were introduced to the EP&A Act. Of significance to this project was the introduction of Part 3A of the Act which provides the assessment framework for major projects, development previously classified as State Significant development, and other projects declared by the Minister.

The Minister, on 10 October 2005, advised that a Concept Plan must be submitted for the remainder of the development within Stage 2 prior to (or concurrently with) seeking Project Approval for any part of the development, pursuant to Part 3A of the EP&A Act.

As the Minister has advised that the project meets the criteria for a major project, approval will be sought for this project pursuant to the provisions of Part 3A of the Act.

Discussions with representatives of DoP on the approvals process to be implemented having regard to the Minister's advice of 10 October 2005, confirmed the following approvals strategy:

- Further works within Stage 2 would require a Concept Approval.
- Concurrent Project Approval could be sought for wells, access routes, gas gathering and water lines within Spring Farm and Menangle Park.

The DoP confirmed that a single Environmental Assessment (EA) could be prepared to provide the necessary level of detail to support the Concept Approval for the further Stage 2 works and concurrent Project Approval for specific works (including wells and gas gathering lines) within Spring Farm and Menangle Park.

Consultation with landholders during the project design phase ensured that wells and other infrastructure were sited to accommodate the primary land use, where possible. This has resulted in the relocation, removal or redesign of wells before the proposal was submitted for approval.

The use of SIS technology, co-location of wells and consultation with landowners has resulted in the Proponent significantly reducing the number of proposed wells from around 45 to 16, which has reduced the overall footprint of the project. In Spring Farm, the proposal was originally for around 20 wells which was then reduced to four (4) well surface locations and in Menangle Park there were around 25 wells originally proposed, while now there are 12 well surface locations.

1.7 Purpose of this Report

This EA has been prepared by HLA on behalf of the Proponent for proposed gas well surface locations and associated infrastructure works within Stage 2 to expand production of the CGP, including works within Spring Farm and Menangle Park.

In accordance with Part 3A of the EP&A Act, the Director-General's EARs for the project were issued in March 2007. This EA has been prepared pursuant to those requirements and addresses the matters listed by the Director-General.

The purpose of this report is to:

- explain the nature of the activities which could occur as part of the CGP expansion (including construction, production, post development and final rehabilitation activities);
- assess the potential environmental impacts of these activities on the physical, social and economic environment (having regard to both existing and future land use);
- establish locational guidelines/ principles as part of the Concept application to minimise potential impacts; and
- identify mitigation measures to be implemented during construction and operation of the project.

1.8 Approach to Environmental Assessment

As explained earlier in this report, the proponent is seeking Concept Approval for works and/or activities which may be implemented to enable further gas production within Stage 2 of the CGP. In addition, concurrent Project Approval is being sought, specifically in relation to the development of gas wells and associated infrastructure (gas gathering lines and access roads) within the Spring Farm and Menangle Park areas.

Concept Approval provides for complex projects to be considered on the basis of a Concept Plan, with the assessment focussing on strategic issues rather than detailed information, and determining the broad requirements of a project up front. If a Concept Approval is granted, further assessment and other forms of approval are generally required prior to commencement of work. More detailed information is provided at these later stages of assessment / approval.

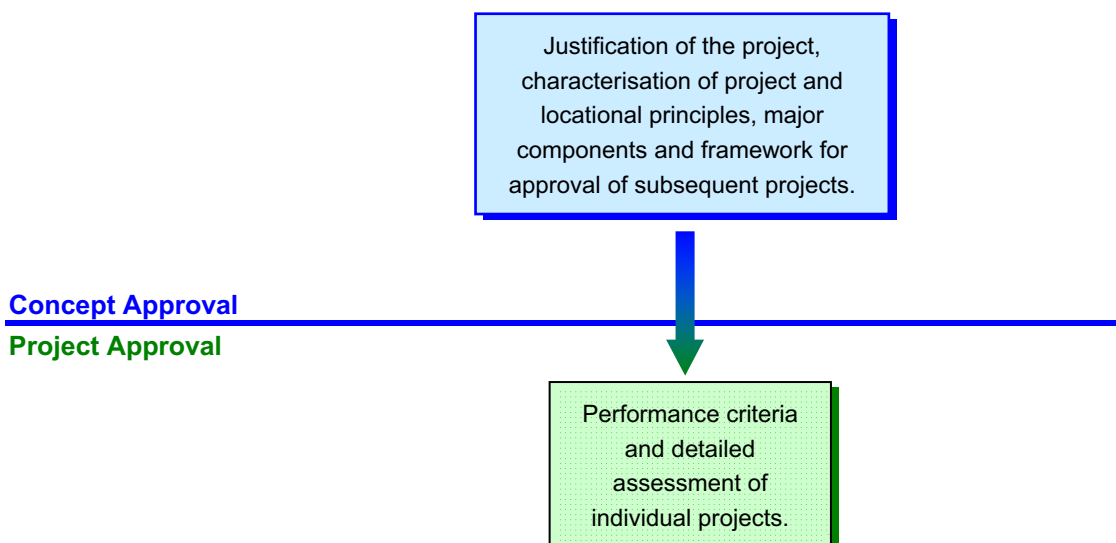
This EA therefore provides different levels of detail in respect of the broader Stage 2 Concept Plan area and the Spring Farm and Menangle Park areas for which concurrent Project Approval is being sought.

The approach adopted for the EA involves describing the types of development and/or activities which may occur within the area and identifying the potential impacts associated with such development/activities.

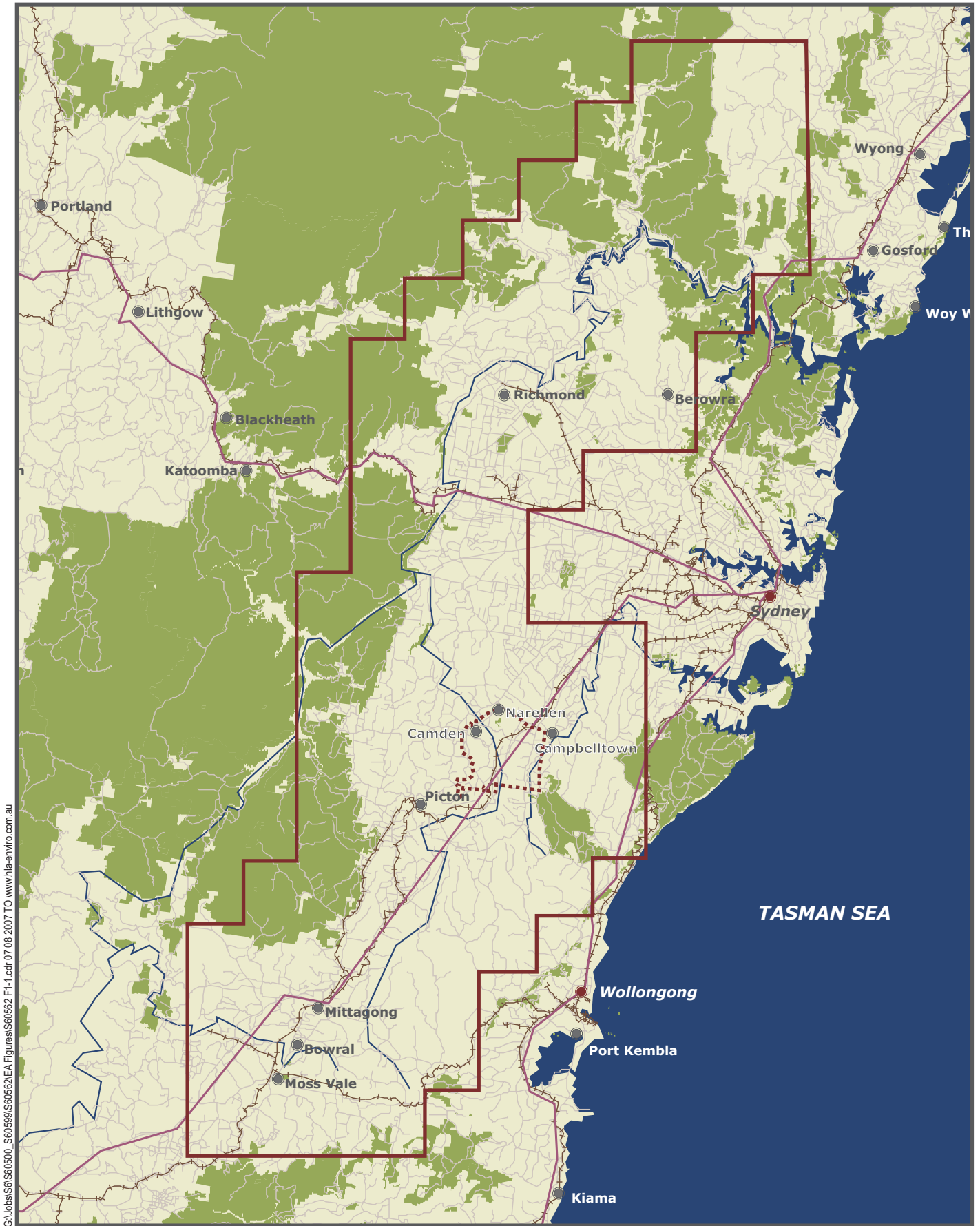
Given the more strategic nature of the Concept Plan, locations for the proposed development/activities are not identified, however locational guidelines/principles have been developed to assist with future siting of wells and associated infrastructure, or operational/maintenance activities. More detailed studies of the physical characteristics and potential impacts of proposed works identified in the Concept Plan would be provided in subsequent applications.

As indicated above, concurrent Project Approval is being sought for the proposed works within Spring Farm and Menangle Park, for which the Proponent has identified proposed locations for the proposed wells and gas gathering lines. Therefore, this EA includes more detailed baseline information and assessment of impacts for works proposed within the Spring Farm and Menangle Park areas based on the construction and operational footprint, together with a suite of mitigation measures and a Statement of Commitments to manage the potential impacts of works. Should Project Approval be granted for works within Spring Farm and Menangle Park, no further planning approvals would be required prior to commencement of works in these areas.

The approach to environmental assessment for this project is illustrated below.



The Environmental Assessment has used an “envelope” approach to the impact assessment which means that the highest impact activities are assessed even when these activities are not the most likely. The envelope approach allows for flexibility and compatibility with future land use in the absence of firm proposals for urban development. The assessment has been carried out on a wider area to allow the final well surface locations to be within an approximately 50 metre radius of the nominated location (in the case of Spring Farm) and an approximately 100 metre radius of the nominated location (in the case of Menangle Park) and 25 metres either side of proposed routes gas gathering lines and access roads. This approach would allow AGL to move infrastructure within the assessed parameters to enable flexibility with landowners and to accommodate future land uses.



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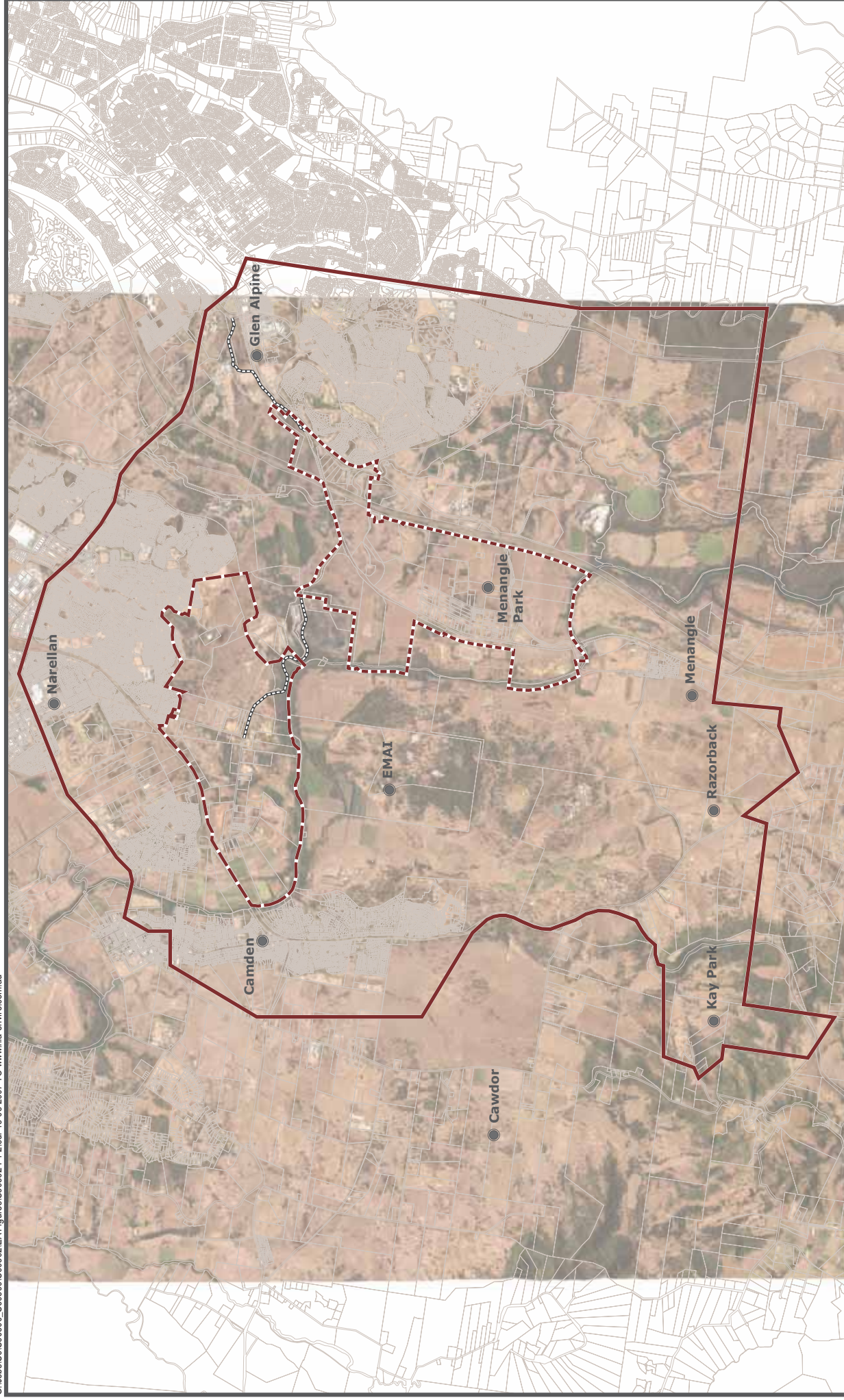
Merged
with ENSR
in 2007



- PEL Boundary
- - - Stage 2 Concept Area boundary
- Highway
- Road
- + + + + Rail
- River
- National Parks Estate

Figure 1.1

Stage 2 Concept Area Within PEL 2
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project



— Stage 2 Concept Area Boundary
- - - Spring Farm Project Area Boundary
... Menangle Park Project Area Boundary
--- Access road



0 2km

Figure 1.2

Stage 2 Concept and Project Area Boundaries
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

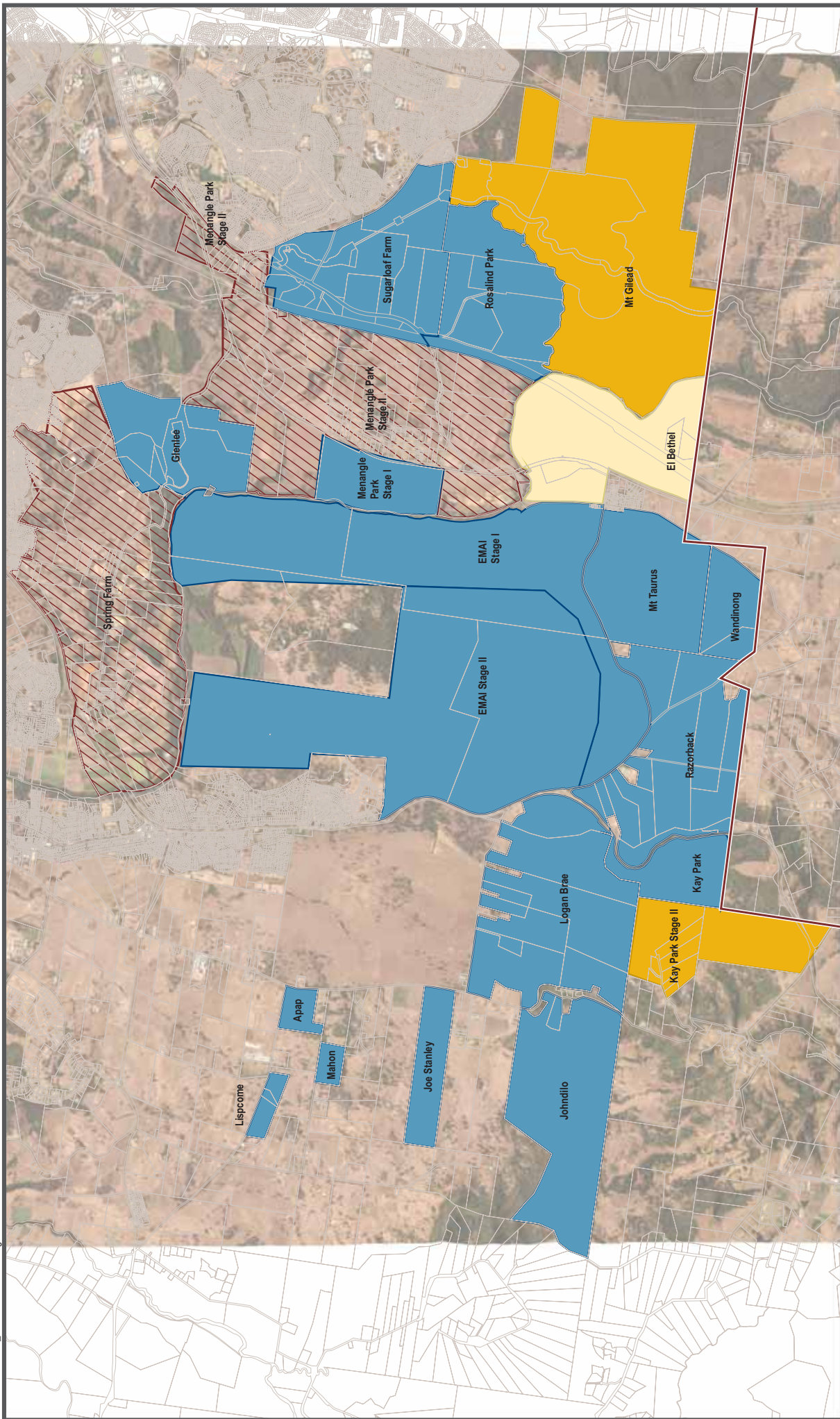
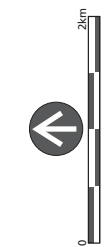


Figure 1.3
Detailed View of Existing and Proposed Well Fields
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

- BHP Billiton coal mining lease
- Drilled well field
- Future well fields within Stage 2 Area
- Approved not yet drilled well field
- Proposed Well Fields



2 THE SITE

2.1 Stage 2 Area – Location

The area subject to the Concept Application (Stage 2 Concept Area) is located approximately 65 kilometres south west of Sydney in the Camden, Campbelltown and Wollondilly LGAs within New South Wales (see **Figure 1.2**). The Stage 2 area of the CGP, incorporating Spring Farm and Menangle Park comprises largely undeveloped lands within a predominantly semi rural landscape. Spring Farm and Menangle Park are however earmarked for future urban development.

2.2 Land Ownership and Legal Description – Spring Farm and Menangle Park

Spring Farm and Menangle Park are located within the Camden and Campbelltown LGAs respectively, and are located between 7km and 21km by vehicle from Camden Airport.

Spring Farm is bounded to the south by the Nepean River, while Menangle Park is bounded by the Nepean River along its western and southern boundaries.

The majority of the well surface locations are sited on flat to gently sloping land. No existing dwelling house or sensitive land use is located within 200 metres of a proposed wellhead surface location. However, according to DoP Locational Guidelines, dwellings may be constructed up to a minimum of 10 metres away from existing gas wells.

The property details associated with the works proposed in Spring Farm and Menangle Park, and the indicative well surface locations are identified in **Table 2-1** below, and are depicted in **Figures 4.1, 4.2** and **4.3** along with indicative routes for gas gathering lines and access roads.

Table 2-1: Property Details

Owner	Lot/DP	Well Surface Location and supporting infrastructure details
Spring Farm		
Landcom	13/ DP 1081753	SF17, SF04/ SF04A, access through lot along WSN right of carriageway to Lot 2 in DP1076817, access roads, gas gathering and water lines
	2/ DP 816858	Access via WSN right of carriageway off Richardson Road to Lot 2 in DP1076817
Camden Council	1/ DP 1007608	SF10, SF20, access, gathering and water lines
	4/ DP 1007608	Access route and gas gathering lines
WSN Environmental Solutions	11/ DP 1081753	Connection of access route and gas gathering lines from SF10, SF17 and SF20 to existing system near GL02/12.
	2/ DP 1076817	Connection of access route and gas gathering lines from SF04 to existing system near GL06.
	14/ DP 1081753	Access via existing road for connection of proposed works SF04 with existing system at GL06.
SADA Services Pty Limited	2/ DP 863680	Access via existing road to Lot 54 in DP 864754 for SF04 and for connection into the existing system near GL06.

Owner	Lot/DP	Well Surface Location and supporting infrastructure details
TJ & RF Fordham Pty Limited	54/ DP 864754	Access via existing road for SF04 works and for connection of gathering into the existing system near GL06, including gathering line underbore of the road.
Menangle Park		
Landcom	7/ DP 253700	MP02, MP03, access, gathering lines and potential underbore options for gathering.
	2/ DP 790254	MP06, access, gathering lines and option for potential underbore of the rail line near underpass to connect MP04 to gathering from MP05.
	X/ DP 378264	MP06, access road and gas gathering line to interconnect to existing gas gathering trunk line.
	D/ DP 19853	Access road and gas gathering line to interconnect to the existing gas gathering trunk line.
	2/ DP 737485	MP11, MP19, access road and gas gathering line options
	8/ DP 249530	MP19, MP22, access road and gathering line options which may include a gathering underbore
	1/ DP 598067	MP21, MP23, access road and gathering lines
	11/ DP 584016	MP21, MP22, MP23, gathering lines and access route which may include a gathering underbore
	2/ DP 554242	Access route option off cnr Taber St & Cummins Rd
	3/ DP 628052	Gathering line and access route from MP04 to rail line underbore.
	5/ DP 249530	Access route option off Glenlee Road (East)
	41/ DP 259152	Access route for MP02 and MP03 off Gilchrist Drive
University of Western Sydney	6/ DP 253700	Access route for MP02 and MP03 off Gilchrist Drive
Minister Administering the EP&A Act	8/ DP 253700	Access and gathering for MP03 as well as a potential underbore of the rail line for potential gathering options either along freeway adjacent to Lot 4 in DP 205663 and Lot 1 in DP 249549 or option along rail line to connect to MP04.
	1085/ DP 792746	Potential gathering line option (Menangle/ Glenlee Roads) to link MP02 and MP04 which may include an underbore of Upper Canal at junction of Menangle and Glenlee Roads from either Lot 1085 in DP 792746 or Lot 2 in DP 842735 to Glenlee Road
	181/ DP 791988	Potential gathering line option (Menangle/ Glenlee Roads) to link MP02 and MP04 which includes a potential underbore from Lot 9 in DP 253700
	2/ DP 842735	Potential gathering option (Menangle/ Glenlee Roads) which may involve an underbore of Upper Canal at junction of Menangle and Glenlee Roads from either Lot 1085 in DP 792746 or Lot 2 in DP 842735 to Glenlee Road (East)
TransGrid	31/ DP 1100981	MP04, access, gathering lines and potential underbore from the Freeway or railway line gathering options

Owner	Lot/DP	Well Surface Location and supporting infrastructure details
Sydney Catchment Authority	26/ DP 249530	Access road off Glenlee Road (East)
	27/ DP 249530	Continuation of access road from Glenlee Road (East)
	1/ DP 616271	Potential access option to MP04 along Upper Canal and potential gathering line option to link MP03 and MP04 which would require underbore of the F5 and possible underbore or crossing of Upper Canal from either to Lot 3 or 5 in DP 249529 to Lot 31 in DP 1100981
	2/ DP 616271	Potential gathering option (Menangle/ Glenlee Roads) which requires underbore of Upper Canal and potentially Menangle Road at the junction of Menangle and Glenlee Roads from either Lot 1085 in DP 792746 or Lot 2 in DP 842735
	2/ DP 1086648	Potential gathering option (Menangle/ Glenlee Roads) which requires underbore of Upper Canal at junction of Menangle and Glenlee Roads
Australian Rail Track Corporation (ARTC)	1/ DP 790254	MP05, access, gathering lines and gathering line underbore of the south rail spur line to Lot 2 in DP 790254
	9/ DP 253700	Access and gathering for MP02 and a potential underbore location for the potential gathering line option (Menangle/ Glenlee Roads) to connect MP02/03 across from Lot 181 in DP 791988 with MP04.
	1/ DP 234108	Access for MP02 and MP03
	10/ DP 253700	Access for MP02 and MP03
	Govt. Gazette 5/11/1858 Folio 1823 Book 70 No. 447 Book 80 No. 475 Book 71 No. 92 Book 68 No. 798	- Main Southern rail line easement for gathering line option to link MP02 and MP03 with MP04 - Main Southern Rail line underpass for access south of the Glenlee rail spur and north of Glenlee House from Glenlee Road (East) and gathering which may include a potential underbore from Lot 3 DP628052 to Lot 2 DP790254 - Access through Main Southern Rail line underpass at the Howes Creek crossing
SADA Services Pty Limited	1101/ DP 883495	Access for MP05 and MP06
	38/ DP 1098588	Access for MP05 and MP06
	1/ DP 405624	Access for MP05 and MP06
J Tripodi	1102/ DP 883495	Access for MP05 and MP06
Campbelltown City Council	2/ DP 236059	MP24, access, gathering lines and underbore of Menangle Road
	3/ DP 236059	Gathering line from MP24 to link into existing system and access option off Menangle Rd to MP33
	1/ DP 249393	MP33, gas gathering lines and access route options

Owner	Lot/DP	Well Surface Location and supporting infrastructure details
	7/ DP 787284	Access to Menangle Road and potential gas gathering lines
	124/ DP 1097090	Access to Menangle Road
	125/ DP 1097138	Access to Menangle Road
	33/ DP 1101983	Access to Menangle Road
	19/ DP 260090	Access to Menangle Road
	22/ DP 260090	Access to Menangle Road
	23/ DP 260090	Access to Menangle Road
	1/ DP 708770	Access to Menangle Road
	1/ DP 707225	Access to Menangle Road
L & E Trevisan	4/ DP 205663	Potential gathering line option (Freeway) to link MP03 and MP04
A & M Begaj	1/ DP 249529	Potential gathering line option (Freeway) to link MP03 and MP04
P & B Durovic	2/ DP 249529	Potential gathering line option (Freeway) to link MP03 and MP04
M Harris	3/ DP 249529	Potential gathering line option (Freeway) to link MP03 and MP04, including potential underbore location.
Roads & Traffic Authority (RTA)	Menangle Road (Crown Road) reserve between the rail overpass and the Nepean River Bridge	Gathering line underbore of Menangle Road just west of the rail line, then gathering line in verge of road under the rail overpass for connection to existing gathering system.
	4/ DP 249529 5/ DP249529 6/ DP249529 7/ DP249529	Potential gathering line option (Freeway) to link MP03 and MP04 which may require underbore of the F5 from Lot 3 in DP 249529 to Lot 31 in DP 1100981
	4/ DP 210548	Potential gathering line option (Menangle/ Glenlee Roads) to link MP02 and MP04
	17/ DP249530 19/ DP249530 20/ DP249530 21/ DP249530 22/ DP249530	Potential gathering line option (Menangle/ Glenlee Roads) to link MP02 and MP04 which may involve an underbore or strap on to the Mark Evans Bridge. (F5 freeway at the Mark Evans Bridge)
Torrens Re-Development and Research Pty Limited	3003/802845	Potential gathering line option (Menangle/ Glenlee Roads) to link MP02 and MP04 which may include underbore

2.3 Site Description

As previously mentioned, the area subject to Concept Approval crosses three LGAs, Camden, Campbelltown and Wollondilly, located south west of Sydney. The Stage 2 area is characterised by low lying gently undulating plains and rolling low hills and rises. The Nepean River is a dominant feature of the landscape. The general nature of the area is predominately rural and rural industrial land uses with the larger areas of residential development occurring along the northern, north eastern and north western boundaries of the area. Scattered pockets of residential development occur within the Stage 2 area and include the Menangle Park village and small residential lots in Spring Farm.

Land uses dominating the Spring Farm area include poultry farming, sand and soil extraction, an electricity substation, Jacks Gully Waste Management Facility, grazing and some residential development. In the Menangle Park area, land uses include horse related activities, livestock grazing, orcharding and extractive industries such as a coal washery and sand and soil mining. There is significant infrastructure within the Menangle Park area including the southern railway and south western freeway.

Both Menangle Park and Spring Farm have been identified as future urban (residential, industrial and commercial) land release areas. The planning of the Spring Farm Urban Release Area is more advanced than that for Menangle Park due to the development of LEP 121, adoption of the Spring Farm Master Plan and Development Control Plan – Spring Farm (refer to **Section 5.3.1**). It is expected that further environmental/ planning studies would be undertaken over the next 3 to 5 years with the intention of rezoning the Menangle Park area for future urban (residential, commercial and industrial) land development.



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3 PROJECT NEED AND ALTERNATIVES

3.1 Need for the Project

According to statistics provided by the Ministry of Energy and Utilities (2001), natural gas constituted around 11% of energy usage in New South Wales in 1998-99. About 70% of this is used by industry, with the remainder used by domestic and commercial customers. Most of NSW's supply is currently provided from the Cooper Basin in South Australia via the Moomba to Sydney pipeline and the Eastern Gas Pipeline, which runs up the New South Wales east coast from the landfall of the Bass Strait fields at Longford (Victoria).

Both of these natural gas supplies are sourced from sandstone reservoirs, using traditional development techniques that have been universally employed by the oil and gas industry for many decades.

The Proponent has identified a significant gas resource in the Sydney Basin which, contrary to a conventional gas resource, is held within coal seams instead of porous sedimentary rocks. The technology required to extract and produce this gas is an emerging industry in Australia which has been operating overseas for many years (particularly in the USA) but until now has had very limited application in Australia, although in Queensland up to 25% of all gas consumed now comes from coal seams. The Proponent has developed the application of this technology locally and based on the history of existing operations believes that NSW presents a viable application to use this technique to develop gas reserves to meet ever increasing future energy needs.

The development of viable coal seam methane production (CSM) in the Camden area has been demonstrated by the Proponent as a result of several factors:

- the user market for gas producers is immediately adjacent to the gas source, thus resources do not need to be consumed in the construction of hundreds of kilometres of pipeline to transport the gas; and
- appropriate strategic planning, design and operation of the project will ensure that its life-cycle will be appropriately integrated with the other existing and future land uses in the area.

The importance of securing an indigenous, cost-effective energy supply, with lower greenhouse emissions is considered vital to the social and economic growth of the project area and the State.

Projections of natural gas usage in New South Wales estimate that it will increase to around 230 petajoules (PJ) per annum by the year 2015, an increase of some 90 PJ over existing levels, thus placing additional pressure on both suppliers and prices (Australian Bureau of Agricultural and Resource Economics (ABARE)).

The majority of energy consumed in NSW is generated from the combustion of black coal. Natural gas (including CSM) produces around 55% of greenhouse gas emissions per gigajoule of energy relative to coal, making it the cleanest fossil fuel. Gas typically costs more per gigajoule than coal but it is a more efficient fuel so a competitively priced gas supply from the CGP will reduce local reliance on more greenhouse gas intensive fuels.

The development of new gas supplies to the ever increasing Sydney and NSW market is important to guarantee supply. This Project will provide the next step both in ensuring that

supply to the Sydney market is maintained in the future and in helping to protect the environment.

The Australian Gas Association (AGA) is less optimistic than ABARE about Australia's future gas supply and demand balance. In AGA's view, the delivery of gas from new sources is required much earlier than ABARE envisages if Australia is to ensure that competitively priced gas is available when major contracts come up for renegotiation later this decade.

Analysis of Australia's future natural gas reserves and production have been reported by ABARE and show that based on current gas demand forecasts, reserves in the Cooper-Eromanga, Bass, Bowen-Surat and Adavale Basins will be all but depleted by 2019, with only the Gippsland Basin maintaining a significant reserve.

It is therefore incumbent upon government to ensure that current Australian supplies of gas are supplemented from additional sources sooner rather than later. The Moomba – Sydney and the Eastern Gas pipelines run through the CGP, consequently, the Proponent is well placed to assist in bringing additional gas to the market from Stage 2 of this project.

The expansion of the CGP will also assist in the achievement of several NSW and regional energy objectives and initiatives which are formulated to provide safe, efficient and secure energy supplies into the future.

3.2 Alternatives Considered

Alternatives for the Project include consideration of alternative energy types, alternative locations with access to CSM resources, alternative siting for wells and gas gathering system connections and the “do nothing” approach. Each of these are addressed in the following sections.

3.2.1 Alternative Energy Sources

There are two main conventional gas sources available as gas supplies, the Gippsland Basin in Victoria and the Cooper Basin in South Australia. These sources currently supply the majority of NSW's gas.

Gas from the Gippsland Basin (offshore gas fields off the coast of Victoria from Lakes Entrance to Sale) is supplied into the New South Wales market via the Eastern Gas Pipeline at a number of delivery points (Horsley Park, Wollongong, Nowra etc). Gas from the Cooper Basin in South Australia is supplied into the New South Wales market via the Moomba-Sydney Pipeline at a number of delivery points (Wilton, Orange, Wagga etc).

In consideration of alternative energy sources, this Project has been specifically designed to develop and exploit an existing gas source. CSM has significant advantages in terms of energy efficiency and reduced greenhouse emissions compared to fossil fuel based energy sources such as coal. Natural gas is also cleaner and generally contains no sulphur products. CSM is therefore considered to be a superior option for development in this case.

3.2.2 Alternative CSM Resource

In terms of alternative locations of CSM resources, there are two main coal producing basins within NSW which could be targeted for methane production. These are the Sydney Gunnedah-Bowen Basin, and the Clarence-Moreton Basin. However, the production of CSM within these basins is dependant upon a number of factors including coal depth, and thickness, appropriate land uses, permeability of the coal seams, and appropriate maturity and gas saturation. While exploration has been carried out in a number of areas throughout these basins, the Proponent's

CGP and the Eastern Star Gas Narrabri Power Project are the only ventures that have been successfully progressed to the development phase.

The CGP is located within the Sydney market, close to the State's energy intensive users. This reduces the transportation costs compared with more remote projects. In addition, the existence of readily available infrastructure including gas plants and trunk gas mains ensures the commercial competitiveness of the project. Other infrastructure essential to the project such as roads, powerlines, and nearby service businesses, already exist in the area, in contrast with consideration of similar projects in more remote regions.

3.2.3 Alternative Siting of Wells and Infrastructure

Options for the siting of wells, the location of the gas gathering system, and supporting infrastructure in Spring Farm and Menangle Park have been chosen carefully, taking into consideration existing land uses and development, future urban use of these areas, as well as technical, environmental and site-specific constraints including:

- technical criteria including geology;
- the consideration of environmentally sensitive areas;
- proximity to existing residences and future urban development/bushland corridors;
- sediment and erosion hazards;
- visual and acoustic amenity;
- flora and fauna constraints;
- archaeology and heritage constraints; and
- operational requirements including access and proximity to the plant.

For some wells, land constraint maps have been developed to ensure that the chosen well locations will have minimal impact on the surrounding environment, within the bounds of the "high production fairway" (the interpreted trends of the best quality gas producing coal zones).

Consultation with landholders during the early project design phase ensured that wells and other infrastructure were sited to accommodate the primary land use. This has resulted in the relocation, removal or redesign of wells before the proposal is submitted for approval.

The use of SIS technology, co-location of wells and consultation with landowners has resulted in the Proponent significantly reducing the number of wells from around 45 to 16 and the overall footprint of the project. In Spring Farm, the proposal was originally for around 20 wells which has been reduced to four (4) well surface locations and in Menangle Park there were around 25 wells originally proposed, while now there are 12 well surface locations.

The environmental envelope assessment approach allows the well surface locations to move within a 50 metre radius in Spring Farm and a 100 metre radius in Menangle Park (to recognise the differences in the level of information about future urban land releases) and 25 metres either side of gas gathering lines and access roads mean that there is flexibility and an ability to deal with future issues as they arise.

3.2.4 “Do Nothing” Option

If the Project does not proceed, the “do nothing” option would stifle the opportunity to develop a convenient and competitive natural gas supply within the Sydney Basin, sterilising a major state significant resource in an already constrained NSW gas market, and there would be no flow of resulting economic and social benefits to the NSW community. The likely future shortfall in the gas supply to the growing NSW market may in turn lead to an increase in the use of less efficient alternative fossil fuel sources that would increase greenhouse gas emissions.

AGL is confident that gas resource recovery will be maximised for the following reasons:

- SIS drilling technology - The Surface to Inseam (SIS) drilling technique allows AGL to access gas resources that were previously sterilised by surface development. These wells maximise the connection to the gas reservoir leading to a higher recovery rate than vertical or directional wells.
- Well design - The well spacing and design is based on geological modelling, production data analysis and infill drilling results which will maximise economic recovery of the resource.
- Exploration and new techniques - The reservoir is constantly being examined and re-examined to ensure the appropriate extraction techniques and methods are used.
- Infill wells may be drilled once production data is available that indicates further resource exists, which ensures that the resource extraction is maximised.

The “do nothing” option would also be a lost opportunity to contribute positively to Government initiatives such as the development of coal seam methane resources, the National Greenhouse Strategy, petroleum exploration in NSW, and the deregulation of energy markets in Australia. The “do nothing” option is therefore not considered to be an appropriate alternative in this instance.

4 PROJECT DESCRIPTION

4.1 Introduction

The Proponent is seeking Concept Approval for a range of works relating to the remainder of development within the Stage 2 area of the CGP. Concurrent Project Approval is also being sought for works within the proposed Spring Farm and Menangle Park well fields. The Proponent's objective for this Project is to expand its gas production, thereby expanding NSW gas production.

In this section the description of the proposed project has been split between the Concept and Project Approval. The scope of activities for the Project Approval generally includes the same activities for developing new well fields, infill wells and installing gas gathering line upgrades which are proposed under the Concept Approval, therefore the description of these Concept plan activities will be referenced to the Project description where appropriate. The post development activities for which approval is being sought are limited to the Concept Approval

4.2 Overview of Proposed Activities

The works proposed under both the Concept and Project Approval involve the construction and subsequent operation of a number of gas wells, together with associated infrastructure and post development activities, which deliver gas to the gas plant.

Concept and concurrent Project Approval is being sought for a range of activities which can be divided into the following:

- Construction: The activities required to physically develop the wells and supporting infrastructure;
- Production: Production and delivery of gas from well surface locations to the gas plant via gas gathering lines for sale, including commissioning and maintenance activities such as re-drilling;
- Post Development: Operational activities which may be needed to maintain production efficiency. These activities are proposed as part of the Concept Plan only and were generally not included as part of previous approvals in Stage 2. It is anticipated these activities may include the development of infill wells, upgrade of gas gathering lines, re-fracture stimulation (if required) and installation of infield compression; and
- Closure and Final Rehabilitation.

Sections 4.2.1 and 4.2.2 provide an overview of the proposed activities which form part of the Concept and concurrent Project Approval, including **Table 4-1** which provides a breakdown of the Project tasks by activity.

A more detailed description of key activities associated with implementing the proposed works in Stage 2 of the Camden Gas Project has been structured into activity based sections (see **Sections 4.4, 4.5, 4.6 and 4.7**).

4.2.1 Spring Farm and Menangle Park Project Approval

The Project application relates to the areas identified in **Figure 1.2**. **Table 4-1** below provides a breakdown of the tasks proposed as part of the Project application by activity.

Table 4-1: Breakdown of Task by Activity

Construction	Production	Closure and Rehabilitation
• Preparation of access roads, drill pads and environmental controls. • Construction and drilling of wells. • Construction of water transfer and gas gathering lines. • Fracture stimulation of coal seam (where required). • Installation of the wellhead and surface equipment to enable the production of water and gas. • Connection of the wells to the trunk gathering system. • Initial rehabilitation of areas used during construction and drilling activities.	• Commissioning: typically includes initial work over, dewatering and production testing activities to bring the well into production. • Operation of the wells in accordance with the Petroleum Production Lease. • Maintenance of wells (work over). • Maintenance of gathering and access roads. • Production, metering and sale of gas.	• Decommissioning wells at the conclusion of production. • Removal of wellhead assemblies and other equipment from the site. • Plugging and abandonment of wells in accordance with Department of Primary Industries - Minerals Guidelines. • Final rehabilitation of the well surface locations, gas gathering lines and access roads.

The Project application seeks approval for the construction of wells at up to 4 well surface locations within the Spring Farm area and up to 12 well surface locations in the Menangle Park area (with up to six well heads at a one well surface location). A significant component of the construction activities described above are related to the installation of new wells. There are various types of well drilling technologies that could be employed as part of the proposed activities. These types of drilling are discussed in greater detail in **Section 4.4.1**. The proposed wells will comprise a mix of vertical, directional and SIS (horizontal) drilled wells, and other appropriate drilling technologies, the proposed locations of which are illustrated in **Figures 4.1, 4.2 and 4.3**.

4.2.2 Stage 2 Concept Application

The activities which are the subject of the Concept Approval are largely the same as those the subject of the Project approval, however, the Concept Approval also includes the installation of in-field compression and re-fracture stimulation of wells. As the requirement for these activities within the entire Stage 2 Area is not certain, these will be assessed as part of the Concept Plan, and therefore any future requirement to conduct these activities will require a separate Project application and approval.

Utilising the various technologies available the activities proposed as part of the Concept Approval can be allocated into five component groups as follows:

- **new well fields** in areas identified as Spring Farm, Menangle Park, Mount Gilead and Kay Park Stage II (see **Figure 1.3**). Works within the new well fields would involve the construction of wells and associated infrastructure including gas gathering and water pipelines and access roads;
- **infill wells** are either new wells co-located within the pad of existing wells in existing well fields within Stage 2 to access additional resource from

currently disturbed areas through the installation of a new wellhead and bore; or new wells at undisturbed sites with associated infrastructure (including gas gathering and water pipelines and access roads) to be located within existing well fields within Stage 2 where the gas reserve is not able to be accessed from existing wellhead locations;

- **upgrade of gas gathering lines** to allow for increased production capacity, along existing gas gathering line routes, best described as “twinning” the existing gathering lines;
- **installation of in-field compression** in the vicinity of wellheads or along gas gathering lines to increase capacity and production; and
- **re-fracture stimulation** of existing and new wells across all well fields within the Stage 2 Concept Area.

Approval is also sought for the production and transportation of gas from new well surface locations to the gas plant for subsequent sale.

A greater level of detail on post development activities proposed as part of the Concept Approval is provided in **Section 4.6** of this report.

4.3 Location of Proposed Works

4.3.1 Stage 2 Concept Application

As indicated earlier in this report, the Concept Application area is located in the Macarthur region of NSW, approximately 65 kilometres south-west of Sydney, and straddles the Campbelltown, Camden and Wollondilly LGAs. Some properties are likely to be affected by the proposed works, as illustrated by the Concept area boundaries in **Figure 1.2**.

Given the size of the area and the lead time involved in identifying suitable locations for new wells and supporting infrastructure (linked to geology, gas reservoir, environmental constraints and land access), with the exception of the Spring Farm and Menangle Park well fields, the Proponent is not in a position to identify the exact positions of new wells/infrastructure at the Concept Approval stage. This level of detail would be provided as part of subsequent future Project applications.

The boundary of the Stage 2 area for the purposes of the Concept Approval is shown in **Figure 1.2** and has been determined based upon the location of well fields developed to date and areas which may be developed in the coming years.

Table 4-2 describes the approach to locating the various elements of infrastructure proposed as part of the Stage 2 Concept Plan.

Table 4-2: Locational Principles

Development Type	Description of Potential Locations in Stage 2 Concept Area
New Well Fields	- An overview and detailed view of the existing and proposed well fields within Stage 2 Concept Plan area are shown in Figure 1.3. The detailed view includes the location of existing wells and gas gathering infrastructure within the Stage 2 area, including the works approved in December 2006. - New well fields are proposed which will involve drilling a number of new wells within Stage 2. (see Figure 1.3 for proposed location of the new well fields) - The development of new well fields will require the construction of supporting gas gathering lines to connect into the existing network.
Infill Wells	- Infill wells would be considered to maximise resource recovery where there is sufficient production data (anticipated to be several years) that indicates the gas extraction in parts of a well field have been sub-optimal. - Infill wells would first be co-located at existing well platforms to limit new land disturbance. - If surface or geological constraints prevent co-locating the well at an existing site, infill wells would potentially be located at new, undisturbed sites in existing well fields. - Access roads and gathering lines would also be required from existing roads to new well surface locations. - The Proponent has developed an example plan illustrating the approach which would be undertaken to locate infill wells and supporting infrastructure within existing well fields (see Figure 4.4). Infill wells comprise both new wells co-located within a pad of existing wells within Stage 2 through the installation of a new wellhead and bore, and new wells at previously undisturbed sites within Stage 2 where the gas reserve is not able to be accessed from existing wellhead locations.
Infrastructure	If required, increasing the capacity of the existing gas gathering system would be carried out along established gas gathering routes (e.g. through twinning). If required, in-field compression would be located either at existing wellhead locations or along gas gathering routes. Re-fracture stimulation of wells would occur where required. The feasibility of re-fracture stimulation would be subject to environmental considerations at the time. Infrastructure would be located in existing disturbed areas wherever possible.

The Concept Plan represents a strategic overview of future works likely within the Stage 2 area. This approach is intended to provide agencies and the community with an understanding of where the future works may occur, whilst providing the flexibility for the Proponent to determine precise locations subject to future production data, geology and gas reservoir engineering and in consultation with landowners.

The assessment of environmental effects associated with the Concept Plan is based on a more strategic approach to assessment which includes:

- Utilising existing and/or GIS information to identify environmental constraints.
- Developing guiding principles for the location of wells.
- Undertaking an environmental assessment based on a description of the activities proposed, and, where relevant, assessment of surface disturbance based on a defined footprint; and
- Identifying appropriate management measures to be considered in future Environmental Assessments for each activity based on locational scenarios.

In the event Concept Approval is granted for the works in Stage 2, a greater level of detail would be submitted with a subsequent Project application(s) (with the exception of Spring Farm and Menangle Park for which detail is included in this EA as part of the concurrent Project approval application).

4.3.2 Spring Farm and Menangle Park Project Approval

Section 4.3 provides a description of the areas covered by the Spring Farm and Menangle Park Project Approval. The proposed works within the Spring Farm and Menangle Park areas are shown on **Figure 4.1**, **4.2** and **4.3** respectively. Specialist studies have been used to inform the 'envelope' of assessment and identify environmental constraints to the final design location of the wells. For the purpose of flexibility, the EA and associated specialist studies have been undertaken using an 'envelope approach' whereby environmental impacts are assessed within a 50 m radius of the proposed location within Spring Farm and within 100 m of the proposed location for Menangle Park to establish the potential impacts of the proposed works within this broader area. Therefore, the final selected wellhead location could be anywhere within the 50 m or 100 m radius dependant upon identified environmental constraints. Likewise the final routes of the access roads and gas gathering lines may be located anywhere within the 25 m either side of the proposed routes.

This approach provides certainty in the assessment of potential environmental effects and delivering identified environmental outcomes while at the same time enabling site specific flexibility at the detailed engineering stage.

4.3.3 Project Staging

AGL's development schedule for delivery of the CGP identifies that the drilling of wells within Spring Farm and Menangle Park is currently scheduled to commence in late 2007 subject to approval.

4.4 Construction Works

4.4.1 Well Surface Locations

Construction and Preparation of Well Surface Locations

Site preparation and construction works would be carried out generally in accordance with the following sequence:

- Install silt fences and other environmental controls as required;
- Installation of approved road opening to property where necessary;
- Upgrade or installation of access roads;
- Removal of topsoil over access ways and store for initial rehabilitation;

- Truck in hard surface (typically shale) for access road base and drill pad;
- Install drain culverts, cattle grids, fencing, gates, bed level crossing and other works as necessary;
- Earthworks as required on a site-specific basis;
- Construct drilling compound (up to 10,000m²) and fence the perimeter as required by Health, Safety and Environment, and other requirements;
- Strip topsoil and stockpile, then cut and fill as required for a level drill pad area;
- Dig and line drill pit(s) with polyethylene non-permeable liner (typically up to 25x25 metres and 2-3 metres deep). The drill pit(s) are provided to retain and recycle drilling debris and associated water for the drilling process;
- Create a cut-back, flat operating area where wells are constructed on slopes. This construction generally includes an up-slope diversion drain around the site to manage excessive surface flow. The profile is returned (as near as possible) to the original profile during rehabilitation; and
- Rehabilitation of the surplus construction area when construction complete.

Access Roads

Access to the well surface locations will be along existing public roads and private tracks within the relevant property boundary. Earthworks may be required to construct or upgrade access roads to new well surface locations to enable the drilling rig and support equipment access to the sites. Where practicable, existing road and track access will be utilised to minimise construction activity and environmental disturbance. Construction of all access roads will be in accordance with the AGL EHSMP and with previously approved and implemented Soil and Water Management Plans.

Proposed access roads are depicted in **Figures 4.1, 4.2 and 4.3**. All private roads and tracks used during operations will be returned to their pre-operations state, or to a condition agreed by the landholder.

As the urban development proceeds within the locality and new roads are provided, requirements for, and location of access roads may vary. The Proponent will work with this to adapt to the evolving nature of road development and access provision in the locality.

Well Surface Locations

The proposed site of well surface locations has been determined following extensive geological exploration and analysis. The final well surface locations may be adjusted within the assessment envelope during detailed design based on consideration of the environmental and social constraints including land use (existing and future), topography, subsurface geology, flora and fauna, archaeological constraints, noise impacts and the like which have been identified in this EA.

The construction of wells for works under both the Concept and concurrent Project Approval are described above.

Once the well has been drilled and completed, the fenced construction area is reduced to a typically 45 x 45 metre area during the well commissioning phase and the surplus construction area is rehabilitated (see **Figure 4.6**). Photographs of existing typical wellhead facilities are included below, illustrating well facilities located in the rural environment, and a new enclosed well surface and metering facility for a single wellhead intended to have a small footprint and low visual impact, sound insulation and security from vandalism, likely to be situated within the urban environment.

Up to four (4) well surface locations are proposed within Spring Farm and up to 12 well surface locations are proposed in the Menangle Park area (**Figure 4.1, 4.2 and 4.3**) each of which may contain up to six (6) wellheads. The typical wellhead configuration for six SIS wellheads is illustrated in **Figure 4.4**.

The surface production facility typically consists of the wellhead(s), miscellaneous pipe, valves and fittings, water/gas separator and instrumentation (see **Figure 4.5** for typical producing well). Variations to this may be required subject to site constraints, new technical information or to fit with future land uses (such as the enclosure shown in **Figure 4.7**).

The instrumentation has telemetry which transmits well information to the gas plant control room so the production data can be accessed and reviewed, which is shown in **Figure 4.8**. The wells have numerous alarms and automatic shutdown functions which are based on a 'Cause and Effect' design. The well can be shut-in or opened remotely from the gas plant, which is shown in **Figure 4.10**. This feature is available to ensure the safety and control of wells.

The wellhead surface production facility is enclosed in an area of up to approximately 20m x 20m for the typical 6 wellhead configuration (see **Figure 4.4**) which would be fenced in consultation with the landowner and to suit future land use. An area of up to 45 x 45 metres around the surface production facility would be required periodically for maintenance.

Screening and landscaping will be provided where appropriate in consultation with landowners and consideration of future land use. Vegetation will be sourced from the local area and will include drought tolerant species endemic to the local area.

Options such as the use of electricity for construction and production and various storage options for produced water depending on individual site constraints would form part of the detailed post approval engineering design. There are also well surface locations that may be subject to future sand mining or future urban land releases, which may involve re-levelling of the land surface. Proposed construction methods and well design allow for a single change in the level of wells to accommodate these potential future land uses, so that neither gas production nor future land use proposals are affected, which means that the two land uses can co-exist.

A number of well surface locations were moved or alternative sites considered in the design phase following consultation with landholders to either remove or relocate the wells to the landholder's preferred sites in terms of localised amenity impacts, and following identification of certain environmental constraints. One such site is SF04 within the Spring Farm area. Following ecological investigations it was identified that this site was located in close proximity to an area of replanted Elderslie Banksia Scrub (a threatened ecological community under TSC Act), therefore the Proponent has also considered an alternative site – SF04A which would not impact upon the replanted Elderslie Banksia Scrub (refer to **Section 8.9.5** for further details). The other main constraints on the options for the SF04 well surface location are the existing and future transmission lines. Until the final location of the future power lines has been resolved, the final well surface location cannot be determined.

Other surface locations at Menangle Park were moved to the periphery of the developable land following discussions with landowners, as this area is earmarked for future commercial, urban and industrial development. Similarly, wells that were not able to be relocated to avoid matters raised by landowners, such as MP10 in the area of a regionally significant sand resource, were removed from the design and are now not amongst the well surface locations proposed by the Proponent. The remaining wells have been redesigned to maximise gas extraction from fewer alternative locations on many occasions throughout the ongoing landowner consultation process. The envelope approach allows well surface locations to move as part of the assessment to a more suitable location within the envelope.

Drilling Activities

The use of SIS technology, co-location of wells and consultation with landowners has resulted in the Proponent significantly reducing the number of wells from around 45 to 16 and the overall footprint of the project. In Spring Farm, the proposal was originally for around 20 wells which has been reduced to four (4) well surface locations and in Menangle Park there were around 25 wells originally proposed, while now there are 12 well surface locations.

A variety of technologies would be available for the drilling of wells, taking into consideration land access constraints, aboriginal/heritage, other environmental and geological issues and future alternative technologies. The following technologies are currently available to fulfil the development of wells in the CGP. Consideration has been given to the range of impacts anticipated from the proposed drilling technologies, with the assessment of environmental impacts focussing on the surface area disturbed during the construction and operational phases of the development (based on a worst case footprint). Specialist studies have been undertaken on a worst case basis, assessing the drilling technology which is considered to carry the greatest potential impacts in respect of the specific environment issue being assessed.

Drilling Techniques

Typical drilling technologies currently used are detailed below.

1. Under-balanced Vertical Drilling

Under-balanced vertically drilled wells have previously been the standard wells in the CGP and currently represent around 80% of the wells drilled. Under-balanced drilling is when the pressure of the overlying strata exceeds the pressure of the drilling fluid. Drilling penetration rates are maximised through the shallow, abrasive, medium hardness sands and daily metreages of some 300 metres plus can be achieved.

Equipment required (and currently in use) involves a drilling rig equipped with air compressors and booster packages that provide the energy for the percussion air hammer to drive the drill bit and for fluid circulation. The drilling action employed uses a percussion air hammer, button bit and drill collars to provide the impact to break up formations.

Under-balanced drilling also requires a drill pit or pits to capture the drill cuttings and produced water from the drilled formations.

2. Overbalanced Vertical Drilling

Overbalanced drilling is when the pressure of drilling fluid exceeds the pressure of the overlying strata. This technology has predominantly been used to date as a remedial technique. Future use allows the drilling of wells where land access constraints or environmental features limit the use of drill pits. Improvements are being made in the implementation of overbalanced drilling aimed at improving the rate of penetration to a level which is comparable to under-balanced drilling.

Apart from the drill rig, equipment focus is on drill fluid circulation and solid control systems, with operating capacity of some 1,800 litres per minute. The drilling relies on applied weight on bit and rotation to penetrate and remove the formations. Weight is provided by running drill collars (heavy joints of pipe) behind the bit with rotation and torque provided by the rig's top drive or a downhole motor.

3. Directional Drilling

The major advantage of this drilling technology is that bottom hole locations can be typically located up to some 400 metres away from the surface location (depending on the vertical depth of the coal seam). Therefore wells can be drilled into areas that are constrained for vertical well construction. In addition, multiple wells can be

drilled from a single location and gas reserves that are potentially sterilised by surface developments can be accessed from outside of the developed areas.

The drilling of these wells requires similar surface equipment to the overbalanced drilling technique. Directional equipment and a steerable mud motor are added to the downhole equipment to allow control of the drilling angle and direction.

4. Horizontal Drilling (SIS)

Surface to In-Seam (SIS) or horizontal drilling within a coal seam is a technique adapted from the oil industry where horizontal wells are used to increase the drainage area of a reservoir and provide a means of stimulating the reservoir through the drilling process.

The well is drilled vertically from the surface and gradually builds angle so as to intersect the seam near parallel with the seam dip angle. Once intersected, this portion of the well bore is cased, cemented and a smaller hole is subsequently drilled through the seam for up to approximately 1,500 metres. This technique has been successfully used throughout Queensland and in most of the major coal seam methane basins in North America for many years.

The horizontal drilling process was recently introduced to the CGP with encouraging preliminary results to date. It allows a significant reduction in the number of surface locations along with the ability to access previously sterilised gas reserves. This technique requires continuous drilling, and the drilling operation must therefore be conducted 24 hours a day, 7 days a week.

Fracture Stimulation

Some wells may require perforation of the steel casing to connect the wellbore and the coal seam(s). If required, once it has been completed, the fracture stimulation operation (known as 'fracture stimulation') can then proceed. Fracture stimulation involves the injection of a slurry of sand and water at high pressure. This process stimulates the reservoir by providing a highly conductive flow path for gas and water that extends away from the wellbore and into the seam. The frac sand is locked in place by the pressure of the coal formation and the injected water and formation water is allowed to flow back out. As a result of the water production, the reservoir pressure is reduced at which time gas then begins to desorb from the coal and produce to the wellbore. The well then requires a work over to clean the wellbore and to install the wellhead equipment.

Well Stimulation

There are a number of technologies available for well stimulation to encourage gas to flow, under-reaming and fracture stimulation as described above. For the under-reaming technique, wells are drilled conventionally with casing installed across the coal seams of interest. The under-reaming tool is run in hole on conventional drillpipe and hinged cutting arms are opened through rotation. Current tools are able to under-ream a 178mm cased hole out to a maximum of 2000mm. This stimulation technique is best suited to high permeability coals where the reservoir connectivity to the wellbore is high prior to under-reaming and is aimed at maximising the well's contact area with the gas reservoir.

Drill and Frac Water Management

Drilling and fracture stimulation water is delivered from previous drilling and fracture stimulation campaigns, from licensed stand-pipes or from other approved sources in the local area. The delivered volume required for fracture stimulation of a well is in the order of 250 to 500 kilolitres (kL) depending on the frac design and geological parameters. The constructed drill pit (nominally 25 x 25 x 2-3 metres polyethylene lined) has a capacity of some 750 kL to allow free space for rainfall events. Drill pits are constructed with an upslope diversion drain around the site to divert rainwater surface runoff around the pit. This ensures that only direct rainfall enters

the pit. All pits will be lined and designed with adequate capacity to accommodate the water associated with construction and natural rainfall events.

Following fracture stimulation, the waters are removed from the coal seam and either reused in future drilling and fracture stimulation campaigns or are transported to licensed disposal facilities if the waters have become too saline during interaction with the coal seam. Disposal at licensed facilities is in accordance with Department of Environment and Climate Change (DECC) guidelines.

For over-balanced, directional and SIS wells, water and drilling mud is used in the construction of the well. The volume of water required for the drilling process varies depending on the type of drilling. The largest predicted volume of water is required for the SIS option, for circulation to remove cuttings during drilling. Anticipated volumes are approximately 200 kL. Drilling mud and water is pumped from the well following construction and stored in tanks or drill pits prior to reuse or disposal at a licensed facility.

Dewatering pumps and associated equipment are used in approximately 15% of wells to remove the injected fracture stimulation water and the formation water, which reduces reservoir pressure and allows gas desorption of the coal seam methane wells.

To facilitate water collection and to minimise the impact of trucking water, the Proponent proposes to install a water distribution network co-located within the gas gathering line trenches where necessary to allow water to be moved to centralised storage areas that can act as offsite transport points.

Produced water from wells during the dewatering and early production phases of the wells will be transferred via an automatic dump valve from the wellhead separators into the water transport lines. The water transport lines will be HDPE pipelines running in the gas gathering line trenches.

The produced water from the wells will be collected at storage points located at well surface locations that are easily accessible. These storage points are the lined drill pits utilised during drilling and fracture stimulation or storage tanks. The waters will then be transported to future drilling/fracture stimulation operations, disposed of to licensed facilities or other appropriate measure.

Each well will be different and subject to geological parameters applying to that well. Evidence to date from existing vertical wells suggests that approximately one third of the volume of formation water will be produced over the first one to two weeks following fracture stimulation, the second third will be produced over the subsequent one to two months and the final third will be produced over the subsequent three to six months. Transfer or disposal of these waters will be managed to ensure sufficient rainfall freeboard.

While a drill pit is in operation, the water level in the pit is checked on a daily basis. The water level is managed so as not to exceed approximately 80% of the pit holding capacity, providing a 20% freeboard. As the pit water levels approach the 80% holding capacity, arrangements are made for water to be removed from the pit and disposed of offsite. This ensures that in the event of an unpredicted rain event, direct rainfall will not cause the pit to overflow.

Over 90% of existing wells in Camden are referred to as free flowing. This means that the reservoir pressure within the coal seam combined with a velocity string installed in the well, produce the frac and formation water without the assistance of a downhole pump. In the 15% of wells where this does not occur, dewatering pumps and associated equipment are installed in the well and wells pumped to remove water until steady state gas production is achieved.

Drill Cuttings Management

Drill cuttings are collected and stored in the drill pit. The drill cuttings normally contain sandstone and coal so there is very little sulphidic mineralisation to cause acid rock drainage. Once the drilling and fracture stimulation operations are completed and the drill pit is dewatered and desiccated, there are several options to deal with the drill cuttings.

The first option is for the drill cuttings to be buried under some two metres and covered with excavated soils and rehabilitated. This is below the root zone of crops or proposed revegetation species.

The second option is usually used when drilling with bentonite and in this case the drill cuttings are stored in tanks at the wellhead. These tanks are used for recycle management and surge capacity. Drill cuttings are buried and disposed of as per option one above. Materials unsuited to onsite disposal are disposed of offsite at an appropriate licensed facility in accordance with DECC guidelines (currently the Jacks Gully Waste Disposal Facility).

The third option to manage drill cuttings is to capture the coal fines by diverting these solids from the drill pits to a storage point next to the pit where any excess water can drain into the pit. This option is used in the case of SIS drilling which produces a larger amount of coal material than other drilling types due to the length of the well drilled in coal. In this case the coal fines are stored and transported from the site and are recycled at the Glenlee Coal Washery.

4.4.2 Gas Gathering System

The gas gathering system route will be designed, constructed and operated in accordance with the requirements of *Australian Standard AS 3723-1989 Installation and Maintenance of Plastic Pipe Systems for Gas*. The gas gathering system will be buried to a minimum depth of 750mm and up to 1,200mm in some areas, including unsealed and sealed road crossings, and creek and drainage line crossings.

The route of the gas gathering system route for the Stage 2 Concept Area will be selected to utilise previously or currently disturbed land areas wherever possible. Proposed new gas gathering routes for the Spring Farm and Menangle Park Project Areas are shown in **Figures 4.1, 4.2 and 4.3**.

The construction of the gas gathering lines for the Concept Approval and concurrent Project Approval typically involves the following works:

- Survey of pipeline route;
- Clear and grade 'Right of Way' pipeline route including stripping of topsoil (where required);
- Stringing of pipe;
- Welding of pipe;
- Trenching and underboring where necessary;
- Lowering-in of pipe strings (including trench preparation and padding);
- Installation of tracer lines (for pipe tracing) as PE pipe is non conductive;
- Installation of gas marker tape above PE gas pipe;
- Backfilling and compaction of trench;
- Pressure testing of pipeline;
- Rehabilitation of ground along pipeline route;

- Installation of gas line signposts to mark and identify pipeline location; and
- Register gas gathering line on 'Dial before you dig'.

Low water traps would be installed in low areas of the gathering system to allow removal of water that may collect and would be emptied as required.

All work will be conducted in accordance with AGL's Gas Gathering System Construction EHSMP. The ancillary water transfer system, if required, will be co-located in the trenches for the gas gathering system and installed simultaneously.

The proposed gas gathering system allows for a link to the existing Sugarloaf well field, as well as options for links between MP02/03 with MP04 (which are shown in **Figure 4.2**). These options allow for various constraints such as land availability within the proposed corridors. Other options within the proposed gas gathering system include the crossing of Howes Creek (a small tributary of the Nepean River) and options for crossing the rail line at the underpass near Glenlee Road East). The preferred option for these routes would be determined during the detailed engineering and design phase of the project in consultation with the relevant authorities.

The gas gathering route is inspected annually by a specialist third party Gas Detection inspection service that performs a leakage survey of the below ground pipelines. The survey is conducted at 10 parts per million (PPM) sensitivity for gases and the 10 PPM sensitivity reflects the measurement capability of the equipment used to check for leaks. It does not arise from an Australian Standard or any requirement. It represents AGL best practice which has been adopted from the practices used by high pressure gas pipeliners to inspect for gas leaks once a year (AGL only operates low pressure gas gathering lines at the Camden Gas Project and consequently this is a very high standard).

The preferred method of rehabilitation for the gas gathering system would be to purge with air or water in order to remove remaining gas, seal and then leave in position to prevent any further disturbance. This method would be subject to consultation with the land owner. Should removal of the gas gathering system be required, the excavated trench would be backfilled and rehabilitated, including contouring and revegetating.

4.4.3 Other Infrastructure

The proposed works will incorporate project design measures to avoid impacts on other infrastructure in the area, including:

- Power lines;
- Water pipelines;
- Access road improvements (will be within existing profiles); and
- The under boring of existing infrastructure (if required) associated with construction of the gas gathering systems will conform to the standards of the appropriate authority.

4.4.4 Resourcing of Construction Activities

Where possible the Proponent's employees and contractors are sought from the local region. However, artillage technical services such as fracture stimulation and perforating are conducted by industry specialists sourced from oil and gas areas of Australia and overseas. As equipment and personnel are artillage from out of State the work is done in campaign mode,

meaning that a group of wells are drilled (typically eight (8) wells) and then the perforating and fracturing services performed.

4.4.5 Construction Hours

With the exception noted below, construction hours during the construction phase of the works as part of the Concept Area and Project Approval would be 7.00am to 6.00pm, Monday to Friday and 8.00am to 1.00pm Saturday with no work on Sunday or Public Holidays unless authorised by DECC or DPI Minerals for safety reasons, or inaudible at sensitive receivers.

Drilling of wells would require 24 hour drilling activities, for a period of some 25 days per well and this EA has used this requirement as the basis of the assessment criteria.

4.4.6 Services and Amenities

Temporary portable toilets and amenities would be provided on site for use by construction workers during the overall construction program.

Electricity would be provided by portable generating units or from the grid system where available and practical. Non potable water required for construction and drilling activities would be provided from previous drilling activities in the area or from other approved sources.

4.5 Production

Production Testing

Production testing of the coal seam methane resource would be undertaken for all new wells, involving the following program of works:

- Production testing of the well to ascertain the quantities of gas that will flow from the well; and
- Daily checks of gas flow rates are carried out at each well surface location.

Well Surface Location

The surface production facility consists of the wellhead, variable choke, water/gas separator and the flow measuring instrumentation. The instrumentation has telemetry which transmits the critical well information to the gas plant control room which controls all wells remotely. This feature is available to ensure the safety and control of wells.

The surface production facility is typically enclosed in an area up to some 20 metres x 20 metres (for a 6 well head compound).

Screening will be provided where appropriate as outlined in **Section 8.15**. Vegetation will be sourced from the local area and will include drought tolerant species endemic to the local area. Enclosures such as that illustrated in **Figure 4.6** will be used where appropriate on a site by site basis dependent upon the need for acoustic attenuation.

Production and Metering of Gas

During the production phase, gas is transported via low pressure pipeline to the gas plant for compression and sale. Operator involvement at the well surface location is minimised by the installation of various automated and remotely operated functions.

Telemetry is connected to all wells so the production data can be accessed and reviewed from the gas plant. The wells have numerous alarms and automatic shutdown functions which are

based on a 'Cause and Effect' design. Any well can be shut-in or opened remotely from the gas plant control room once the wellhead communication equipment has been installed.

Operational activities at each well surface location typically include:

- Routine daily/weekly inspections;
- Formation water disposal; and
- Well work over maintenance.

Maintenance/ Work over

During the production or operational phase, the wells require an occasional 'work over' to maintain the efficiency of gas production. The work over typically involves a truck or trailer mounted rig to run or remove pipe for clearing the well bore of fill (typically frac sand) or obstructions. Work over activities generally require a team of up to ten personnel and would typically vary between one day and one week.

4.6 Post Development Activities

This section describes in greater detail the post development activities which have been assessed as part of the Concept Plan.

4.6.1 Concept Approval

Upgrade of Gas Gathering Lines

As new well fields within the Camden Gas Project are brought into production an increased amount of gas will be delivered into the existing gas gathering system prior to reaching the gas plant. In some areas it is anticipated that the existing gas gathering pipework may not have sufficient capacity to handle the increased production. Consequently there may be a need to increase the capacity of parts of the network to allow for this increased production.

Increasing the capacity of the existing gas gathering pipework would generally require the duplication ("twinning") of pipes within the affected sections of the gas gathering network. Duplication of the pipes would be carried out along existing gas gathering routes.

In-field Compression

The Proponent anticipates that during the production phase of existing well surface locations the initial high gas pressure at the wellheads will decrease over time. As a result, pressure drops for gas flow from wellhead to plant across the gas gathering system will reduce over time resulting in a reduction in production rates from the wells. In order to maintain gas production from the gas plant, the Proponent may need to boost the pressure in the gathering system by in-field compression within the Stage 2 Concept Area prior to delivery to the gas plant.

In addition, in-field compression may also be required to achieve higher gas flow rate through the main pipeline owing to the distance from the gas plant. The higher gas flow rate through the existing trunk gathering line will require a higher pressure at the inlet of the pipeline to achieve the throughput through the pipeline to the gas plant.

The method for providing in-field compression will be developed as the requirements within the system arise over time. Options include providing compression in the vicinity of existing wellhead locations or at distribution nodes along the gas gathering system.

The Concept application therefore seeks concept approval for the installation of in-field compression at the wellhead and at distribution nodes along the gas gathering system.

Re-fracture stimulation

Re-fracture stimulation of the wells may be required after a period of operation, and would involve the same operational process to the initial fracture stimulation of the wells (refer to Section 4.1.1). It is noted that re-fracture stimulation of the wells would only be undertaken where a production issue is identified, and is therefore extremely unlikely to be undertaken at all well surface locations.

4.7 Closure and Final Rehabilitation

This section describes in greater detail the closure and final rehabilitation activities which will be assessed as part both the Concept and the concurrent Spring Farm and Menangle Park Project approval.

On completion of operations, all areas will be cleaned up and rehabilitated to return the land to pre-existing use and condition or better. This work will involve:

- sealing/ plugging and abandonment of wells in accordance with DPI guidelines;
- removing plant and equipment from wellheads and removal of fenced compounds;
- filling in excavation; and
- rehabilitation, contouring, and artilage / revegetation.

If wells are installed in an area which may impact on future mining, the Proponent is required by the DPI as part of its title conditions to remove the steel pipe/ casing from the coal seam so as not to impact on future mining operations, and to log the location of the well. These activities, when required, would be undertaken during the closure and rehabilitation phase of the project.

Further detail on rehabilitation practices is provided in **Section 8.15** of this EA.

4.8 Environmental Management

4.8.1 Environmental Licensing

The Proponent holds two Environment Protection Licences (EPLs) in relation to the Camden Gas Project, including the RGP and the RBTP. If approved by the Minister for Planning, the proposed works will require a variation to the EPLs to include the proposed wells, gas gathering system and associated infrastructure in the definition of the licensed premises.

4.8.2 Environmental Management

Management measures which will be implemented during the site preparation, construction, operational and closure and rehabilitation phases of the project are detailed in the EHSMPs for the project.

The Statement of Commitments in **Section 9** outlines measures which will be put in place to mitigate against potential adverse impacts on the environment. Adoption of these safeguard measures underlines the commitment of the Proponent and its contractors to environmental management during all phases of the project.

4.8.3 Environmental Monitoring

The Proponent's EHSMPs provide a process for continuous improvement of the environmental management of the project through ongoing monitoring and regulatory management procedures.

The CGP provides a telephone hotline for the reporting of complaints or emergencies, which informs the management and provides ongoing monitoring of operational issues. Complaints received by the hotline are recorded and immediately addressed.

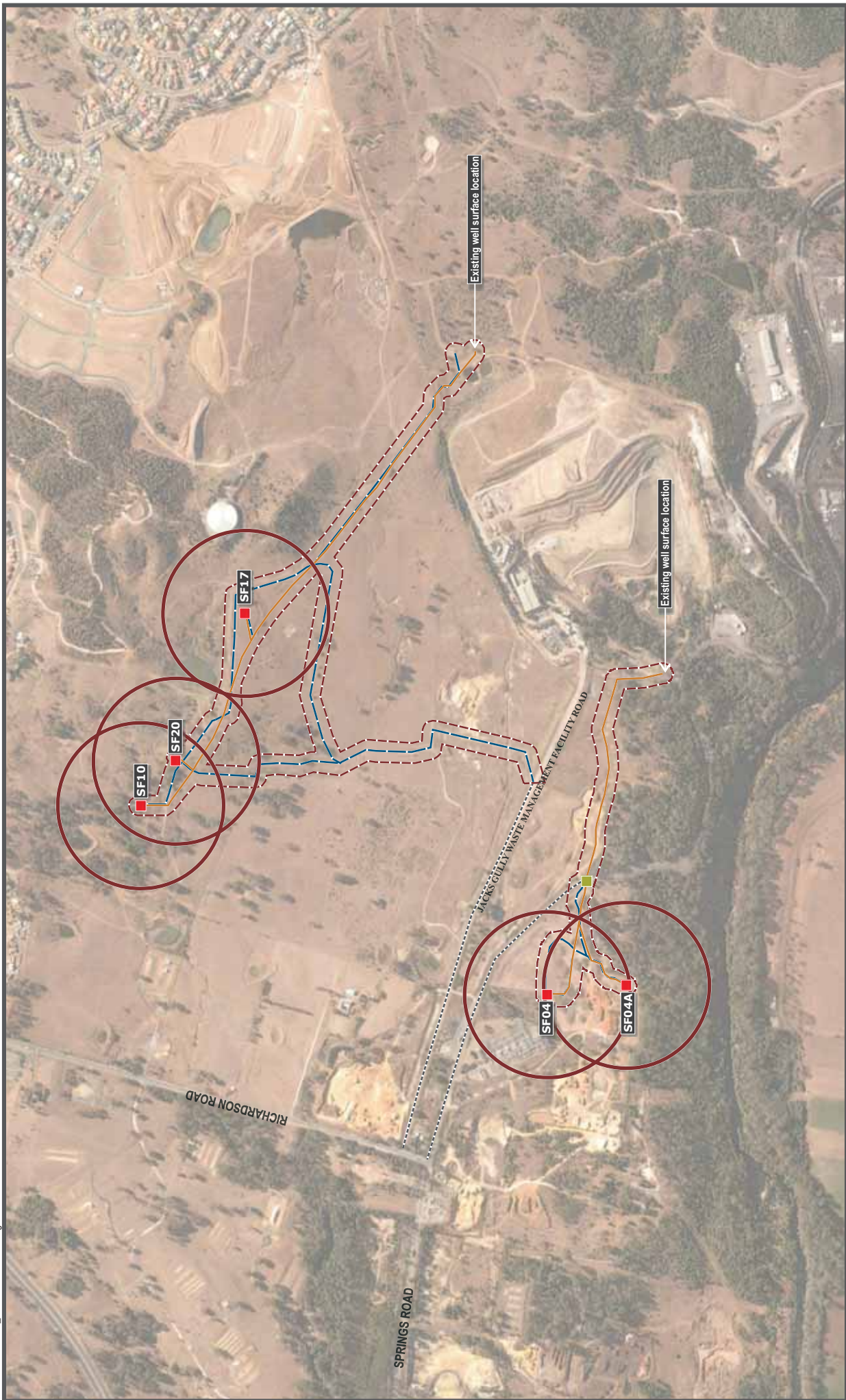


Figure 4.1
Proposed Well Surface Locations and
Associated Infrastructure - Spring Farm
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

- Well surface location assessment area
- Infrastructure assessment corridor
- Access road
- Existing access road
- Proposed gathering pipeline
- Proposed well surface location
- Gathering underbore location



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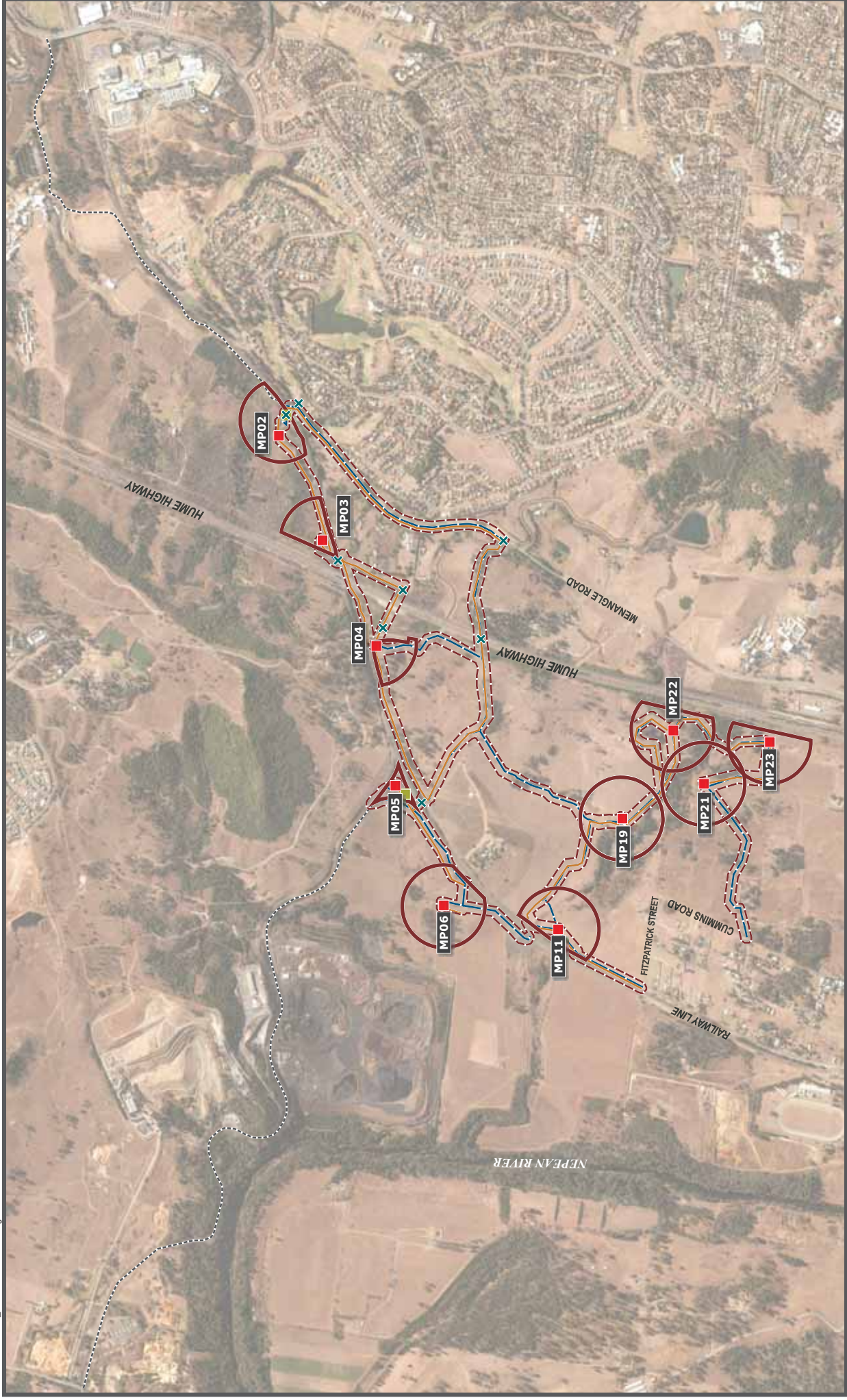


Figure 4.2

Proposed Well Surface Locations and
Associated Infrastructure - Menangle Park (North)

Environmental Assessment -

Expansion of Stage 2 of the Camden Gas Project

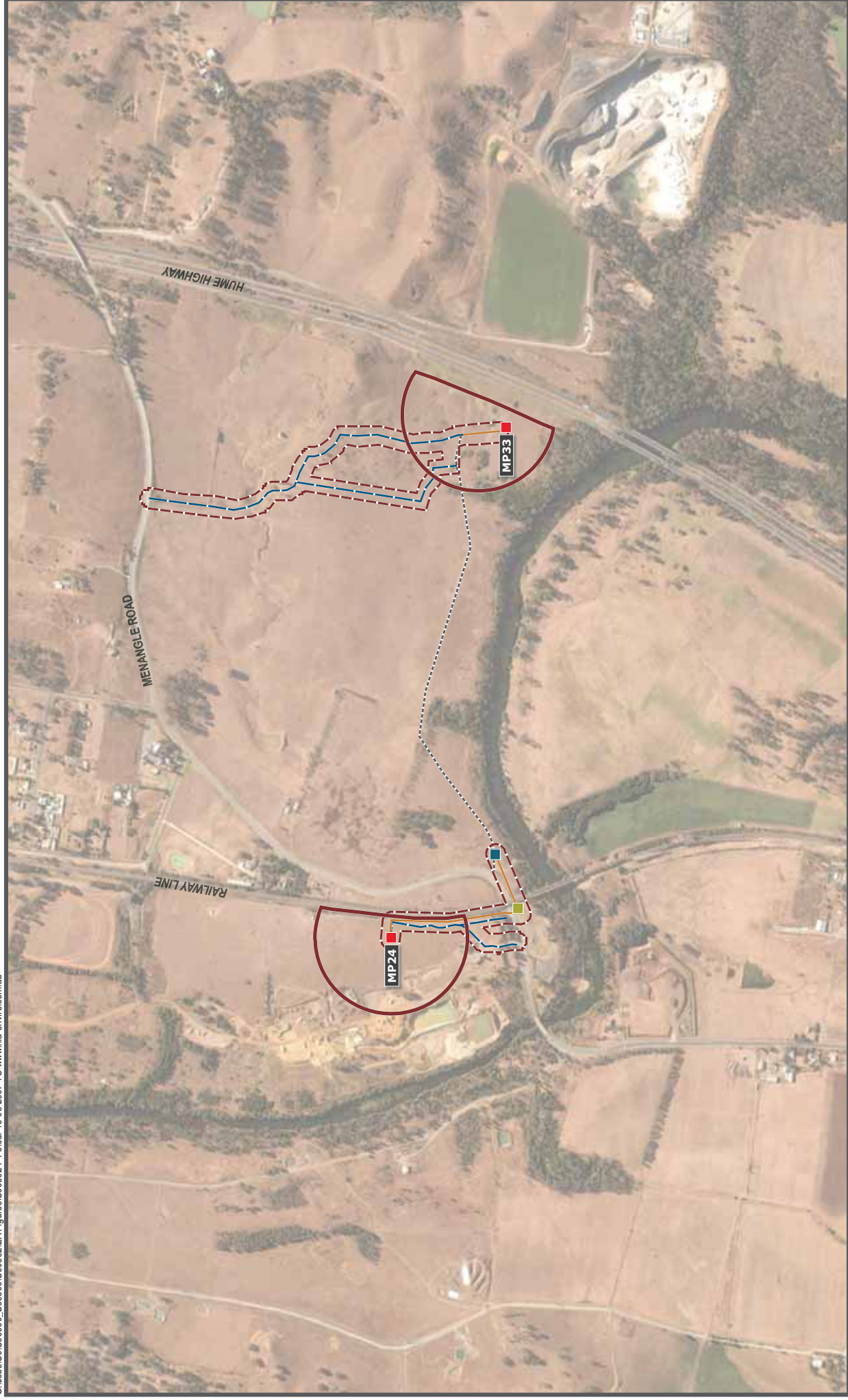


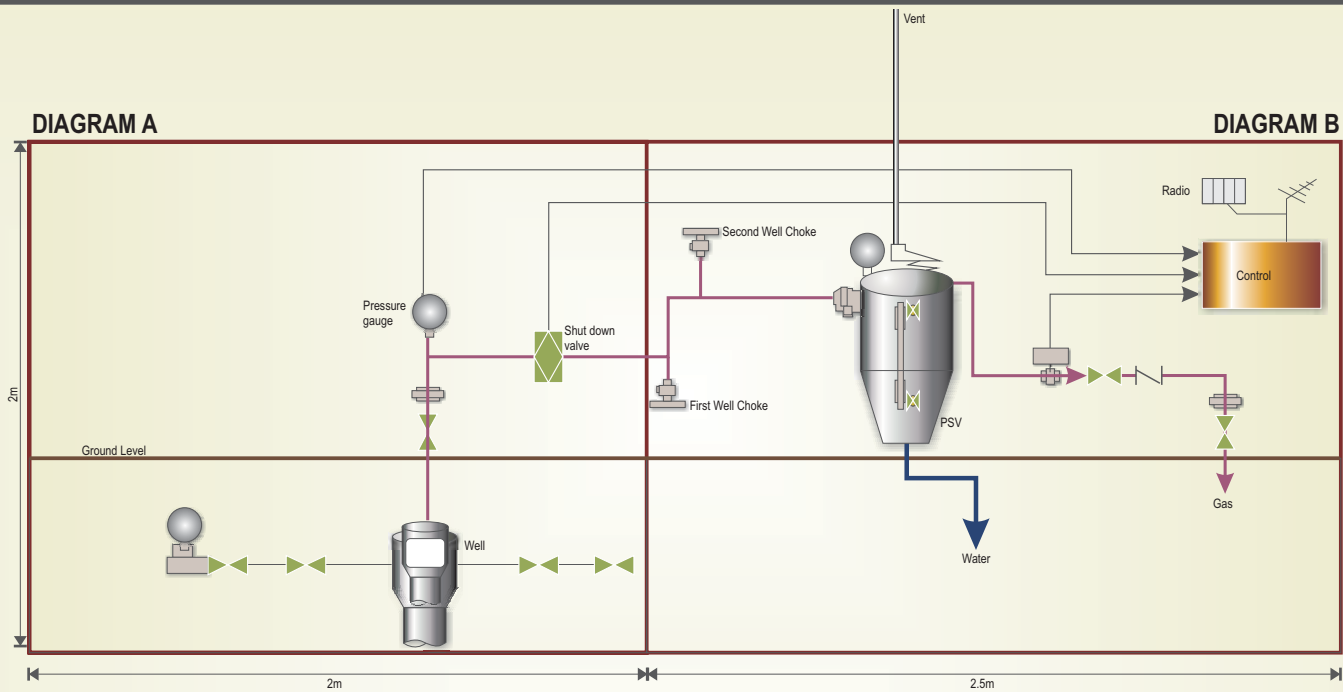
Figure 4.3

Proposed Well Surface Locations and

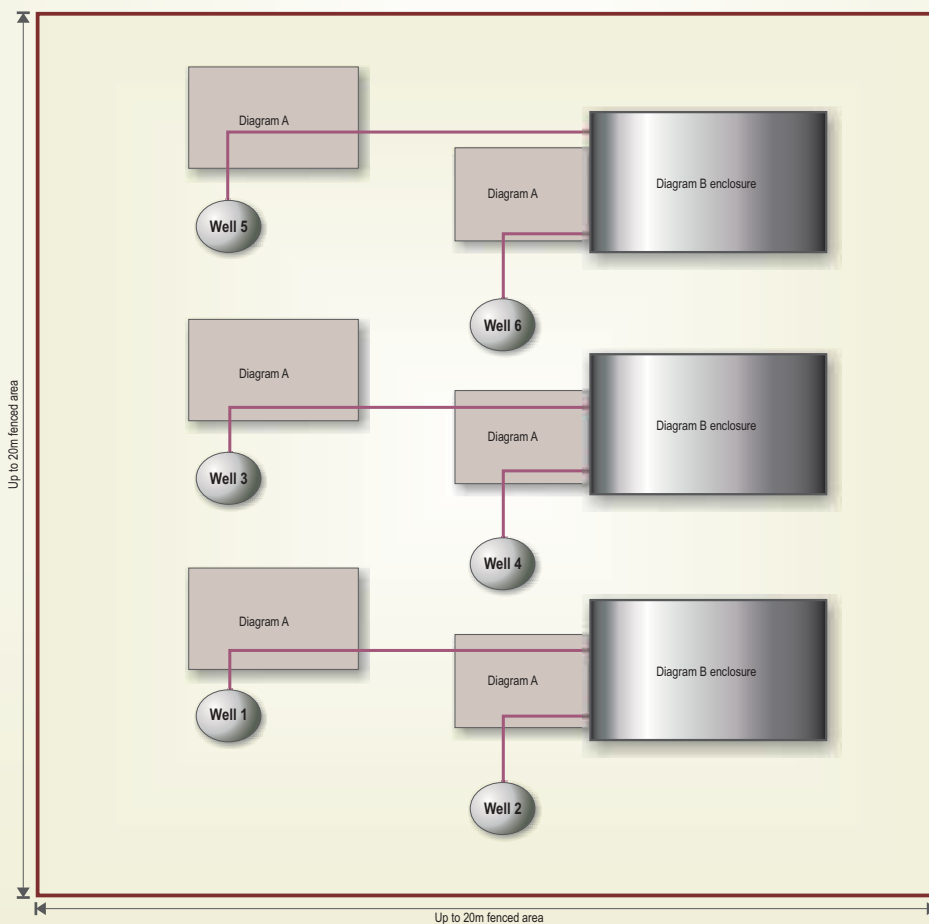
Associated Infrastructure - Menangle Park (South)

Environmental Assessment -

Expansion of Stage 2 of the Camden Gas Project



Typical Cross Section



Typical Plan View

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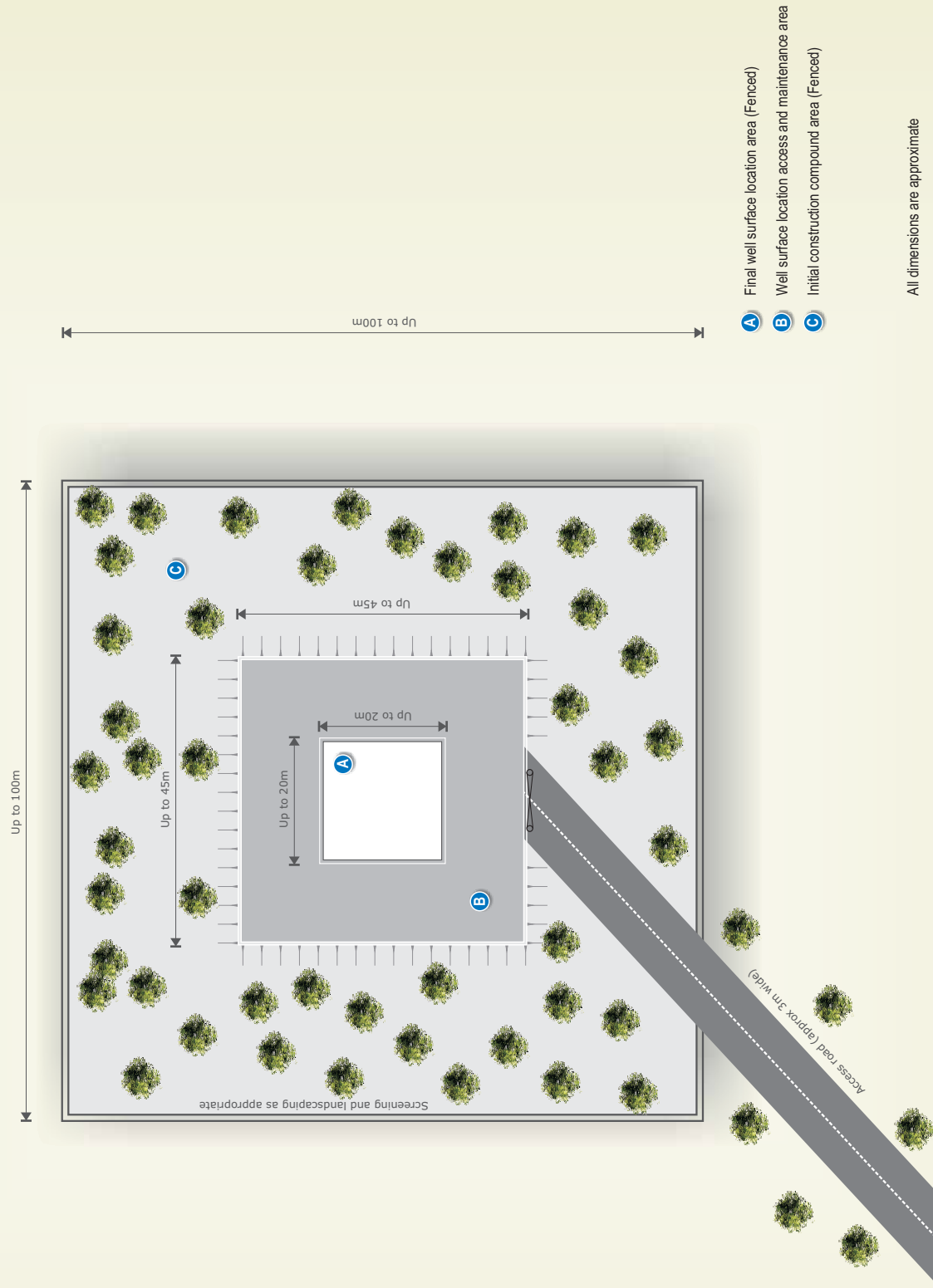


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CONCEPT ONLY
Subject to detailed engineering and design
NOT TO SCALE

Figure 4.4

Concept 6 Well Head Enclosed Surface Location
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project





Photograph 1

Gas gathering line construction
on Elizabeth Macarthur
Agricultural Institute



Photograph 2

Production - Example - Single Well
Head Surface Location - Open
wellhead design (MT10) in the Mount
Taurus well field



Photograph 3

Gas gathering lines from wells EM31/32 to
connect with existing gathering system installed
on the Elizabeth Macarthur Agricultural Institute
property.



Photograph 4

Initial rehabilitation at Em11 in
the Elizabeth Macarthur
Agricultural Institute well field

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Figure 4.6

Photos Illustrating Phases of Development
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

Photograph 1

Typical well head metering equipment (KP02) in the Kay Park Well Field



Photograph 2

Typical well head enclosure for a single well head (SL02) in the Sugarloaf Well Field



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Figure 4.7

Typical Well Head Enclosure and Metering
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

Photograph 1

Operator in the gas plant control room.



Photograph 2

The gas plant control room screen for the remote control of the GL11 well.

Note the SDV or Shut Down Valve is open which means the well is producing gas.

The well metering sends information back to the control room about gas pressure, water volumes and keeps a total for the amount of gas produced.

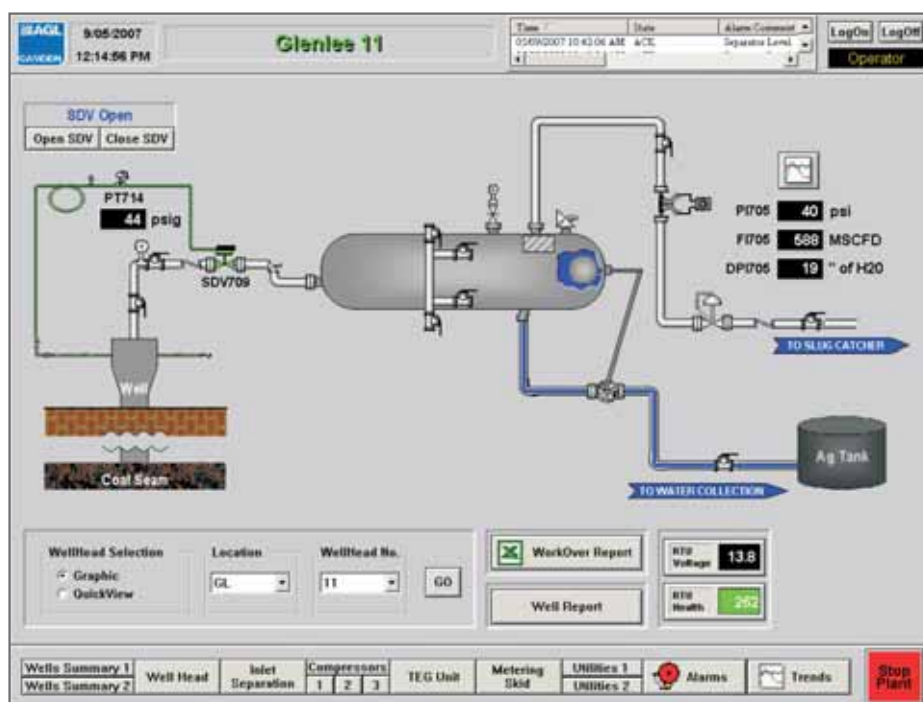


Figure 4.8

Gas Plant Control Room Operations
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

5 REGULATORY ENVIRONMENT

The construction and operation of the Project is subject to numerous statutory requirements. The primary relevant legislation is:

- *NSW Petroleum (Onshore) Act 1991*;
- *NSW Environmental Planning and Assessment (EP&A) Act 1979*;
- *Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act 1999*; and
- *NSW Protection of the Environment Operations (POEO) Act 1997*.

These principal statutes are supported by a range of further regulatory requirements which are also discussed below.

5.1 NSW Petroleum (Onshore) Act 1991

The Proponent proposes to construct and operate the works within Stage 2 of the CGP, including Spring Farm and Menangle Park in accordance with its obligations under the terms and conditions of its Petroleum Production Leases, PPL1, PPL2, PPL4 and PPL5 issued to the Proponent pursuant to the *NSW Petroleum (Onshore) Act 1991*.

Section 41 of the *NSW Petroleum (Onshore) Act 1991* sets out the scope of the PPLs, subject to the terms of that Act. Section 41 states that, with respect to the rights of production lease holders:

The holder of a production lease has the exclusive right to conduct petroleum mining operations in and on the land included in the lease together with the right to construct and maintain on the land such works, buildings, plant, waterways, roads, pipelines, dams, reservoirs, tanks, pumping stations, tramways, railways, telephone lines, electric powerlines and other structures and equipment as are necessary for the full enjoyment of the lease or to fulfil the lessee's obligations under it.

Environmental requirements under the petroleum production regime are specified by:

- Part 6, Divisions 1 to 3 of the *NSW Petroleum (Onshore) Act 1991*; and
- Part 8, Clause 25 of the *NSW Petroleum (Onshore) Regulation 2002*.

These requirements are summarised as follows:

- The need to protect natural resources;
- Conditions for protecting the environment;
- Rehabilitation of areas damaged by operations;
- Directions to rehabilitate land; and
- Removal of petroleum plant at the expiration of the Petroleum Production Lease.

All activities carried out under the authority of a petroleum title are to be carried out in conformity with the DPI (Mineral Resources) *Schedule of Onshore Petroleum Exploration and Production Requirements 1992*.

Part 6 of the Act provides for consideration to be given to the protection of the environment before a petroleum lease is granted. It sets out the scope of PPLs, subject to the terms of the Act. The proposed development within the Stage 2 area, incorporating Spring Farm and Menangle Park will be carried out under the existing PPL 4 and PPL 5. In the event that future works are proposed outside the current PPLs operated by the Proponent, an application seeking an appropriate PPL would need to be lodged with the DPI for approval.

5.2 NSW Environmental Planning and Assessment Act 1979

The EP&A Act and the EP&A Regulation provide the framework for environmental planning in NSW and include provisions to ensure that proposals which have the potential to impact the environment are subject to detailed assessment, and provide opportunity for public involvement.

As outlined in **Section 1.5** of this EA, the proposed project has been declared by the Minister as a major project under the provisions of the EP&A Act and *State Environmental Planning Policy (Major Projects) 2005* (SEPP 2005), and is therefore subject to the provisions of Part 3A of the EP&A Act.

Under Part 3A, a proponent can seek a Project approval or a Concept approval. Concept approvals allow the project to be considered on the basis of a Concept Plan with the assessment focussing on the strategic issues. The proponent is able to obtain approval of the Concept Plan prior to undertaking detailed studies of the various components of the project. Further details would subsequently be submitted as part of a Project approval.

In accordance with the provisions of Part 3A of the EP&A Act, the Proponent intends to seek the Concept Plan approval for works within Stage 2 of the CGP, and concurrent Project approval for installation of wells and associated infrastructure for Spring Farm and Menangle Park. The Minister for Planning is the consent authority for the Concept and Project applications.

The following sections of this EA also address the State and regional planning policies and the local planning instruments that have been created under the EP&A Act that are relevant to the CGP.

5.2.1 State Environmental Planning Policies

There are four State Environmental Planning Policies (SEPPs) of specific relevance to the proposal. These policies are addressed below.

SEPP 2005 (Major Projects)

State Environmental Planning Policy (Major Projects) 2005 (SEPP 2005) was gazetted on 25 May 2005 and amended on 1 August 2005 and 18 April 2007. It replaces all previous provisions related to former 'State significant development' in planning instruments, directions and declarations.

The primary aim of SEPP 2005 is:

'to identify development of economic, social or environmental significance to the State or regions of the State so as to provide a consistent and comprehensive assessment and decision making process for that development'.

Group 6 of Schedule 1 to SEPP 2005 identifies classes of development which are defined as 'major projects' and includes projects related to petroleum (oil, gas and coal seam methane), being:

'Development for the purpose of drilling and operation of petroleum wells (including associated pipelines) that:

(c) Is in the local government areas of Camden, Wollondilly, Campbelltown City, Wollongong City, Wingecarribee, Gosford City, Wyong, Lake Macquarie City, Newcastle City, Maitland City, Cessnock City, Singleton or Muswellbrook, but only if the principle resource sought is coal seam methane.'

The recovery of coal seam methane involves the drilling and operation of petroleum well surface locations associated gas gathering lines and ancillary works. The proposal involves well site development within Stage 2 (including Spring Farm and Menangle Park) which is located within the Camden, Campbelltown and Wollondilly LGAs. Therefore the proposal falls within the definition under Group 6 of Schedule 1 of SEPP 2005.

The Minister's declaration of the project as a 'major project' was issued on 14 November 2006 and is included as **Appendix A** to this EA.

State Environmental Planning Policy 33 – Hazardous and Offensive Development

State Environmental Planning Policy No.33 – Hazardous and Offensive Development (SEPP 33) applies to any industry that has the potential to create an off-site risk or offence to people, property or the environment. SEPP 33 has two categories of industry to which it relates, hazardous industry and offensive industry. Where there is a potential to cause harm to humans or the environment a further distinction exists in relation to the potential harm. The definitions most relevant are:

potentially hazardous industry means a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:

- (a) to human health, life or property, or
- (b) to the biophysical environment,

and includes a hazardous industry and a hazardous storage establishment.

Potentially offensive industry means a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment.

Should it be found that a proposed development has the potential to cause risk to humans or the biophysical environment, or to emit a polluting discharge, then a Preliminary Hazard Analysis (PHA) is required.

The proposed project is defined as a *utility installation* or a *public utility undertaking* (see **Sections 5.3.1 to 5.3.6**) and therefore does not meet the definition of an *industry*. As such, a PHA is not strictly required. However, in order to satisfy community and stakeholder concerns regarding risk issues, a Quantitative Risk Assessment (QRA) has been prepared in respect of the proposal and is included as **Appendix D** of the EA. The QRA concludes that the proposed

works do not pose a significant risk to humans or the biophysical environment subject to recommended separation distances for SIS wells with a six well configuration (see **Section 8**).

With regard to risk to humans and the environment, the Proponent has designed the project to incorporate technical controls for the gas wellhead assemblies which comply with Section 2.3 of the guidelines prepared by the former Department of Infrastructure, Planning and Natural Resources entitled *Locational Guidelines – Development in the Vicinity of Operating Coal Seam Methane Wells*, dated May 2004.

The Locational Guidelines provide guidance for separation distances between development and existing/ future operating coal seam methane wells with a single well configuration. As mentioned above, the QRA undertaken in respect of the proposal provides revised separation distances for SIS wells with a six well configuration, as proposed under the Concept and Project applications. Residential and sensitive land uses in the vicinity of wells which incorporate the designs and operational controls specified in the Locational Guidelines and the updated QRA would not be exposed to unacceptable risk.

The Proponent will update the existing Emergency Response Plan to include the additional wells and gas gathering system, along with the EHSMPs.

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

State Environmental Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP) was gazetted on 28 July 2006 and will predominantly affect works within future stages of the CGP.

The Growth Centres SEPP provides land use zones, objectives and land use tables which identify the permissibility of development and matters for consideration by the consent authority.

The land use zones identify development for the purposes of 'public utility installations' as being permissible without consent.

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (SEPP 2007) was gazetted on 16 February 2007. The Policy applies to the whole of NSW and while recognising the importance of mining, petroleum production and extractive industries within the State, requires the consent authority to consider factors such as land use compatibility, greenhouse gas emissions, environmental management and resource recovery.

The aims of the Policy are:

- a) *to provide for the proper management and development of mineral, petroleum and extractive material resources for the purpose of promoting the social and economic welfare of the State, and*
- b) *to facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and*
- c) *to establish appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources.*

Clause 6 of SEPP 2007 allows for certain development to be carried out without consent, including petroleum exploration. Clause 7(2) of the SEPP identifies development which can be carried out only with consent and includes the following of relevance to the Project:

Petroleum production development for any of the following purposes:

- (a) petroleum production on land which development for the purposes of agriculture or industry may be carried out (with or without development consent),*
- (b) petroleum production on land that is, immediately before the commencement of this clause, the subject of a production lease under the Petroleum (Onshore) Act 1991,*
- (d) facilities for the processing or transportation of petroleum on land which petroleum production may be carried out (with or without development consent), but only if the petroleum being processed or transported was recovered from that or adjoining land.*

Clause 8 of the SEPP states that if an LEP provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if provisions of the plan are satisfied:

- (a) development for that purpose may be carried out on that land with development consent without those provisions having to be satisfied, and*
- (b) those provisions have no effect in determining whether or not development for that purpose may be carried out on that land or on the determination of a development application for consent to carry out development for that purpose on that land.*

The SEPP also identifies development which is prohibited, including open cut mining within the local government area of Lake Macquarie, except in identified areas.

Part 3 of the SEPP sets out the matters for consideration for development applications for relevant development and includes:

- The compatibility of a proposed mine, petroleum production or extractive industry with other land uses;
- The compatibility of proposed development with mining, petroleum production or extractive industry,
- Natural resource management and environmental management (including potential impacts on significant water resources, threatened species and biodiversity and greenhouse gases),
- Resource recovery (including the efficiency of the proposal in terms of resource recovery),
- Transport (including the form of transport proposed and the potential impacts upon public roads),
- Rehabilitation (including proposed end use and landform of the affected land, waste management and land remediation).

Clause 19 of SEPP 2007 sets out the transitional arrangements with respect to the policy and provides that the SEPP does not apply to or with respect to an application for approval under Part 3A of the EP&A Act made but not finally determined before 16 February 2007. As the subject application under Part 3A was made prior to this date, the provisions of the SEPP do not strictly apply. However, with a view to undertaking a full and comprehensive environmental assessment of the proposed Project, the above matters for consideration have been assessed as part of this EA and are addressed in the document as summarised in the **Table 5.1**.

Table 5-1: Matters for Consideration – SEPP 2007

Matter	Reference in EA
Compatibility of proposed mine, petroleum production or extractive industry with other land uses	Section 8.1
Compatibility of proposed development with mining, petroleum production or extractive industry	Section 8.1
Natural resource management and environmental management (including potential impacts on significant water resources, threatened species and biodiversity and greenhouse gases)	Sections 8.3, 8.8, 8.9 and 11.3
Resource recovery (including the efficiency of the proposal in terms of resource recovery)	Sections 3 and 4
Transport (including the form of transport proposed and the potential impacts upon public roads)	Section 8.13
Rehabilitation (including proposed end use and landform of the affected land, waste management and land remediation)	Section 8.15

5.2.2 Regional Planning Policies

Sydney Regional Environmental Plan 20 – Hawkesbury-Nepean

Sydney Regional Environmental Plan 20 – Hawkesbury-Nepean (SREP 20) applies to certain land within the Hawkesbury-Nepean Catchment, including certain land within the LGAs of Camden, Campbelltown and Wollondilly. The aim of SREP 20 is as follows:

To protect the environment of the Hawkesbury-Nepean River system by ensuring that the impacts of future land uses are considered in a regional context.

The plan sets out general and specific planning considerations and recommends strategies which must be taken into consideration by the consent authority determining an application. Those relevant to the proposed development are addressed below.

The general planning considerations relevant to this proposal are:

- (a) *the aim of this plan, and*
- (b) *the strategies listed in the Action Plan of the Hawkesbury-Nepean Environmental Planning Strategy, and*
- (c) *whether there are any feasible alternatives to the development or other proposal concerned, and*

Section 4 *the relationship between the different impacts of the development or other proposal and the environment, and how those impacts will be addressed and monitored.*

The relevant specific planning considerations and recommended strategies for consideration include:

- Total Catchment Management;
- Environmentally Sensitive Areas;
- Water Quality
- Water Quantity
- Cultural Heritage
- Flora and Fauna
- Riverine Scenic Quality

The Proponent considers that Stage 2 of the CGP is likely to have minimal impact on the catchment of the Nepean River, given the design, safeguards and mitigation measures to be implemented to manage potential impacts on water flows, water usage and water quality, including the following:

- implementation of Soil and Water Management Plans (SWMPs) specifying erosion control measures to divert surface runoff around the well surface location construction areas;
- design of the drilling compound which includes lined drill pits to capture formation waters from the coal seams for reuse in other operations;
- construction and implementation of a water transfer system where necessary to facilitate the reuse of water for other operations across the project area;
- initial rehabilitation of the drill pits following construction works, and final rehabilitation of the well surface locations following closure;
- reuse of waste water as part of the project, or alternatively, disposal to a licensed waste disposal facility.

SREP 20 lists certain items of heritage value and requires assessment of potential impacts on those listed items. Indigenous and non-Indigenous heritage is addressed in **Sections 8.11** and **8.12**.

Consideration of the impact of the project on flora and fauna and scenic quality has been addressed in **Sections 8.9** and **8.10** of this EA.

SREP 20 also sets out specific development controls for certain types of development, including land uses in or near the river. These are defined as:

'All uses in the river or a tributary of the river, or within 40 metres of the high water mark of the river or a tributary of the river where it is tidal or within 40 metres of the bank where it is non-tidal. This includes clearing and the construction and use of piers, wharves, boat sheds or other structures which have direct structural connection to the bank or bed of the river or a tributary of the river.'

As the study area comprises lands located within 40 metres of the high water mark/ bank of the Hawkesbury-Nepean River works in these areas would be classified as 'land uses in or near the river', although it should be noted that all well surface locations in the Spring Farm and Menangle Park areas are located at least 40 metres from the rivers and streams. SREP 20 requires that consent be obtained for such development, with the following matters to be considered by the consent authority:

- '(a) The need to locate access points where riverbanks are stable, away from river shallows and major beds of attached aquatic plants, away from fishing grounds and fish breeding areas, where the proposed activities do not conflict with surrounding recreational activities, and where significant fauna and wetland habitats will not be adversely affected.*
- (b) The need to require remedial works, such as the re-establishment of flora and fauna habitats.*
- (c) The potential for use of the land as a buffer to filter water entering the river.*
- (d) The need for an Erosion and Sediment Control Plan.*
- (e) The need for a Vegetation Management Plan.'*

Certain works for the installation of gas gathering lines may be located within 40 metres of the Nepean River and/ or its tributaries. Minor infrastructure works would cross Howes Creek which is a small tributary of the Nepean River and an access road near MP11 will cross a drainage line. As the proposed development will be determined under Part 3A of the EP&A Act, a Part3A permit under the *Rivers and Foreshore Improvement Act 1948* (RFI Act) is not required. However, in relation to proposed construction activities on "protected land or water" under the RFI Act the Proponent will prepare SWMPs and EHSMPs aimed at mitigating potential adverse impacts.

Sydney Regional Environmental Plan No 9—Extractive Industry (No 2—1995) – Sand Resources

Sydney Regional Environment Plan No. 9 – Extractive Industries (No. 2) 1995 (SREP 9) applies to LGA's listed under Schedule 4 and includes Camden and Campbelltown. The aims of the plan are:

- a) to facilitate the development of extractive resources in proximity to the population of the Sydney Metropolitan Area by identifying land which contains extractive material of regional significance, and*
- b) to permit, with the consent of the council, development for the purpose of extractive industries on land described in Schedule 1 or 2, and*
- c) to ensure consideration is given to the impact of encroaching development on the ability of extractive industries to realise their full potential, and*
- d) to promote the carrying out of development for the purpose of extractive industries in an environmentally acceptable manner, and*
- e) to prohibit development for the purpose of extractive industry on the land described in Schedule 3 in the Macdonald, Colo, Hawkesbury and Nepean Rivers, being land which is environmentally sensitive.*

Clause 5 of SREP 9 defines extractive industry as

- a) the winning of extractive material, or
- b) an undertaking, not being a mine, which depends for its operations on the winning of extractive material from the land on which it is carried on, and includes any washing, crushing, grinding, milling or separating into different sizes of that extractive material on the land.

Under Clause 5, extractive material includes sand, gravel, clay, turf, soil, rock, stone or any similar substance.

The proposed development involves the extraction of CSM, therefore is not defined as an extractive industry or extractive material under SREP 9. This plan is largely concerned with

development for the purpose of an extractive industry, as well as considerations for Council when preparing an environmental planning instrument in areas identified as containing extractive material. Therefore many of the provisions of the plan do not strictly apply to the proposed development.

Clause 16 provides restrictions on development that is in the vicinity of extractive resource sites and applies to land in the vicinity of land described in Division 1, 4, 6, 7, 8 or 9 of Schedule 1. It states:

- 2 *A council must not grant an application for consent to carry out development of land to which this clause applies unless it is satisfied that, if the development is carried out in accordance with the consent:*
 - a) *the proposed development will not be adversely affected by noise, dust, vibration or reduced visual amenity from any nearby extractive industry, and*
 - b) *the proposed development will not in any way adversely affect any existing nearby extractive industry or prevent any such extractive industry from realising its full economic potential by adversely affecting future expansion of the extractive industry of which the council is aware.*

Consultation with landholders during the early project design phase ensured that wells and other infrastructure were sited to accommodate other land uses including the extractive industry. This has resulted in the relocation, removal or redesign of wells before the proposal is submitted for approval.

The use of SIS technology, co-location of wells and consultation with landowners has resulted in the Proponent significantly reducing the number of wells from around 45 to 16 and the overall footprint of the project. In Spring Farm, the proposal was originally for around 20 wells which has been reduced to four (4) well surface locations and in Menangle Park there were around 25 wells originally proposed, while now there are 12 well surface locations.

Overall, the proposed development involves the installation of a total of 16 well surface locations and associated works within Spring Farm and Menangle Park areas, some of which may be within the vicinity of extractive resource sites identified under SREP 9. However, the proposed development and associated works will be within the existing PPL4 and PPL5 and are unlikely to be adversely affected by nearby extractive industry, nor will the proposed development be likely to have adverse impacts on existing extractive industry or result in limitations on future expansion of extractive industry within the area.

5.3 Local Planning Instruments

The Spring Farm, Menangle Park and remaining Stage 2 Concept works straddle three different LGAs, being:

- Camden;
- Campbelltown; and
- Wollondilly.

Spring Farm is wholly situated within the Camden LGA, while Menangle Park is wholly situated within the Campbelltown LGA.

There are a variety of local Environmental Planning Instruments (EPIs) which apply to the land subject of the Stage 2 works, which are identified in the following table.

Table 5-2: EPIs Applicable to Stage 2 Works

Local Government Area	Relevant EPIs
Camden	Camden Local Environmental Plan No. 121 – Spring Farm (LEP 121) Camden Local Environmental Plan No. 46 (LEP 46) Camden Local Environmental Plan No. 47 (LEP 47)
Campbelltown	Campbelltown Interim Development Order No. 15 (IDO 15)
	Campbelltown Local Environmental Plan (Urban Areas) 2002 (LEP 2002)
Wollondilly	Wollondilly Local Environmental Plan 1991 (LEP 1991)

5.3.1 Camden LEP 121 – Spring Farm

Camden Local Environmental Plan (LEP) No. 121 – Spring Farm applies to the Spring Farm area, affecting the four proposed well surface locations. The aims of this plan are:

- (a) *to rezone the land to which the plan applies to allow for urban development, the conservation of ecological and riparian corridors and to maintain existing agriculture, and*
- (b) *to describe the desired future character of the locality and set out the zones and development controls necessary to ensure that the development of the land achieves that desired future character and complements and supports the suburban and historic rural character of the Camden area, and*
- (c) *to require that, prior to the subdivision of land into lots of less than 40 hectares for residential uses, that satisfactory arrangements have been made for the provision of regional transport infrastructure, and*
- (d) *to ensure that the housing, accessibility and social needs of the growing Camden community are provided for, and*
- (e) *to achieve ecological corridors which will link William Howe Reserve and Gundungarra Reserve with the riverine environment of the Nepean River and protect endangered ecological communities, and*
- (f) *to protect the local environment, particularly in relation to air and water quality in the south-western Sydney region, by promoting the implementation of ecologically sustainable development practices, and*
- (g) *to introduce a range of heritage conservation provisions for the land and to provide for protection of heritage items, potential heritage items, archaeological sites and significant views, and*
- (h) *to ensure that residential amenity of a high quality is maintained, given the proximity of industrial, mining and waste disposal activities, and*
- (i) *to ensure the urban development and the protection of residential amenity does not jeopardise the recovery of regionally valuable sand deposits, as identified in Sydney Regional Environmental Plan No 9—Extractive Industry (No 2—1995).*

Definition of the Development

The proposed project involves the development of well surface locations for the recovery of gas in the Illawarra Coal Measures located within Stage 2 of the CGP.

Clause 7 of LEP 121 states that the *Environmental Planning and Assessment (EP&A) Model Provisions 1980* are adopted for the purpose of the plan, except for:

- (a) the definitions of child care centres, home industry, home occupation, map and residential flat building in clause 4(1), and*

Section 4 *clause 7, 8, 15 and 35(c).*

The *EP&A Model Provisions 1980* (Model Provisions) were repealed on 30 September 2005. However, given the provisions of LEP 121 were made prior to the date of repeal, the Model Provisions remain applicable in this instance.

Part 2 of the *Model Provisions* provides definitions. The proposed development comprises a 'public utility undertaking' defined as:

'any of the following undertakings carried on or permitted or suffered to be carried on by or by authority of any Government Department or under the authority of or in pursuance of any Commonwealth or State Act:

- (a) railway, road transport, water transport, air transport, wharf or river undertakings,*
- (b) undertakings for the supply of water, hydraulic power, electricity or gas or the provision of sewerage or drainage services,*

and a reference to a person carrying on a public utility undertaking shall be construed as including a reference to a council, county council, Government Department, corporation, firm or authority carrying on the undertaking.'

The Proponent is the holder of a Petroleum Production Lease over the subject land issued under the *Petroleum (Onshore) Act 1991*. This lease allows the Proponent the exclusive right to conduct petroleum extraction operations in and on the land included in the lease together with the right to construct and maintain on the land such works, buildings, plant, waterways, roads, pipelines, dams, reservoirs, tanks, pumping stations, tramways, railways, telephone lines, electric powerlines and other structures and equipment as are necessary for the full enjoyment of the lease or to fulfil the lessee's obligations under it.

As the proposal is for works to be carried out by a corporation, for the primary purpose of the supply of gas, authorised under the *NSW Petroleum (Onshore) Act 1991*, it falls within the definition of a 'public utility undertaking' as defined in the Model Provisions.

Under the Model Provisions a 'utility installation' is defined as:

'a building or work used by a public utility undertaking, but does not including a building designed wholly or principally as administrative or business premises or as a showroom'.

As the proposed development is defined as a 'public utility installation' and the definition of a utility installation involves 'a building or work used by a public utility undertaking', the proposed development is defined as a 'utility installation' under the Model Provisions.

5.3.2 Camden LEP 46

Camden Local Environmental Plan 46 (LEP 46) applies to land in the far west of the Spring Farm area. The general aims of LEP 46 are:

- (a) to promote the retention of, and to enhance, the characteristics of the different localities in which housing is or will be situated within the area of Camden;*

- (b) to provide for a wide range of housing needs;*
- (c) to achieve a high quality of development;*
- (d) to achieve sustainable development;*
- (e) to promote the use of buildings which are designed, sited and constructed, using passive solar principles, so as to maximise energy efficiency by reducing the consumption of non-renewable forms of energy for heating and cooling purposes;*
- and*
- (f) to conserve the environmental heritage of the area of Camden.'*

Definition of Development

Clause 7 of LEP 46 relates to the adoption of the Model Provisions, including the definitions set out in Clause 4. Under the Model Provisions, the proposal fits within the definition of a 'public utility undertaking', as discussed above.

5.3.3 Camden LEP 47

Camden Local Environmental Plan 47 (LEP 47) applies to land to the north-east of the Spring Farm area.

The general aims of this plan are:

- '(a) to promote the retention of, and to enhance, the characteristics of the different localities in which housing is or will be situated within the area of Camden;*
- (b) to provide for a wide range of housing needs;*
- (c) to achieve a high quality of development;*
- (d) to achieve sustainable development; and*
- (e) to promote the use of buildings which are designed, sited and constructed, using passive solar principles, so as to maximise energy efficiency by reducing the consumption of non-renewable forms of energy for heating and cooling purposes.'*

Definition of the Development

Clause 7 of LEP 47 relates to the adoption of the Model Provisions, including the definitions set out under Clause 4. The proposal fits within the definition of a 'public utility undertaking' as discussed above.

5.3.4 Campbelltown (Urban Areas) LEP 2002

Campbelltown (Urban Area) Local Environmental Plan 2002 (LEP 2002) applies to certain well surface locations within the Menangle Park area. The aims of this plan are:

- (a) to provide controls on development for the urban area of the City of Campbelltown in a local environmental plan which consolidates and simplifies existing controls applying in that area, and*
- (b) to establish a broad framework of controls and allow the opportunity for more detailed provisions relating to specific types of development or specific areas to be provided by development control plans, and*
- (c) to promote the objectives of the Act and, in particular, to maintain and enhance the amenity of the urban area of the City of Campbelltown.'*

Definition of Development

Schedule 3 of LEP 2002 provides a range of definitions including that of a 'public utility undertaking', being:

'any of the following undertakings carried on or permitted or suffered to be carried on by or by authority of any Government Department or under the authority of or in pursuance of any Commonwealth or State Act:

- (c) *railway, road transport, water transport, air transport, wharf or river undertakings,*
- (d) *undertakings for the supply of water, hydraulic power, electricity or gas or the provision of sewerage or drainage services,*

and a reference to a person carrying on a public utility undertaking shall be construed as including a reference to a council, county council, Government Department, corporation, firm or authority carrying on the undertaking.'

As also previously discussed, the Proponent is the holder of a Petroleum Production Lease over the subject land issued under the *Petroleum (Onshore) Act 1991*. This lease allows the Proponent the exclusive right to conduct petroleum extraction operations in and on the land included in the lease together with the right to construct and maintain on the land such works, buildings, plant, waterways, roads, pipelines, dams, reservoirs, tanks, pumping stations, tramways, railways, telephone lines, electric powerlines and other structures and equipment as are necessary for the full enjoyment of the lease or to fulfil the lessee's obligations under it.

As the proposal is for works to be carried out by a firm, for the primary purpose of the supply of gas, authorised under the *NSW Petroleum (Onshore) Act 1991*, it falls within the definition of a 'public utility installation' as defined under Schedule 3 of LEP 2002.

Under Schedule 3 of LEP 2002 a 'utility installation' is defined as:

'a building or work used by a public utility undertaking, but does not including a building designed wholly or principally as administrative or business premises or as a showroom'.

As the proposed development is defined as a 'public utility undertaking' and the definition of a utility installation involves 'a building or work used by a public utility undertaking', the proposed development is defined as a 'utility installation' under the provisions of LEP 2002.

5.3.5 Campbelltown IDO No. 15

Interim Development Order No. 15 – City of Campbelltown (IDO 15) applies to most of the well surface locations within the Menangle Park area. Well surface locations covered by IDO 15 are located within Zone No. 1 – Non-Urban (40 ha). Within this zone, utility installations are permissible with consent as provided by Clause 4 of the IDO.

Clause 3 relates to the adoption of the Model Provisions for the purposes of this order. Under the Model Provisions, the proposal fits into the definition of a 'public utility undertaking' as previously discussed.

5.3.6 Wollondilly LEP 1991

Wollondilly Local Environmental Plan 1991 (LEP 1991) applies to the southern portion of the Stage 2 Concept Plan area. The aims of this plan are:

- (a) *to consolidate the provisions of the Wollondilly Planning Scheme Ordinance and other deemed environmental planning instruments and local environmental plans within a single local environmental plan, and*
- (b) *to simplify planning controls within the Shire of Wollondilly, and*
- (c) *to correct mapping anomalies and rationalise zonings, and*
- (d) *to conserve the environmental heritage of the Shire of Wollondilly, and*
- (e) *to integrate heritage conservation into the planning and development control processes, and*
- (f) *to provide for public involvement in the matters relating to the conservation of the Shire of Wollondilly's environmental heritage, and*
- (g) *to ensure that new development is undertaken in a manner that is sympathetic to and does not detract from the significance of heritage items and their settings, as well as the streetscapes and landscapes of Picton and Thirlmere and the distinctive character that they impart to the Shire of Wollondilly, and*
- (h) *to ensure that development does not compromise the protection and maintenance of water quality within water supply catchment areas, and*
- (i) *to ensure that development reflects the integrated resource management principles of total catchment management, and*
- (j) *to reduce the incidence of rural land use conflict by introducing appropriate planning controls, and*
- (k) *to introduce planning controls to protect and maintain areas of significant agricultural production, and*
- (l) *to ensure that agricultural uses are considered to be equally as important as urban and rural residential uses, and*
- (m) *to maintain the rural natural landscape character of the Wollondilly local government area by providing a balance between agricultural and other land uses, and*
- (n) *to provide for rural residential living opportunities which are compatible with the capability of the land, and*
- (o) *to protect areas of identified ecological significance, and*
- (p) *to provide for a diversity of well-located housing types within the local government area of Wollondilly.*

Definition of Development

Clause 7 of LEP 1991 relates to the adoption of the Model Provisions, except for the definitions of:

'arterial road, extractive materials, home industry, home occupation, map, residential flat building and service station in clause 4(1),'

As identified above, the Model Provisions were repealed on 30 September 2005. However, given the provisions of LEP 1991 were made prior to the date of repeal, the Model Provisions remain applicable in this instance.

Under Part 2 of the Model Provisions, the proposal fits into the definition of a 'public utility undertaking' as discussed above.

5.3.7 Permissibility of the Development

There are a number of land use zones within the Stage 2 Concept Plan area. The permissibility of the proposed works within each of the land use zones affected by the Concept Plan (which includes the area affected by the Spring Farm and Menangle Park Project application) is summarised in **Table 5-3** below. As demonstrated, the proposed works, which are defined as either a *public utility undertaking* or *utility installation*, are permissible within the various land use zones as indicated in **Table 5-3**.

Table 5-3: Permissibility of Stage 2 Concept Plan Works

Relevant Instrument	Land Use Zone	Permissibility	Comment
Camden LEP 121	1(a) Rural	Yes	A public utility undertaking is permissible with consent
	2(d) Residential	Yes	A public utility undertaking is permissible with consent
	5(b) Special Uses	Yes	Permissible in accordance with Clause 35 of EP&A Model Provisions
	5(c) Special Uses – Future Arterial Road Widening	Yes	Utility installations are permissible without consent.
	7(a) Environmentally Sensitive Land	Yes	Utility installations are permissible with consent
Camden LEP 46	1(a) Rural	Yes	A public utility undertaking is permissible with consent
Camden LEP 47	2(d) Residential D (Release Areas)	Yes	A public utility undertaking is permissible with consent
	6(d) (Regional Open Space)	Yes	Permissible in accordance with Clause 35 of EP&A Model Provisions
Campbelltown IDO 15	Non-Urban (40 ha)	Yes	A public utility undertaking is permissible with consent
Campbelltown (Urban Areas) LEP 2002	10(a) Regional Comprehensive Centre	Yes	A public utility undertaking is permissible with consent
Wollondilly LEP 1991	1(a) Agricultural Zone	Yes	A public utility undertaking is permissible with consent
	1(a2) Rural “A2” Zone	Yes	A public utility undertaking is permissible with consent
	1(b) Agricultural Landscape Zone	Yes	A public utility undertaking is permissible with consent
	9(b) Arterial Road Reservation Zone	Yes	Utility installations are permissible with consent

5.4 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act came into effect in July 2000 and requires the approval of the Commonwealth Minister for the Environment and Heritage for actions that may have a significant impact on

matters of National Environmental Significance (NES). Approval from the Commonwealth is in addition to any approvals under NSW legislation.

Approval under the EPBC Act is triggered by a proposal which has the potential to have a significant impact on a matter of NES or by a proposal which has the potential to have a significant impact on the environment of Commonwealth land or which involves the Commonwealth. The EPBC Act lists eight matters of NES which must be addressed when assessing the impact of a proposal.

A search of the Department of Environment and Heritage (DEH) protected matters database was undertaken on the 21 August 2006, based on a 5km area around the Stage 2 Concept Plan area which incorporates the proposed Spring Farm and Menangle Park well fields. The following provides a preliminary assessment of the proposal and its potential impacts on matters of NES, based on the results of the database search.

- **World Heritage properties:** There are no world heritage properties proximate to the proposed project, or that would potentially be affected by the proposal.
- **National Heritage Places:** There are no Commonwealth Heritage Places identified within the search area, however, a total of 64 places listed on the Register of the National Estate (RNE) were identified within the search area which are protected by the provisions of the Act. Guiding principles for the location of surface wells and infrastructure are detailed in **Section 4.3.1** of the EA, aimed at minimising potential impacts on matters identified by the RNE.
- **Wetlands of National Importance:** The search identified the proposed project would be located within the same catchment as a Ramsar site, Towra Point Nature Reserve, which is located approximately 16 km south of the Sydney CBD. Given the nature of the proposal, the history of previous works for the Camden Gas Project and the distance of the site from the Towra Point Nature Reserve, around 45 km, it is not anticipated that there will be a significant impact on the Ramsar Wetland.
- **Commonwealth-listed Threatened species:** 31 Commonwealth listed threatened species were identified within the search area and therefore, potential exists for the project to impact on threatened species listed under Commonwealth legislation. The sites for well surface locations and infrastructure development will be selected having regard to minimising impacts upon threatened species. A more detailed assessment of the impact of the proposed works within Spring Farm and Menangle Park on threatened flora and fauna has been provided in **Section 8.9** of this EA and finds that the proposed Project can be carried out without significant adverse impacts upon threatened flora and fauna. The findings of the flora and fauna assessment have been used to develop locational guidelines and environmental safeguards in respect of the proposed works within the Stage 2 Concept Plan area to minimise potential impacts. Further detailed assessment of flora and fauna impacts would be undertaken in respect of Stage 2 Concept works in subsequent Project applications.
- **Commonwealth-listed Migratory Species:** 8 migratory species were identified within the search area. Given the nature of the proposed project, significant impacts on protected migratory species are not expected. An assessment of the impact of the project on fauna species has been provided in **Section 8.9** Of the EA and finds that the proposed Project will not result in significant adverse impacts upon these migratory species.

- **Nuclear Action:** The proposed project will not involve a nuclear action as defined under the EPBC Act 1999.
- **Commonwealth Marine Area:** There are no Commonwealth Marine Areas proximate to the proposed project, or that would potentially be affected by the proposal.
- **Commonwealth Land:** One Commonwealth Land site was identified within the search area. The proposed project is not on Commonwealth land nor, given the location and nature of the proposed works, is any Commonwealth land likely to be significantly affected by the proposal.

The proposal is not anticipated to have a significant impact on matters of NES. The EPBC Act is not triggered and referral to, and approval from, the Commonwealth Minister for Environment and Heritage is not required.

5.5 NSW Protection of the Environment Operations Act 1997

The *NSW Protection of the Environment Operations Act 1997* (POEO Act) prohibits any person from causing pollution of waters, or air, and provides for penalties for air, water and noise pollution offences. Schedule 1 of the POEO Act identifies “scheduled activities” which are required to be licensed by the DEC.

The CGP is operated under separate premises-based Environmental Protection Licences (EPLs) to permit petroleum refining and waste generation activities. The proposed Spring Farm and Menangle Park gas wells and associated infrastructure form part of Stage 2 of the CGP and subject to approval, the new wells and infrastructure will be added to the existing EPL.

5.6 NSW Heritage Act 1977

The purpose of the *NSW Heritage Act 1977* (Heritage Act) is to protect and conserve non-Aboriginal cultural heritage, including scheduled heritage items, sites and relics. The Heritage Act is administered by the NSW Heritage Office.

The Heritage Act makes provision for a place, building, work, relic, moveable object, precinct, or land to be listed on the State Heritage Register. If an item is subject of an interim listing, or is listed on the State Heritage Register, a person must obtain approval under Part 4 Division 1 Subdivision 3 of the Heritage Act for the following works or activities:

- Demolition of the building or work;
- Damaging or despoiling the place, precinct or land, or any part thereof;
- Moving, damaging or destroying the relic or moveable object;
- Excavating any land for the purpose of exposing or moving the relic;
- Carrying out any development in relation to the land on which the building, work or relic is situated, the land that comprises the place, or land within the precinct;
- Altering the building, work, relic or moveable object;
- Displaying any notice or advertisement on the place, building, work, relic, moveable object or land, or in the precinct; and
- Damaging or destroying any tree or other vegetation on or removing any tree or other vegetation from the place, precinct or land.



However, as the project falls under Part 3A of the EP&A Act, once the proposal is approved under Part 3A, it is exempt from any requirements for approvals required under Part 4 of the Heritage Act.

6 CONSULTATION AND IDENTIFICATION OF ISSUES

6.1 New South Wales Formal Procedures

This EA has been prepared in accordance with Part 3A of the EP&A Act and its Regulation. Part 3A of the EP&A Act ensures that the potential environmental effects of a proposal are properly assessed and considered in the decision making process.

In preparing this EA, of the Director-General's Environmental Assessment Requirements (EARs) have been addressed as required by Clause 75F of the EP&A Act. The Director-General's requirements were sought for both the Project and Concept Approval components of the proposal. The key matters raised by the Director-General for consideration in the EA are outlined in **Table 6-1** and **Table 6-2** below, together with the relevant section of the EA which addresses that matter. A full copy of the Director-General's EARs for both the Project and Concept Approval components of the project are provided in **Appendix B**.

Table 6-1: Director-General's Environmental Assessment Requirements (Concept Application)

Key Matters	Reference in EA
Surface and Groundwater	
Assessment of the potential impacts on streams, the local groundwater regime and water quality (including salinity), and a description of the proposed water management systems;	Section 8
Noise and Vibration	
A broad assessment of construction and operational noise and vibration and off-site transport noise;	Section 8.2
Air Quality	
Dust and odour impacts arising from the construction and operation;	Section 8.1
Flooding	Section 8.8
Hazards	
Risk assessment of the construction and operation of the proposal;	Section 8
Soils and Land Use	Section 8.2 and Section 8.1
Flora and Fauna	
Impacts on threatened species, populations or endangered ecological communities or their habitats; and details of vegetation offsets to ensure that there is no net loss to the flora and fauna values of the area in the medium to long term	Section 8.9
Rehabilitation and Final Land Form	
Description of how the sites would be progressively rehabilitated and integrated into the surrounding landscape; a description of the measures that would be implemented to ensure that sufficient resources are available to implement the proposed rehabilitation measures, and for the ongoing management of the sites following the cessation of gas production;	Section 8.8
Waste	Section 8.14

Key Matters	Reference in EA
Visual	Section 8.7
Heritage	
Aboriginal and non-Aboriginal Heritage	Section 8.11 and Section 8.12
Consultation	
Consult with the relevant Local, State or Commonwealth government authorities, service providers, community groups or affected landowners. The consultation process and issues raised are to be addressed. In particular, consultation must be undertaken with the following parties: Department of Education and Training; Department of Environment and Conservation; Department of Natural Resources; Department of Primary Industries; Landcom; Mine Subsidence Board; NSW Heritage Office; NSW Rural Fire Service; Roads and Traffic Authority; Sydney Catchment Authority; Camden Council; Campbelltown City Council; Wollondilly Shire Council; and Australian Rail Track Corporation (ARTC).	Section 6.2 and Section 6.3

Table 6-2: Director General's EA Requirements (Project Application)

Key Matters	Reference in EA
Surface and Groundwater	
Assessment of the potential impacts on streams, the local groundwater regime and water quality (including salinity), and a description of the proposed water management systems;	Section 8
Noise	
A broad assessment of construction and operational noise and vibration and off-site transport noise;	Section 8.5
Vibration	Section 8.5
Air Quality	
Dust and odour impacts arising from the construction and operation;	Section 8.3
Flooding	Section 8.8
Hazards	
Risk assessment of the construction and operation of the proposal;	Section 8.2

Key Matters	Reference in EA
Flora and Fauna	
Impacts on threatened species, populations or endangered ecological communities or their habitats; and details of vegetation offsets to ensure that there is no net loss to the flora and fauna values of the area in the medium to long term	Section 8.9
Rehabilitation and Final Land Form	
Description of how the sites would be progressively rehabilitated and integrated into the surrounding landscape; a description of the measures that would be implemented to ensure that sufficient resources are available to implement the proposed rehabilitation measures, and for the ongoing management of the sites following the cessation of gas production;	Section 8.15
Waste	Section 8.14
Visual	Section 8.10
Heritage	
Aboriginal and non-Aboriginal Heritage	Section 8.11 and Section 8.12
Consultation	
Consult with the relevant Local, State or Commonwealth government authorities, service providers, community groups or affected landowners. The consultation process and issues raised are to be addressed. In particular, consultation must be undertaken with the following parties: Department of Education and Training; Department of Environment and Conservation; Department of Natural Resources; Department of Primary Industries; Landcom; Mine Subsidence Board; NSW Heritage Office; NSW Rural Fire Service; Roads and Traffic Authority; Sydney Catchment Authority; Camden Council; Campbelltown City Council; Wollondilly Shire Council; and Australian Rail Track Corporation.	Section 6.2 and Section 6.3

In addition to the above, the EA must include the general requirements for projects under Part 3A of the EP&A Act, which were specified in the Director-General's EARs and are outlined in **Table 6-3** below.

Table 6-3: Statutory Requirements for EA (Including EP&A Regulation Clause 51 Matters)

Requirement	Reference in EA
Executive Summary	Executive Summary
Description of the proposal, including construction, operation and staging	Section 4
Details of the location of the project and environmental planning provisions applicable to the site and the project	Sections 2, 4 and 5
Consideration of Alternatives	Section 3
An assessment (detailed assessment for Project Application) of the environmental impacts of the project, with particular focus on the key assessment requirements specified below	Section 8
Proposed mitigation/ management measures of residual environmental impacts	Section 10
Justification for undertaking the project with consideration of the benefits/ impacts of the proposal, and proposed management/ mitigation	Section 11
A draft Statement of Commitments for environmental mitigation, management and monitoring for the project	Section 9
Certification by the author of the Environmental Assessment that the information contained in the Assessment is neither false nor misleading	Certificate at front of EA

The Director-General's EARs for the Project and Concept Applications contained only two notable differences. One difference is that a more detailed assessment of key issues is required for the Project Application component of the project. The second difference identified is that soils and land use were identified as a key issue to be addressed for Concept Approval but not for Project Approval. Hence, **Table 6-1** and **Table 6-2** above show the Director-General's requirements for both the Concept and Project Approval components of the proposal, however the higher level of assessment and detail required for the Project Approval component has been taken into consideration and is reflected in the preparation of this EA.

6.2 Consultation with Stakeholders and Other Relevant Authorities

6.2.1 Planning Focus Meeting

Having regard to the history of the CGP, the DoP in this instance advised that a formal Planning Focus Meeting (PFM) was not required. However, DoP, on behalf of the Director-General, sought the views of relevant statutory authorities on issues to be included in his EARs, by referring a copy of the Preliminary Project Application and Environmental Assessment Scoping Report (EASR). This process provided opportunity for key statutory authorities to establish the requirements for the form and content of the EA.

6.2.2 Statutory and other relevant authorities

The Proponent has undertaken consultation with key local and state Government agencies as specified in the EARs during the preliminary design phase and preparation of this EA. The purpose of this consultation has been to provide an overview of the project and to seek input into matters they would like to see addressed in the EA.

In this regard, written comments were sought from relevant statutory agencies identified in the EARs to assist with the preparation of the EA (and are provided in **Appendix C**). **Table 6-4** below summarises the responses received together with the relevant section of the EA which addresses the matter.

Table 6-4: Agency Responses

Agency	Matters for Consideration	Reference in EA
Wollondilly Shire Council	• Management of risk and hazard • Impacts on locality in terms of noise, vibration, dust and amenity • Impacts on air quality • Management of water including stormwater and water used in construction • Management of waste • Impacts on flora and fauna • Suitability of well surface locations in terms of geotechnical and soil considerations • Impacts on items and areas of Indigenous and non-indigenous cultural significance • Management of access and traffic • Impacts of any new access ways to be constructed • Impact of proposal on adjoining land uses • Visual impact of wells and any ancillary development • Restoration of well surface locations	Section 8.2 Sections 8.5, 8.3 Section 8.3 Section 8.8 Section 8.14 Section 8.9 Section 8.4 Sections 8.11, 8.12 Section 8.13 Section 8 Section 8.1 Section 8.10 Section 8.15
NSW Department of Education and Training	• Not anticipated that there will be an operating school in either Menangle Park or Spring Farm during the scheduled drilling phase of the project. • The future operation, amenity and education provision in Spring Farm and Menangle Park should not be compromised by the proposed project. • The DET welcomes the opportunity to work with AGL to ensure that there are no negative impacts in relation to the health, safety and welfare of school students living in the vicinity of a gas well.	Noted Noted Noted, and refer to Section 4.8.2
NSW Heritage Office	• With regard to the Concept Application: - Elizabeth Macarthur Agricultural Institute listed on the State Heritage Register and should be considered in all future assessments and applications regarding proposed Stage 2 developments. - Approach to the assessment of Concept activities is supported.	Noted but relate to future applications and works.

Agency	Matters for Consideration	Reference in EA
	- Future wells and infrastructure forming part of the Concept application should be located on disturbed ground adjacent to existing wells where possible outside the airtillage of items listed on the State Heritage Register and should avoid disturbing items listed on Local Environmental Plans. - Prior to finalising the location of future wells and infrastructure, areas where excavation is proposed should be surveyed by a qualified heritage practitioner with historic sites experience to identify and record previously undocumented heritage items. The survey should include an assessment of the potential for sub-surface relics. • Environmental assessments for subsequent Major Projects applications should include a detailed heritage impact assessment and Statements of Heritage Impact(s) that comply with NSW Heritage guidelines. • With regard to the Project Application: - The heritage significance of identified heritage items and any impacts the project may have upon the significance should be assessed. The assessment should include natural areas and places of Aboriginal, historic or archaeological significance. - Recommended that the archaeological survey and assessment of Glenlee House be reviewed as part of the EA. - Recommended that lists maintained by the National Trust be consulted as well as heritage listings under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> and relevant local Councils. - Non-Aboriginal heritage items within the affected area should be identified and impacts assessed in accordance with Heritage Council guidelines. - The proposal should have regard to any impacts on places, items or relics of significance to Aboriginal people.	Sections 8.11 and 8.12 and Appendix H Noted however, Glenlee House is not considered to be impacted due to distance from footprint and lack of visibility.
Sydney Catchment Authority	• Proposed works may be in the vicinity of the Upper Canal which is part of the Sydney drinking water supply system. • The Upper Canal has significant heritage value and is listed on the State Heritage Register.	Section 8.8 Section 8.12

Agency	Matters for Consideration	Reference in EA
Department of Environment and Conservation	The EA should include an assessment of the potential for subsidence and groundwater contamination as a result of the proposal, including the identification of any mitigation measures to address any such impacts.	Sections 8.4 and 8.8 and Appendix E

The Aboriginal Heritage Assessment undertaken as part of this EA also involved consultation with local Aboriginal groups. Results of this consultation are summarised in the Aboriginal Cultural Heritage Assessment discussed in **Section 8.11** of this EA and included as **Appendix H**.

6.3 Community Consultation

As part of the preliminary project planning for the proposed works, AGL undertook a program of community consultation targeting local landowners and stakeholders through a program of meetings and workshops. Details of this consultation program are provided in the following sections.

6.3.1 Objectives

The overall objective of the Community Consultation Strategy implemented for the Project was to ensure clear, effective, open, two-way communication at all times by listening, recording and responding to issues. Specific objectives identified included:

- to ensure the community was aware of the proposal and that an EA was being prepared for these works;
- to facilitate information exchange from an early stage between the study team and the community to enable joint understanding of the key issues;
- to provide opportunity for public comment and to assist and supply interested parties with information;
- to provide an explanation of the EA process;
- to identify, analyse and address community issues and suggestions;
- to identify potentially conflicting issues at an early stage in the project which may lead to problems during other stages of the program; and
- to demonstrate that issues were being addressed.

6.3.2 Community Consultation

The approach adopted to distribute information to the local community involved the following:

- Discussions with landowners affected by the proposed works;
- Workshops for the CGP CCC and interested community and business groups;
- Meetings with local council staff, Members of Parliament and government agencies.

The variety of consultation techniques implemented was designed to enable information about the project to effectively reach target audiences.

6.3.3 Landowner Consultation

The Proponent has engaged in discussions with landowners potentially affected by the proposed works within the Spring Farm and Menangle Park areas. This has included the following parties:

- Spring Farm – Landcom, Camden Council, the Cornish Group, Mirvac Homes; and
- Menangle Park – Landcom, Campbelltown Council, ARTC, University of Western Sydney (UWS) and TransGrid.

These discussions have influenced and changed the siting and design of the proposed well surface locations and the supporting infrastructure. A summary of issues raised landowners is provided in **Table 6-5**.

Table 6-5: Summary of Issues Raised – TransGrid, ARTC, Mirvac, Cornish Group, Campbelltown Council, Camden Council and Landcom

Issues Raised	Comment / Reference in EA
TransGrid	
Land use conflicts between the proposal and TransGrid's Macarthur Substation development.	AGL is undertaking ongoing consultation and negotiations with TransGrid in relation to the location, access arrangements and construction footprint of MP04. Visual impacts associated with well surface locations are addressed in Section 8.10 .
Siting and security of construction sites and access roads.	Security and environmental management measures would be detailed in EHSMPs for the project, and are discussed in Section 4.8.2 and in relation to potential impacts in Section 9 .
Management of construction activities.	CEMPs would be prepared and implemented associated with the proposed project, and are discussed in relation to potential impacts in Section 9 .
Footprint of well surface locations	Following construction, well surface locations would be reduced to a footprint of up to up to some 20 metres x 20 metres.
Access arrangements to TransGrid land via adjacent property owned by Sydney Catchment Authority (SCA).	AGL is undertaking ongoing consultation and negotiations with SCA in relation to access arrangements for MP04.
Vibration on heritage canal located adjacent to TransGrid land (owned by SCA).	Potential impacts to heritage canal have been assessed in Section 8.12 .
Ecological impacts	Ecological impacts resulting from the proposal are addressed in Section 8.9 .
Potential for transferred and/or induced voltage, earth potential rise and low frequency induction hazards in the vicinity of TransGrid's substation.	AGL is undertaking ongoing consultation and negotiations with TransGrid in relation to potential hazards.

Issues Raised	Comment / Reference in EA
Campbelltown Council	
Technology to be used for the extraction of gas, and the associated impacts.	Section 4 describes the project, and potential impacts are assessed in Section 8 .
Security needs to be considered in wellhead design and location.	Management measures would be implemented throughout all phases of the project, and would include security and environmental management measures. These would be detailed in EHSMPs for the project, and are discussed in Section 4.8.2 and in relation to potential impacts discussed in Section 9 .
Flexibility	The Environmental Assessment has used an “envelope” approach to the impact assessment. The assessment has been carried out on a wider area to allow the final well surface location to be within an approximately 50 metre radius of the nominated location (in the case of Spring Farm) and an approximately 100 metre radius of the nominated location (in the case of Menangle Park). This approach will allow AGL to move infrastructure within the assessed parameters to enable flexibility with landowners and to accommodate future land uses.
Camden Council	
Bush corridors are an issue for community and for council – significant value to the local area	Ecological impacts resulting from the proposal are assessed in Section 8.9 .
Environmental Assessment to take into account the current planning for Spring Farm	The EA has taken into account the future urban development plans for Spring Farm (see Section 8).
The Gundungurra Reserve and its Plan of Management (POM) would need to be considered	The EA has taken into account the Gundungurra Reserve and the POM in Section 8 , particularly with respect to rehabilitation.
ARTC	
Fencing of the site to ensure there is no entry to the rail corridor.	All sites would be securely fenced. Management measures, including security would be included in the EHSMPs for the project.
Lighting direction to be discussed for 24 hour drilling to ensure train drivers are not affected.	Management measures associated with the positioning of lighting would be included in the EHSMPs for the project.
Adherence to the <i>Occupational Health and Safety Act 2000</i> . All personnel working on the site must complete the Track Safety Awareness training.	Details would be included in EHSMPs prepared and implemented for the project. Training and induction requirements are discussed in Section 9 .

Issues Raised	Comment / Reference in EA
Ensure no impact on ARTC operations.	AGL would co-operate as much as possible to ensure no impacts on ARTC occur as a result of the proposed project.
Mirvac / Cornish Group	
Bushfire zones	Refer Section 8 .
Security/ vandalism	All sites would be securely fenced. Management measures, including security would be included in the EHSMPs for the project.
Landcom	
The AGL proposals for the Menangle Park release area are premature in the context of land use planning in this area and detrimental to the development potential of the land.	The timing of the completion of the structure plan for the Menangle Park release area is not known and the Proponent has built sufficient flexibility into the design and planning for the proposal to accommodate future urban (residential, commercial and industrial) development in the area. The proposed Project is not expected to have a detrimental impact upon the development potential of the land. Further discussion of the compatibility of the proposed Project with future land use is provided in Section 8.1 of this EA.
Proposed well surface locations MP02 and MP03 fall outside AGL's legal lease area (PPL 4)	These well surface locations fall within the bounds of PPL 5.
The number and location of gas well head infrastructure needs to be reviewed.	The number and location of proposed surface locations have been determined following an extensive review process which is based upon a range of technical and environmental considerations in consultation with landowners. These locations are the subject of commercial negotiations which are not relevant planning considerations to be addressed in the EA.
The proposal will compromise the ability of the landowner to realise the development potential of the land.	Compatibility with existing and future land uses in the area is discussed in Section 8.1 of the EA. A degree of flexibility has been built into the design and planning for the proposed Project to accommodate future land use and development such that the proposed works will not compromise the development potential of surrounding land.
The proposal will create additional development costs on Landcom in implementing development proposals.	A degree of flexibility has been built into the design and planning for the proposed Project to accommodate future land use and development such that the proposed works will not compromise the development potential of surrounding land. The issue of development costs is not a relevant planning consideration.

Issues Raised	Comment / Reference in EA
The presence of AGL's infrastructure on the land will prevent Landcom from being able to transfer the land to Campbelltown City Council and consequently cause additional financial burden on Landcom.	This is not a relevant planning consideration.
The presence of AGL's infrastructure will place constraints on the land and create environmental, visual and other imposts that will reduce the value of adjoining future residential allotments and impact the amenity of residents.	The issue of devaluation of land is not a relevant planning consideration. Extensive environmental studies have been undertaken including an acoustic assessment, visual assessment and hazard and risk assessment and these studies have found that the proposal will not significantly detract from the amenity of existing or future land uses in the surrounding area. Further discussion of land use compatibility is provided in Section 8.1 of this EA.
Indemnity and compensation issues were raised by Landcom	These are not a relevant planning consideration.

6.3.4 Workshops

In consultation with local Councils and Members of Parliament, HLA and the proponent identified key community groups with an interest in environmental/ development issues, and invited them to participate in briefing workshops on the project. **Table 6-6** provides a summary of the groups invited to attend the workshops.

Table 6-6: Local Community Groups

LGA	Community Groups
Camden, Campbelltown and Wollondilly	Community Consultative Committee (CCC), established as a requirement of past development consents, and including representatives of each of the local Councils, the community residing in the areas subject to current approvals, a local environmental group and the Proponent. National Parks Association of NSW – Macarthur Branch
Camden	Camden Resident Action Group (CRAG) Narellan Action Group (NAG) Camden Chamber of Commerce Narellan Chamber of Commerce
Campbelltown	Menangle Park Community Network NSW Harness Racing Club Campbelltown Chamber of Commerce
Wollondilly	Razorback Environmental Protection Society

The Proponent together with HLA's Community Consultation Coordinator organised a series of three workshops as follows:

- 17th August 2006 - CCC Workshop (includes community and council representatives from each of the LGAs);
- 17th August 2006 – Camden Community Workshop; and

- 22nd August 2006 – Campbelltown Community Workshop.

A total of 7 representatives (excluding the Proponent and HLA personnel) attended the CCC workshop held on 17 August 2006, while two representatives of the community (one each from the National Parks Association of NSW – Macarthur Branch and the Menangle Park Community Network) attended the second workshop held on 17 August 2006. No community representatives attended the planned workshop for the Campbelltown area which was to be held on 22 August 2006.

At each of the workshops, a presentation was provided on the following:

- Overview;
- What is Coal Seam Gas?
- Economic and Greenhouse Issues;
- Camden Gas Project – Introduction;
- Project Overview and Description;
- Approval Process and Applications;
- Project Timeframe;
- Environmental Impact Assessment Process; and
- Opportunities for Community Involvement.

Given the size of the workshop groups, attendees were able to ask questions throughout the presentation, which resulted in a number of questions being raised and answered about elements of the project. Following the presentation, attendees were asked if there were any specific issues they would like to see addressed in the EA. The community representatives did not raise any specific issues they would like to see addressed in the EA. The website details for the CGP were distributed to provide interested people with information on the Project.

Summary of Issues Raised by the Community

A total of one submission was received from the community outlining issues associated with the proposal. A summary of the key issues raised in the submission received and by workshop participants is provided in **Table 6-7** below, together with reference to relevant section of the EA in which the issue is addressed.

Table 6-7: Summary of Issues Raised - Community Submissions

Matters for Consideration	Comment / Reference in EA
Project Matters	
Potential life of wells (CCC Workshop, Camden Community Workshop).	The average life of a well is up to an estimated 15 years, however they estimate that a more realistic life is 8 – 10 years. At the end of its production life, the well is plugged and abandoned. This is further discussed in Section 4 .
Types of gas produced and effect of methane gas production in terms of greenhouse effect? (CCC Workshop)	Natural gas (including CSM) produces some 50% less greenhouse gas per gigajoule of energy than coal, and is widely considered to be the cleanest and most environmentally acceptable fossil fuel. This is further discussed in Section 11 .

Matters for Consideration	Comment / Reference in EA
Average depth of the coal seam (CCC Workshop).	The coal seam in Menangle Park commences at around 650 metres depth and is approximately 3.5 metres thick (between 2.5 and 4 metres).
Availability of CSM technology (Camden Community Workshop)	The technology has been around for some 20 years in the United States, and since then, there has been growth in knowledge about the technology.
Type of gas coming produced by the coal seam, and difference to Moomba (Camden Community Workshop)	The CGP is unconventional gas, while Moomba is conventional gas derived from sandstone reservoirs, and therefore the mechanism and process for extracting the gas is different. The product is similar, although other sources have components which are more flammable than the gas produced from the CGP. However, these components are stripped out and used for other purposes, thereby making the product more compatible with that produced at Camden.
Whether the gas produced at the CGP goes into compressed natural gas (used for motor vehicles) (Camden Community Workshop).	AGL advised that the gas could be used in motor vehicles, but AGL does not use it for this process.
Source of fracture stimulation sand (Camden Community Workshop).	Fracture stimulation sand is typically sourced from Western Australia, but can also be sourced from South Australia.
Ideal spacing between wells (Camden Community Workshop)	AGL advised that the ideal spacing between wells for optimal production is an average of 600 metres (between 500 and 700 metres).
Land Use	
Effects of fracture stimulation on future land use potential for mining (CCC Workshop, Camden Community Workshop).	The fracture stimulation process does not impact on the ability to conduct future mining operations in an area. AGL would remove the steel pipe/casing from well surface locations, which is required as a condition on the leases. Wells would also be logged with DPI. This is further discussed in Section 8.1 and Section 8.8 .
Potential land use conflicts at Spring Farm, and whether there has been consideration of draining the gas from the existing tip (CCC Workshop).	Land use and landscape and visual impacts have been addressed in Section 8.1 and Section 8.10 . In regards to the existing tip, AGL advised that gas from the tip is currently being utilised by other parties.
Minimum distance a well could be located from a residential dwelling (CCC Workshop).	Locational guidelines and principles have been developed to assist with siting of wells and associated infrastructure.
Use of Project and Concept Areas for future land uses such as mining (CCC Workshop).	Future land uses in the Stage 2 area are likely to comprise urban development and other compatible land uses. Notwithstanding this, AGL does work co-operatively with mining companies where required.

Matters for Consideration	Comment / Reference in EA
Land tenure and the potential impact on landowners ability to develop their land (Camden Community Workshop).	AGL advised that the land on which wells are proposed to be located is privately owned, and they are talking with landowners. Planning of locations is undertaken having regard to the future land release areas.
Landowner compensation (Camden Community Workshop).	AGL advised that Access and Compensation Agreements are made under the relevant legislative framework, and owners are paid for installation per well, lineal metre of access road and gas gathering line, then an ongoing fee per year of operation. Land is subsequently rehabilitated in consultation with the landowner.
Hazard and Risk	
Security (CCC Workshop).	Hazards and risks associated with the project are discussed in Section 8.2 .
Flares at gas treatment plants (CCC Workshop).	Emergency response procedures are incorporated in to the Camden Gas Project Emergency Response Plan, (refer Section 9). AGL has included within their procedures to notify emergency services (fire) when they know they are going to burn gas/cause flare.
Noise	
Noise generation from fracture stimulation (Camden Community Workshop).	AGL advised that fracture stimulation is one of the activities which generates noise, but only for very short durations. Impacts associated with noise are assessed in Section 8.5 .
Social	
Reasons for AGL gas production in populated areas (Camden Community Workshop)	There are higher gas levels/reserves and potential for production in these areas.
Benefits of gas production for local residents (Camden Community Workshop).	Section 11
Flora and Fauna	
Removal of vegetation (Camden Community Workshop).	Vegetation removal would be minimised where possible. Potential impacts associated with vegetation removal are assessed in Section 8.9 .
Landscape and Visual	
Selection of well type/design and compatibility with rural areas (Camden Community Workshop).	The visual impacts associated with the proposal are assessed in Section 8.10 .

7 ISSUE PRIORITISATION

7.1 Issues Identification

7.1.1 Methodology

Consultation with the relevant statutory authorities and meetings held with the local community and landowners, as well as the Proponent's experience with the project to date, assisted with the identification of issues relating to the project.

7.1.2 The Issues

The issues identified through consultation with the community, State and local government agencies the Director-General's EARs and include:

- hazard and risk;
- land use (in particular, compatibility with future land use);
- noise and vibration;
- air quality;
- water management;
- visual impact;
- soils and stability;
- flora and fauna;
- cultural heritage;
- transport and traffic;
- social impacts; and
- economic impacts.

7.2 Prioritisation of Issues

7.2.1 Approach

The prioritisation of issues for the proposed project is based on the need to recognise that the higher the potential severity of adverse environmental effects and the greater the consequence of those unmanaged effects, the higher the degree of environmental assessment required.

Where a high potential effect was identified, the attribute or issue was allocated a higher priority for assessment.

Table 7-1 provides the Issues Prioritisation Matrix upon which the ranking of environmental issues has been based. This method assesses priority on the basis of the potential severity of environmental effects and the likely consequences of those potential effects if unmanaged. The potential severity and consequence of the environmental effect are each given a numerical value between 1 and 3. The numbers are added together to provide a result which is then ranked and shaded in the matrix by the level of priority being High, Medium or Low.

The allocation of priority is based upon the following considerations:

Severity of Effects

Low: localised implications; imperceptible or short term cumulative impacts.

Medium: regional implications; modest or medium term accumulation of impacts.

High: inter-regional implications; serious or long term accumulation of impacts.

Consequences of Unmanaged Effects

Low: minor environmental change; offsets available.

Medium: moderate adverse environmental change; offsets available.

High: important adverse environmental change, offsets not readily available.

Table 7-1: Issue Prioritisation Matrix

Severity of Effects	Consequence of Unmanaged Effects		
	3 High	2 Medium	1 Low
1 Low	4 (Medium)	3 (Low)	2 (Low)
2 Medium	5 (High)	4 (Medium)	3 (Low)
3 High	6 (High)	5 (High)	4 (Medium)

7.2.2 Prioritisation Assessment

The prioritisation of environmental issues for the activities proposed as part of the Concept and concurrent Project Application taking into consideration each of the key issues identified is shown in **Table 7-2**. This assessment aims to allow the prioritisation of issues for assessment and does not consider the application of mitigation measures to manage these environmental effects.

Table 7-2: Prioritisation of Issues

Issue	Severity	Consequence	Priority
Aspect: Hazard and Risk			
Exposure of surrounding land uses to risks and hazards during construction.	1	2	3 (Low)
Exposure of surrounding land uses to risks and hazards during operation.	2	2	4 (Medium)
Exposure of employees to risks and hazards.	1	2	3 (Low)

Issue	Severity	Consequence	Priority
Community perception of risk issues.	2	3	5 (High)
Aspect: Land Use			
Inappropriate use of land	1	1	2 (Low)
Incompatibility of land use with surrounding environment	1	2	3 (Low)
Incompatibility of land use with new land uses proposed for area	2	3	5 (High)
Aspect: Noise and Vibration			
Temporary noise nuisance to local residents during construction.	2	2	4 (Medium)
Noise nuisance to local residents during operation/ maintenance.	2	2	4 (Medium)
Aspect: Air Quality			
Construction related impacts on air quality.	1	2	3 (Low)
Emissions to the atmosphere with the potential to result in degradation of air quality in the local area.	1	1	2 (Low)
Odour emissions as a result of drilling activities.	2	2	4 (Medium)
Community concern regarding degradation of air quality.	1	2	3 (Low)
Regional and inter-regional impacts upon air quality.	1	1	2 (Low)
Aspect: Water Management			
Impacts caused by the flooding of the Nepean River system and tributaries.	1	2	3 (Low)
Impact upon groundwater	1	2	3 (Low)
Degradation of water quality in the local area during construction.	1	2	3 (Low)
Degradation of water quality in the local area during operation.	1	1	2 (Low)
Impacts on local water resources due to water use during construction	1	2	3 (Low)

Issue	Severity	Consequence	Priority
Visual Impacts			
Visual impacts during construction.	1	2	3 (Low)
Visual impacts during operation.	1	2	3 (Low)
Aspect: Soils and Geology			
Erosion and sedimentation during construction.	2	1	3 (Low)
Subsidence due to extraction of gas resource.	1	2	3 (Low)
Potential geotechnical impacts as a result of drilling and fracture stimulation operations.	2	2	4 (Medium)
Potential sterilisation of coal seams for future mining activities.	1	2	3 (Low)
Contamination and sterilisation of land for future uses.	1	2	3 (Low)
Aspect: Ecological			
Loss of habitat due to clearing and development.	1	1	2 (Low)
Reduction in biodiversity due to loss of habitat for native species.	1	1	2 (Low)
Spread of weeds and feral animals.	1	2	3 (Low)
Impact upon threatened species.	1	1	2 (Low)
Aspect: Cultural Heritage			
Impacts on Non-Indigenous heritage.	2	1	3 (Low)
Impacts on Indigenous heritage.	2	1	3 (Low)
Aspect: Transport and Traffic			
Increase in traffic on local road network during construction.	1	1	2 (Low)
Increase in traffic on local road network during operation.	1	1	2 (Low)

Issue	Severity	Consequence	Priority
Aspect: Social			
Impacts upon amenity of surrounding properties such as noise, visual, etc	2	2	4 (Medium)
Impacts upon demand for community resources	1	1	2 (Low)
Aspect: Economic			
Direct economic impacts such as job creation.	2	1	3 (Low)
Indirect local, regional and State economic impacts (positive).	2	2	4 (Medium)

The above table identifies the prioritisation of environmental issues in relation to the project. Those with high and medium outcomes require closer scrutiny and the development of safeguards as listed below:

High

- Land use (compatibility with future land use); and
- Hazard and risk (community perception).

Medium

- Air Quality (Odour);
- Soils and Geology;
- Noise and vibration;
- Social; and
- Economic.

Low

- Water management;
- Ecological;
- Visual Impacts;
- Cultural Heritage; and
- Traffic and Transportation.



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8 ENVIRONMENTAL IMPACT ASSESSMENT

8.1 Land Use

8.1.1 Overview

As previously indicated in this EA, Stage 2 of the CGP is located approximately 65km south west of Sydney, and includes portions of three LGAs (Camden, Campbelltown and Wollondilly), which form part of an area referred to as the Macarthur region.

The Camden LGA comprises a mix of agricultural lands, country towns and new residential areas with associated commercial and industrial developments. Campbelltown City is a significant regional centre offering a range of services including a major regional hospital, a university, two TAFE campuses and a significant tourism industry, while a significant proportion of the Wollondilly LGA comprises national park and rural areas, with scattered urban settlements.

Each of the LGAs include non-urban or rural lands, which are used for agricultural purposes, although mining and extractive industries (gas, sand and coal) are also a significant land use activity within certain parts of the LGAs. Coal mining remains a major industry in the Wollondilly area.

The south western area of Sydney, including Campbelltown and Narellan, together with the adjoining LGA to the north, Liverpool City, has provided a significant proportion of land towards Sydney's metropolitan growth over the past three decades. Areas around Narellan, including Spring Farm, Menangle Park, Elderslie and Harrington Park have been committed for urban development (NSW Government, 2005). Land further to the north of the Stage 2 Concept Area has recently been identified as part of the South West Growth Centre, earmarked to provide for new urban development over the next 25 to 30 years.

The land within the Stage 2 Concept area is serviced by the larger commercial centres of Narellan and Campbelltown which are located to the north east and north west of the area. These centres provide a range of land uses and services, including retail, commercial, medical, education and community facilities.

Existing producing coal seam gas wells and associated infrastructure are interspersed throughout the existing Stage 2 area (including Menangle Park) and form part of the existing rural landscape.

8.1.2 Existing and Surrounding Land Use

The Stage 2 Concept Plan area is predominantly rural in nature with scattered industrial areas, although residential development has occurred along the northern, north eastern and north western edges. Wells and associated infrastructure are an existing land use in the locality including in the Menangle Park, Glenlee and Spring Farm areas.

The Spring Farm area currently comprises a mix of rural and rural residential development, with the predominant land uses being poultry farming, sand and soil extraction, a waste disposal facility, an electricity substation, grazing and two groups of small lot residences (Patterson Britton & Partners, 2000). LEP 121, which was gazetted on 21 May 2004, rezoned the land within Spring Farm from its former Rural 'A' and 5(a) Special Uses (Electricity Substation) land

use zoning to a mix of Rural 1(a), Residential 2(d), 7(a) Environmentally Sensitive Land and Special Uses land use zones.

The Menangle Park area is characterised by a mix of rural land uses, including horse-related activities, livestock grazing and orcharding, together with extractive industry related activities (including Glenlee Coal Washery and Menangle Sand and Soil). Menangle Park Village comprises some 138 privately owned dwellings on a mix of rural and rural residential allotments. Significant infrastructure running through or adjacent to the Menangle Park area includes the Southern Railway Line and the Southwestern Freeway. Whilst not yet zoned for urban development, Menangle Park has been identified by Campbelltown Council as a future urban (residential, commercial and industrial) land release area.

8.1.3 Future Land Use

As previously stated in this EA, portions of land within the Stage 2 Concept Area, including Spring Farm, Menangle Park, Elderslie and Harrington Park have been committed for future urban (residential, commercial and industrial) development (NSW Government, 2005). Land further to the north of the Stage 2 Concept Area has recently been identified as part of the South West Growth Centre, earmarked to provide for new urban (residential, commercial and industrial) development over the next 25 to 30 years.

Spring Farm

Planning for the Spring Farm Release Area is more advanced than Menangle Park, with LEP 121 having been gazetted on 21 May 2004, together with the adoption of a Master Plan and Development Control Plan (DCP) for the future development of the area.

LEP 121 has created the zoning framework to facilitate the future development of the Spring Farm release area, and includes the following land uses:

- Rural 1(a), located at the western end of the release area and characterised by a 40 hectare lot size, intended to provide for a range of agricultural and extractive industry purposes;
- Residential 2(d), which is intended to provide for a range of compatible activities to support residential development, including a variety of housing types, a village centre (to provide retail, commercial, residential, community and recreational activities), and supporting educational, recreational, community and religious activities;
- 7(a) Environmentally Sensitive Land, intended to protect and manage environmentally sensitive lands for the principal purpose of biodiversity conservation, and provide links with other natural areas as part of an open space and bush corridor network;
- 5(a), 5(b) and 5(c) Special Uses zones, which provide for the existing electricity substation, local and future roads and road widening.

LEP 121 envisages the future development of Spring Farm will comprise a series of urban villages, shaped by bush corridors linking William Howe Reserve and Gundungurra Reserve with the Nepean River.

Up to a maximum of 4,083 and minimum of 3,717 new dwellings are expected to be provided within the Spring Farm release area, in a range of housing forms including single dwellings on individual lots, attached housing and multi-unit housing, together with land uses required to support the residential population.

Of significance to the environmental and visual amenity of the Spring Farm release area is the establishment of bushland corridors, which are generally located along creeklines and facilitate the conservation of endangered ecological communities including Elderslie Banksia Scrub Forest and Cumberland Plain Woodland.

The value of sand mining to the economy and its relationship with future development is recognised by Clause 3(7) of LEP 121 which states that development of the villages will commence before the completion of sand mining associated with the recovery of the Elderslie sand deposits.

The Spring Farm Master Plan establishes a broad subdivision pattern for the area. A copy of the Master Plan is included as **Figure 8.1** to this EA.

Menangle Park

Menangle Park has been earmarked for urban development having been included by the State Government on the Metropolitan Urban Development Program in 2001, with a notional yield of some 4,200 lots.

In response to this, Campbelltown Council, DoP (then Department of Infrastructure, Planning and Natural Resources) and Landcom commissioned a range of specialist studies of the land. On the basis of these studies, key environmental constraints associated with the future development of the site were identified as follows:

- Constraints posed by flooding, given the proximity of the site to the Nepean River;
- Existing sand resources in two major deposits, representing some 6.2 million tonnes;
- Existing coal and coal bed methane resources of State significance and the effect of mine subsidence if these resources are mined;
- Matters of indigenous and non-indigenous heritage significance and areas of indigenous archaeological sensitivity which would need to be managed; and
- Areas of ecological significance which would need to be managed.

It is anticipated that further environmental/ planning studies will be undertaken during the next 3 to 5 years with the intention of rezoning the Menangle Park area for future urban development.

8.1.4 Potential Impacts

The proposed Project has been designed and planned with a degree of flexibility in order to accommodate future development in the surrounding areas, including both residential and other forms of development. Well surface locations have been chosen in consultation with landowners and negotiations with landowners are ongoing. Well design and construction methods also allow for a single change in levels as may be required in relation to future development of roads and possible sand extraction in the Spring Farm and Menangle Park areas. Overall, the flexibility built into the proposal should ensure that there is no significant detrimental impact or constraint imposed upon land uses or future development on surrounding land as a result of the proposed Project.

Construction

As identified in **Section 4.4** of this EA, construction activities include the preparation of access roads, drill pads, environmental controls, the construction of gas gathering and the drilling, fracture stimulation (where required) and completion of wells. Earthmoving equipment, drill rigs and fracture stimulation equipment are used during the construction period.

Given the program for implementation, construction related activities are expected to be completed prior to the construction and occupation of residential dwellings within Spring Farm and Menangle Park as currently indicated by landowners, and therefore the impact of construction activities is to be considered in the context of existing land uses (predominantly rural in nature).

The impacts of construction activities on the use of the land on which wells and associated infrastructure are proposed and on surrounding land uses, relate to:

- hazard and risk;
- air quality impacts;
- noise impacts associated with use of equipment on the site;
- water quality impacts associated with site disturbance;
- short term visual impacts on surrounding land uses, particularly associated with site disturbance, removal of minimal vegetation and location of equipment on the site; and
- construction traffic.

These impacts are discussed in **Sections 8.2, 8.3, 8.5, 8.8, 8.10 and 8.13** of this EA respectively. The visual impacts of the proposed Project will be most significant during the construction phase due to the presence of earth moving machinery and equipment required for drilling, however, these impacts will be temporary and as construction will be completed prior to residential development and occupation of the release areas, these impacts will not affect future residents. Similarly with noise, the most significant impacts will be during construction, however, the temporary nature of these impacts along with the availability of mitigation measures means that these impacts can be managed to maintain acceptable levels of noise for existing residents. Future residents will not be affected by this construction process. The issues of hazard and risk, air quality, water quality and traffic are considered to be minor during construction and potential impacts would again be temporary.

Potential impacts of the construction phase of the development would be managed through the implementation of mitigation measures which include a Construction Environmental Management Plan (CEMP) developed for the Project.

Activities associated with construction would be temporary and short-term in nature. During construction activities, the use of a portion of the Project site for agricultural purposes may need to be managed to ensure the movement of vehicles and agricultural land uses are effectively managed.

Once construction and rehabilitation of surplus construction areas is complete, land affected by the proposed wells and infrastructure would be significantly reduced to a footprint of approximately up to 45 metres x 45 metres.

Production

During the production phase, the primary impact on land affected by the proposed works relates to the constraints posed on alternative land uses occurring in the area immediately affected by the CGP infrastructure. Site constraints would be limited to the presence of infrastructure at the well head, which may temporarily limit some forms of land use. There would be no residual impact on the land use capability of the site following decommissioning.

Other impacts on the use of the subject land or on adjacent land associated with the production phase uses include:

- visual impacts associated with the producing well head infrastructure;
- noise impacts associated with the operating well and maintenance activities and work over, use of equipment on the site;
- hazard and risk; and
- operational traffic.

As described in this EA, there are principally two well head design options which may be implemented, one involving an open, fenced design, the other being an enclosed facility with a design and appearance similar to other utility installations (see **Figure 4.6**). The visual impact of these facilities is addressed further in **Section 8.10** of this EA and is generally considered to be minor given the small scale of the infrastructure, the existing presence of similar infrastructure in the area and the screening methods available (including landscaping).

It is noted that the proposed well surface locations at Spring Farm are to be sited within a current Reserve and in areas designated as future bushland corridors. Well surface location development may result in minor impacts to vegetation, however, following initial rehabilitation of surplus construction areas surrounding the well surface location with native species, impacts are expected to be limited to the operational footprint. Following closure and final rehabilitation of well surface locations they would be returned as close as possible to pre-operational land use or as agreed with the landowner.

With the exception of SF04A, the proposed well surface locations will not be sited within 30 to 40m of future residential dwellings within the Spring Farm release area (based upon the master plan from the Camden Council website). SF04A is an alternative location for SF04 and has been designed to avoid EBS and existing and future electricity infrastructure plans. Confirmation regarding the final location of the surface wells would be discussed between AGL and key stakeholders.

The location of future residential dwellings in Menangle Park is not yet known, however, the proposed well surface locations have been moved to the periphery of the developable land and the envelope approach allows well surface locations to be moved as part of the assessment to a more suitable location within the envelope area. For example, other surface locations that were not able to be relocated to avoid matters raised by landowners, such as MP10 in the area of a regionally significant sand resource, were removed and are now not amongst the well surface locations proposed by the proponent. These measures, along with the ability for a single change in levels as may be required in relation to future development of roads and possible sand extraction in both the Spring Farm and Menangle Park areas, are aimed at ensuring there is sufficient flexibility built into the proposal that will mean appropriate distances to potential future housing can be maintained.

This locational design approach undertaken by AGL also enables a twofold benefit to the area in that a state significant natural resource (gas) would be utilised, as well enabling future urban (residential, commercial and industrial) development with the Stage 2 Concept Area.

The noise impacts of the proposed project during production were assessed and are discussed in **Section 8.5** and **Appendix F**. The design of the project included a two stage process whereby site-specific design measures were incorporated into the well heads in order to achieve compliance with relevant noise criteria for current and future residents of the area.

Traffic impacts during the production phase are expected to be minimal. Traffic movements during the production phase would be associated with the general maintenance and monitoring of the well surface locations. The well heads will have the capacity to be controlled remotely, which reduces the need for vehicles. Continuous staffing would not be required at the individual

well surface locations as production is monitored from the gas plant, therefore minimising the daily traffic required for the operation of the proposed well surface locations.

During maintenance and work over activities, rigs and associated equipment such as generators and heavy vehicles would be required. The works are site specific and once completed the associated equipment is removed from the site. Similar impacts to the construction phase are expected although over a much shorter period, with noise impacts expected to generate the most concern from adjacent land uses. It should be noted that maintenance is a temporary activity and will be carried out during normal daytime hours and in accordance with the EHSMP.

The impacts of the proposal during the production phase in respect of the above issues are discussed in greater detail in **Sections 8.2, 8.5, 8.10 and 8.13** of this EA.

Post Development

The primary activities identified in this EA as occurring during the post development phase of the CGP are Concept Plan activities in the Stage 2 area, namely, the development of new wellfields and infill wells, the upgrade of gas gathering lines where required, re-fracture stimulation and in-field compression.

For re-fracture stimulation, rigs and associated equipment similar to that required for initial fracture stimulation would be required. The works are site specific and once completed the associated equipment is removed. Similar impacts to the construction phase are expected, with noise impacts expected to generate the most concern from adjacent land uses. Re-fracture stimulation occurs in daytime hours.

The impacts associated with post development activities are site specific and temporary in nature, and have been addressed in other sections of this EA. Infield compression would be limited to the Stage 2 Concept area at well surface locations or along gas gathering lines. A more detailed assessment of the impacts of these activities would be provided in subsequent project applications.

Closure and Final Rehabilitation

Final rehabilitation would be undertaken in two stages; initial rehabilitation of surplus construction area, and closure and final rehabilitation following cessation of gas production from a well surface location.

Land use impacts during these stages of work would relate to the noise, visual, air and water impacts arising from construction traffic and the plant and equipment used to plug and abandon the well and remove the surface well head equipment. These impacts would be temporary, and would result in the site being rehabilitated to pre-existing land use or better, or to a condition agreed with the landowner. The location of the well would be surveyed and logged in accordance with DPI guidelines.

Similarly the gas gathering lines would be removed and the land rehabilitated to either pre-production land use or to a condition agreed with the landowner. Operations of the CGP to date have only required the plugging and abandonment of a few wells and sections of gas gathering lines and none of the landholders have yet required the gas gathering lines to be removed, preferring instead to have the lines cleaned for irrigation use.

The Proponent is required by DPI to remove the steel/ pipe casing from the coal seam as part of the title conditions.

8.1.5 Environmental Safeguards

Safeguards to minimise the potential impacts of the proposal upon existing and future land use are largely built into the design of the Project and include:

- Consultation with landholders during the early project design phase ensures that wells and other infrastructure can be sited to accommodate the primary land use. This has resulted in the relocation, removal or redesign of wells before the proposal is submitted for approval;
- The use of SIS technology, co-location of wells and consultation with landowners has resulted in the Proponent significantly reducing the number of wells from around 45 to 16 and the overall footprint of the project. In Spring Farm, the proposal was originally for around 20 wells which has been reduced to four (4) well surface locations and in Menangle Park there were around 25 wells originally proposed, while now there are 12 well surface locations;
- The environmental envelope assessment approach allows the well surface locations to move within a 50 metre radius in Spring Farm and a 100 metre radius in Menangle Park (to recognise the differences in the level of information about future urban land releases) and 25 metres either side of gas gathering lines and access roads mean that there is flexibility and an ability to deal with future issues as they arise;
- Development of locational principles for works the subject of the Concept application in order to provide agencies and the community with an understanding of where the future works may occur, whilst providing the flexibility for the Proponent to determine precise locations, based on geology and consultation with landowners;
- Well design and construction methods which allow for reduction in the level of wells to accommodate future development which may require re-levelling such as road construction associated with future urban (residential, commercial and industrial) development and sand mining; and
- Completion of the construction period (where the most significant potential impacts are likely to occur) prior to development of the surrounding land for urban purposes will minimise impacts upon future residents in the area.
- Co-location of up to six well heads at a single well surface location which has reduced the footprint of the project;
- Screening and revegetation; and
- Design of the wellhead surface facilities so that either an enclosed wellhead design or an open fenced compound can be used as is needed to fit with the future land use or security as appropriate. This would also address to matters like electricity at compounds, redesigned telemetry and other equipment.

Given that many of the other impacts on land use relate to issues discussed elsewhere in this EA the measures proposed in **Sections 8.2, 8.3, 8.5, 8.8, 8.10 and 8.13** to manage hazard and risk, air quality, noise, water quality, visual and traffic impacts respectively would also assist in managing potential land use impacts.

8.1.6 Conclusion

The impact of works proposed under the Concept and Project Applications for Stage 2 of the CGP on land use is not considered significant, given the relatively short term duration and temporary nature of construction and post development activities, and the relatively low impacts associated with the production and closure phases of the development.

The proposal is a transient use of land to facilitate the extraction of a State significant resource. Land surrounding well surface locations would not be sterilised as a result of the proposed development following rehabilitation. The measures proposed within this EA to manage the environmental impacts of the proposed development will assist in managing land use impacts.

The identified impacts associated with the gas gathering line and access roads, primarily relate to vehicles and equipment required during the construction phase. However, these impacts are temporary and through the implementation of identified mitigation measures are significantly reduced during the construction phase.

Identified impacts during the closure and final rehabilitation phase would be temporary with the well surface location and gas gathering lines to be rehabilitated to either a pre-production land use or to a condition that landowners have agreed to through negotiations with AGL.

8.2 Hazard and Risk

8.2.1 Overview

In 2002, Planager undertook a Quantitative Risk Assessment (QRA) of the CSM production wells at Camden for a number of single CSM well designs. With recent developments in drilling technology, it was necessary for Planager to update its QRA to include the potential configuration of up to six wells at one surface location. Accordingly, the Proponent engaged Planager to undertake a QRA in March 2007 based on the QRA completed in 2002 to assess the risk associated with up to six SIS wellheads at a single surface location (included as **Appendix D**). It should be noted that the use of up to six SIS wellheads at a single surface location is a very conservative assessment and represents a worst-case scenario.

The findings of these QRAs have been used to inform and assess the potential hazard and risk impacts associated with the proposed expansion of Stage 2 of the CGP as summarised in this Chapter.

8.2.2 Existing Environment

As discussed above, the risk profile associated with a single well head configuration (as for wells within the existing Camden wellfields) was assessed by Planager in 2002 and in subsequent environmental assessments and approvals issued for the existing wellfields.

The QRA completed by Planager in 2007 is for CSM production wells for up to 6 wellhead configuration, and uses the input information and methodologies described in the *Location Guidelines for Development in Vicinity of Operating Coal Seam Methane Wells*, May 2004 by the Department of Infrastructure, Planning and Natural Resources (now the Department of Planning). The Guidelines describe the use of separation distances to ensure an appropriate buffer between a development and an existing or future operating CSM well and its associated equipment. Separation distances result in circular areas around the existing and future operating CSM wells, within which controls should apply to development. The Guidelines specify the recommended separation distances between single gas well installations and certain

sensitive land uses such as residential and open space. Separation distances were developed for three types of gas wells and for two different operating pressures.

The Guidelines do not, however, address a six well configuration as is proposed under the current Stage 2 expansion. Therefore, the Planager 2007 report investigated and assessed the risks associated with the operating gas well surface location from its initial production and onwards, including normal operation and maintenance, along with the risk associated with domino effects from one gas well initiating an incident at another gas well in the same compound.

It should be noted that the proposed works have been considered against *Applying SEPP 33 – Hazardous and Offensive Development Application Guidelines* prepared by the Department in 1994 to provide assistance primarily to councils, but also to industry, consultants and other government agencies, in implementing SEPP 33. The Guidelines recommend a ‘risk screening’ method for determining whether a proposal is hazardous and provide guidance on assessing potentially offensive development proposals. The screening process considers the class and volume of materials to be stored on the site and the distance of the storage area to the nearest site boundary.

The guidelines state that the first step to determining whether SEPP 33 applies to a proposal is to consider whether the proposed use falls within the definition of *industry* adopted by the planning instrument which applies.

As previously mentioned in **Section 5.3** there are a total of six local EPIs applying to the land subject of Stage 2 works comprising five LEPs (LEP 121, LEP 46, LEP 47, LEP 2002 and LEP 1991) and one IDO (IDO 15). With the exception of LEP 2002, the majority of the local EPIs adopt the following definition of *industry*:

- (a) *any manufacturing process within the meaning of the Factories, Shops and Industries Act 1962, or*
- (b) *the breaking up or dismantling of any goods or any article for trade or sale or gain or as ancillary to any business, but does not include an extractive industry.*

The definition of *industry* under LEP 2002 is:

the manufacturing, assembling, altering, repairing, renovating, ornamenting, finishing, cleaning, washing, dismantling, processing or adapting of any goods or articles for commercial purposes.

However, as addressed in **Section 5.3**, the proposal is defined as a *utility installation* or a *public utility undertaking* and not considered to satisfy the definition of ‘*industry*’ under the relevant local EPIs. Therefore, the provisions of SEPP 33 do not strictly apply to the proposed expansion of Stage 2 of the Camden Gas Project.

However, in order to comprehensively address the issue of hazard and risk in relation to the proposal, a detailed QRA has been prepared in respect of the proposed development. It should be noted that this does not imply that the development falls under the definition of *potentially hazardous industry* under SEPP 33. Rather, it demonstrates the Proponent's desire to ensure that perceived risks in relation to the proposal are addressed as part of the environmental assessment process.

8.2.3 Potential Impacts

The potential impacts of the proposed Project in terms of hazard and risk are related to both the risk to human health and the risk to the environment. The potential impacts of CSM wells in this

respect are generally related to flammable events which could occur due to a loss of containment of CSM coupled with an ignition event. A CSM release may be a result of equipment failure and mal-operation. Initiating release scenarios include:

- Leaks during routine operation from fixed piping, valves, or separator vessel due to equipment failure or mechanical damage; and
- Leaks during equipment maintenance or work over operations.

As part of the proposed Stage 2 expansion, up to six SIS wellheads may be located within the same well surface location therefore an incident at one well may result in damage to another well, thus initiating a loss of containment and subsequent flammable event from the second well, and so forth. This is commonly referred to as a *domino incident* or the *domino effect*.

Therefore, another type of initiating release scenario requires consideration, being:

- Leaks due to a domino effect from one well to another.

Depending on the circumstances of the release, the following outcomes may occur:

- Jet fires: these result from the ignition of a (semi-)continuous release of CSM producing a long, stable, high temperature flame;
- Flash fires: these occur when a cloud of CSM vapour is ignited, resulting in a flame travelling through the cloud; and
- Vapour Cloud Explosion (VCE): if prior to ignition, the released cloud is large or there is a high degree of confinement, an explosion may occur, although this is very unlikely. While the effect of the flash fire is largely limited to the area within the cloud, an explosion can have far reaching effects. As the mass release rates from CSM are relatively low, the potential for formation and ignition of a large gas cloud is limited. Although theoretically possible vapour explosions were not considered a credible outcome from a loss of containment from a CSM well.

The effect upon people who may be exposed to a flammable event depends on the duration of exposure and their distance away from the fire. As such, the QRA recommends minimum separation distances for proposed well surface locations (with up to six SIS wellheads) from certain sensitive land uses such that the potential risks would be kept to an acceptable level. An acceptable level is taken to be the risk criteria for residential and other development, expressed as a probability per million, per year (pmpy) being:

- Active open space – 10 pmpy;
- Business – 5 pmpy;
- Residential development – 1 pmpy; and
- Sensitive development – 0.5 pmpy.

Table 8-1 below summarises the recommended separation distances required to meet the above risk criteria, measured from the edge of the compound, to a number of different land uses during early/ intermediate operation of the CSM gas well surface locations and during established operation.

Table 8-1: Minimum Recommended Separation Distances

Minimum Distance to Satisfy Risk Criteria				
Gas Well Operation (up to 6 well compound)	Minimum Distance (metres)			
	Active open space (10 pmpy)	Business (5 pmpy)	Residential development (1 pmpy)	Sensitive development (0.5 pmpy)
Early/ intermediate operation	20 metres	20 metres	20 metres	20 metres
Established operation	10 metres	10 metres	15 metres	20 metres

The potential environmental impacts of the proposed gas well surface locations are related to environmental pollution caused by a release of the gas handled in the gas wells. This risk is considered to be negligible. The gas handled is a simple asphyxiant and has no toxic properties. Further, combustion products of the gas are water, carbon dioxide and carbon monoxide and there is no significant potential for environmental pollution from the burning of gas in air. The risk of significant harm to the natural environment associated with the proposed facilities after initial start-up is therefore negligible.

As assessed by Planager in 2002, there is potential for bushfire or grassfire to impact on the operations of a well surface location and the potential for operation at a well surface location to increase the incidence of fires and bushfire or grassfires in the general area. The wellheads and the gas gathering lines contain protective fire-safe ball valves and other fire-safe components therefore such an event would not compromise the integrity of the surface infrastructure. Additionally, operational management measures such as weed and grass control would minimise the incidence of fires and bushfire or grassfires in the general area.

Indirect impacts associated with events such as an accident involving a vehicle transporting material to the site may result in spillage of materials onto the road and adjacent roadside zones. Further safety issues may arise should vehicles collide, enter holes, ditches or uneven ground at speed. In order to minimise this risk, designated parking spots for maintenance vehicles and defined access / egress routes would be implemented during operation of the project.

8.2.4 Environmental Safeguards

There are a range of technical safety features built into the design of the gas wellheads to ensure that the potential impacts associated with the proposal in terms of hazard and risk are minimised. These measures include overpressure controls (such as pressure monitoring and control, pressure rating of equipment and pressure relief) and leak and fire protection (including instrumented protective features and fire detection). All these measures are controlled remotely from the gas plant control room which is staffed 24 hours a day, seven days a week. Further details of these inbuilt design measures are provided in the QRA included as **Appendix D** to this report.

General mitigation measures to be adopted in order to minimise potential risks associated with the Project include:

- Application of the Camden Gas Project Emergency Response Plan (ERP) to the proposed expansion works. This ERP contains mitigation measures relating to:

- Well blowout, fire or explosion emergency at a well surface location;
- Bush fires at a well surface location ;
- Gas gathering line emergencies; and
- Oil or chemical spill.
- General inspection and maintenance of wells to form part of the ongoing operation of the well in order to maintain the integrity of the equipment and systems. Measures include:
 - Visual inspections of each well (at least three-weekly);
 - Regular leak testing (soap testing at least 6-monthly or more often depending on the location of the well in relation to urban development); and
 - Regular (at least yearly) testing of pressure safety valves, as per regulatory requirement.

In addition, field operations personnel will visit the well regularly, to monitor equipment operation, record gas flow rates and pressures.

In addition to the above general measures which will be applied to all wells, the following mitigation measures are recommended specifically for well surface locations with up to six wellheads in order to minimise and manage the potential risk associated with the proposal:

- Well compounds are to include a fenced-off area which exceeds the identified hazardous zone (within the well surface location, which is up to 20m x 20m);
- Bollards to be installed in high risk areas to protect the well installation against damage from vehicles or other moving machinery;
- The Proponent to assess the practicality of extending the fusible link past the shut down valve, to incorporate the entire gas well installation in this protective system up to and including the metre run;
- The Proponent to investigate the possibility of shutting down all wells within the compound in case of initiation of the shut down valve from an identified emergency scenario (for example in case of a closure of the shut down valve due to a failure of the fusible link);
- Pipe-length between the well head and the first shut down valve to be minimised;
- The number of connections used on the wells is to be minimised;
- The Proponent to investigate the use of flanges instead of screwed connections; and
- Final well design must minimise the risk of confinement and subsequent ignition of a release of natural gas, also in the case of an enclosed well.

8.2.5 Residual Risk

In order to put the residual risk of the proposal (in terms of hazard) into perspective, the table below rates the assessed risk of six SIS wellheads at a single surface location (a worst-case risk scenario in terms of well configuration) against a range of published information on the level of risk to which people may be exposed from day to day due to a variety of activities. It should

be noted that some of these are voluntary, for which people may accept a higher level of risk due to a perceived benefit, while some are involuntary.

Table 8-2: Risk Perspective

Activity / Type of Risk	Published levels of risk (pmpy ¹)
Risk Criteria – Gas Well Operation (6 SIS Well Configuration)	
Active Open Space	10
Business	5
Residential	1
Sensitive development	0.5
Voluntary Risks (Averaged Over Active Participants)	
Smoking	5,000
Drinking alcohol	380
Swimming	50
Playing rugby	30
Travelling by car	145
Travelling by train	30
Travelling by aeroplane	10
Involuntary Risks (Averaged Over Whole Population)	
Cancer	1,800
Accidents at home	110
Struck by motor vehicle	35
Fires	10
Electrocution (non industrial)	3
Falling objects	3
Storms and floods	0.2
Lightning strikes	0.1

The table above shows that the level of risk associated with the proposed gas well surface location (up to six wellhead configuration) which is considered “acceptable” for residential housing is three times lower than the risk of being killed by a falling object or being electrocuted in a non-industrial environment, and is about ten times lower than the risk of being killed in an aeroplane accident in Australia (or 145 times lower than being killed while travelling in a car).

It should also be noted that based upon the QRA methodology used in NSW, a person is assumed to be at their residence 100% of the time (day and night, day in and day out) throughout the year. As this is rarely the case, the risk imposed on the person from a potentially hazardous installation is in fact lower than that calculated in the QRA and reported in this EA.

¹ pmpy = per million per year

8.2.6 Conclusion

The proposed well surface locations will be configured and sited taking account of the separation distances specified in the Department of Planning's 'Locational Guidelines', along with the specific findings of the updated QRA prepared by Planager in respect of up to six wellheads at a single surface location. With the application of appropriate mitigation measures identified above, the potential impacts of the proposed wells in terms of hazard and risk to both human health and the environment are expected to be minimal.

8.3 Air Quality and Odour

8.3.1 Existing Environment

The Stage 2 Concept area of the CGP is a largely undeveloped area with pockets of urban residential, industrial and commercial lands within a predominantly cleared landscape. As such, it is anticipated that air quality would be generally good with few potential pollution sources. Background air quality data within the region is compiled from the Camden Airport Meteorological Station, located approximately 8 km to the north west of the Stage 2 Concept area and Campbelltown Swimming Centre Meteorological Station, and located approximately 6.5 km to the east of the Stage 2 Concept area.

Although microclimate conditions associated with vegetation, topography and geomorphic units may provide for variation within the location data collected by the Bureau of Meteorology (BoM) at these sites, it is considered to be generally indicative of meteorological conditions within the Stage 2 Concept Plan area, including the Spring Farm and Menangle Park areas. A summary of key meteorological features recorded at the stations relevant to the Stage 2 Concept Plan area is provided in the table below.

Table 8-3: Meteorological Data

Rainfall (mm)	Max	Min	Annual Average	
Camden Airport	99.3 (Feb)	38.9 (Jul)	828.2	
Campbelltown Swimming Centre	100.7 (Mar)	33.7 (Jul)	829.8	
3pm Wind Speed (km/h)				
Camden Airport	18.4 (Dec)	12.3 (May)	15.8	
Campbelltown Swimming Centre	14.7 (Sep)	8.6 (Apr)	10.6	
Temperature (°C)			Max	Min
Camden Airport	29.2 (Jan)	2.9 (Jul)	23.6	10.2
Campbelltown Swimming Centre	28.4 (Feb)	3.1 (Jul)	23.5	10.7

Source: Bureau of Meteorology at station 068192 Camden Airport and 068081 Campbelltown Swimming Centre.

Typical weather conditions for the NSW east coast prevail within the Stage 2 Concept Plan area with warm summers (December, January and February) and cool winters (June, July and August). The average rainfall distribution is approximately 828mm, with the highest rainfall occurring between January and March, and July and August being the driest months of the year (BoM).

Wind speeds in the area throughout the year peak in the spring months with a reasonable level of consistency throughout the rest of the year. Prevailing winds within the area are from the

south for most of the year with a higher frequency of winds from the south west in winter and from the south east in summer. The variability of wind patterns in the region contributes to an inconsistency in air quality (BoM).

Factors directly affecting air quality in the area include:

- Local and regional sources of air pollution;
- Seasonal wind patterns;
- Temperature inversions; and
- Local topography.

Pollutants affecting air quality in the Concept Plan area are largely produced outside the study area and transported to the study area by prevailing winds. Air pollution in the form of photochemical smog is carried to the region during summer months from the Sydney, Illawarra and Newcastle regions. This occurrence was a key element identified in the *Metropolitan Air Quality Study (MAQS)* and associated air shed modelling for the Sydney Basin undertaken by the Environment Protection Authority (EPA now DECC). This study identified the main air pollutants in urban and semi-urban locations as carbon monoxide (CO), nitrogen oxides (NO_x), hydrocarbons (VOCs), sulphur dioxide (SO₂), lead and particulate matter.

A review of the National Pollutant Inventory (NPI) was undertaken for the three LGAs relevant to the Concept Plan area (Camden, Campbelltown and Wollondilly). Within the Camden LGA, peak sources for emissions are:

- Ceramic product manufacturing (24.5%);
- Motor vehicles (18.8%);
- Lawn mowing (14.5%); and
- Domestic/ Commercial solvents/ aerosols (14.2%).

Peak sources in the Campbelltown LGA are:

- Motor vehicles (17.2%);
- Glass and glass product manufacturing (14.5%);
- Domestic/ commercial solvents/ aerosols (12.7%); and
- Lawn mowing (10.5%).

Peak sources in the Wollondilly LGA are:

- Motor vehicles (17%);
- Cement, lime, plaster and concrete product manufacturing (16.6%);
- Coal mining (15.2%); and
- Domestic/ commercial solvents/ aerosols (14.2%).

Results of peak emission substances for each of the LGAs are summarised in the table below.

Table 8-4: Summary of NPI data

LGA	Peak Substance	Total Emission ('000 kg/year)	Source (>100 000 kg/year)
Camden	Carbon Monoxide (CO)	6 600	Motor vehicles Fuel burning (Domestic) Lawn mowing Ceramic product manufacturing
	Total Volatile Organic Compounds (VOCs)	1 200	Motor vehicles Domestic/ commercial solvents/ aerosols Fuel burning (Domestic)
	Oxides of Nitrogen	950	Motor vehicles
	Particulate Matter 10µm	320	Ceramic product manufacturing
Campbelltown	CO	21 000	Motor vehicles Fuel burning (Domestic) Lawn mowing Burning/ wildfires (reduction, regeneration, agriculture)
	Total VOCs	3 900	Motor vehicles Domestic/ commercial solvents/ aerosols Fuel burning (Domestic) Lawn mowing Service stations
	Oxides of Nitrogen	3 400	Motor vehicles Glass and glass product manufacturing
	Particulate Matter 10µm	520	Motor vehicles Glass and glass product manufacturing
Wollondilly	CO	6 100	Motor vehicles Electricity supply Fuel burning (domestic) Lawn mowing Cement, lime, plaster and concrete product manufacturing
	Oxides of Nitrogen	3 300	Electricity supply Cement, lime, plaster and concrete product manufacturing Motor vehicles
	Total VOCs	1 200	Motor vehicles Electricity supply Domestic/ commercial solvents/ aerosols

8.3.2 Potential Impacts

Air quality in the locality has the potential to be impacted through the construction, operation and closure and rehabilitation phases of the project. Potential impacts relate to:

- Dust and exhaust emissions during the construction phase from vehicles, machinery and drilling operations;
- Odour generation as a result of drilling activities; and
- Exhaust emissions from operation of equipment, plant and machinery.

Construction

The primary potential impacts on air quality as a result of the proposed works will occur during the construction phase of the project and include the following:

- Dust generated as a result of soil disturbance during the construction of drill pads, drill pits and access roads;
- Dust generated by vehicular movements to and from construction sites along access roads, transporting equipment and materials;
- Exhaust emissions generated from civil operations, including equipment and vehicles; and
- Potential gas well emissions from leakages during drilling.

Drilling operations have the potential to generate odour as follows:

- Oxygenation of aquifer waters, which may cause the release of H₂S ("rotten egg gas") as sulphides convert to sulphates;
- Venting of trapped natural gases in overlying formations; and
- Venting of coal seam methane gases which may include odorous gases (methane gas itself is an odourless gas).

Equipment and vehicles used during the construction, drilling and fracture stimulation phase of the Project would include equipment and vehicles powered by diesel, which has the potential to impact on air quality. Pollutants from construction phase exhaust equipment include particulate matter, nitrogen dioxide, hydrocarbons, carbon monoxide and sulphur dioxide. The Proponent will implement monitoring of equipment in accordance with the EHSMP to minimise potential impacts.

The potential for dust generation from vehicle movement will be managed through the use of traffic control techniques such as implementing reduced speed limits, the use of water carts where necessary and minimising disturbance to groundcover. Access to each of the well surface locations will be designed and constructed so as to minimise significant disturbance to existing vegetation, surrounding land uses and impacts on local traffic, with further information on vegetation provided in **Section 8.9**.

The potential for odour impacts to be significant is considered to be unlikely based upon past experience from similar operations and the siting of well surface locations relative to sensitive residential receivers. Additionally although development of part of the Spring Farm urban release area has commenced, the construction of the well surface locations are expected to be completed prior to the construction and release of residential areas in the vicinity of the proposed surface locations.

There is a very small potential that gas would need to be vented in the drilling phase, which would be during under-balanced vertical drilling. A typically drilled under-balanced vertical well will always require water injection to cool the drill bit, to suppress dust and to prevent drying out of the well bore. Following well shut in periods overnight where a hydro-carbon bearing formation is exposed to the well bore, the accumulated background gas is vented for a period of 5 to 10 minutes until the wellbore is depressurised. This event happens rarely as the drilling sequence is predominantly timed to prevent this from happening as a regular occurrence. The

need to vent gas in this way would occur on average approximately once in every 10 under-balanced vertical wells and it should be noted that this is not the most commonly used drilling technique.

The other drilling technologies use mud or water as drilling fluid and the hydrostatic pressure of this fluid column prevents the release of gases to surface, so primary well control is always maintained. Therefore the likelihood of venting is not considered to be significant as it is an infrequent and very short-term event.

In the rare case that oxygenation of aquifer waters occurred it would be due to lost circulation during under-balanced air drilling. In such circumstances, tell tale signs of deteriorating well conditions are noted and existing protocols are enacted so that drilling is immediately and temporarily suspended. Drilling would then divert to over-balanced drilling to overcome these geological conditions.

Consequently, the potential for the oxygenation of aquifer waters causing the release of H₂S is not considered to be significant, as surface casing is set to prevent and isolate surface aquifers from having an influence on the drilling process. Occurrences of H₂S are not likely to be natural deposits, but man made and as a result the probability of drilling through an occurrence and losing circulation during under-balanced drilling is therefore considered to be extremely low.

Previous well field developments in the CGP have demonstrated there are relatively minor air quality impacts during construction and this is also expected to be the case for construction of the proposed well surface locations. Given the scale and localised nature of the construction of the proposed works and the implementation of effective mitigation measures, the abovementioned potential impacts are not expected to yield significant adverse effects on air quality in the locality.

In addition, notification of surrounding landowners prior to construction in accordance with the Proponent's EHSMPs and existing approved CEMPs and the ongoing community consultation through the Camden Gas Project Community Consultative Committee will assist in identifying concerns that arise throughout various stages of construction. A 24 hour telephone hotline is also provided for reporting complaints or emergencies, which informs project management, the continuous improvement program and provides ongoing monitoring of operational issues. Any complaints are recorded and immediately addressed.

Environmental safeguards would be incorporated into the CEMP to ensure potential air quality impacts during construction are minimised.

Production

Potential air emissions during the production phase are related to the following:

- Dust generation during use of unsealed roads;
- Venting of gas during well commissioning; and
- Exhaust emissions generated from civil operations, including equipment and vehicles.

The potential for dust generation is significantly reduced once construction is complete. During the production phase, dust generating activities largely relates to vehicles movements on unsealed roads to undertake routine inspections (daily/weekly) and well work over maintenance (see **Section 4.5**) which may be required occasionally and usually occur over a week period. Traffic control techniques for the management of vehicle movement will be continued from the construction phase and include enforcing speed limits, use of water carts (where necessary) and minimising disturbance to groundcover. The access to each of the well surface locations is

not expected to disturb existing vegetation, surrounding land uses and impacts on local traffic, with further information on vegetation provided in **Section 8.9**.

Pollutants from the normal operation processes are mainly generated by vehicle use and include particulate matter, non-methane hydrocarbons, carbon dioxide and carbon monoxide.

There is limited venting of gas required for production testing in the well commissioning phase for certain types of wells, typically only wells that have been fracture stimulated. The venting of gas is necessary to by-pass the gas and water separator to ensure that the large initial volumes of water produced in the first days and weeks after fracture stimulation do not cause damage to the separator. There are several options for this production-testing phase, namely controlled venting of gas, or venting of gas to a mobile flare, or an immediate link-in to the gas gathering system and some of these significantly limit or even remove the need for venting. As the Camden Gas Project's operations have developed, venting has been required less and less and this trend is expected to continue.

Emissions have the potential to occur through maintenance and work over activities, however, these impacts are infrequent, minor and occur only for short periods of time.

The ongoing community consultation through the Camden Gas Project Community Consultative Committee will assist in identifying concerns that arise during production and a 24 hour telephone hotline is also provided for reporting complaints or emergencies, which informs project management, the continuous improvement program and provides ongoing monitoring of operational issues. Complaints are recorded and immediately addressed.

Post Development

Post development activities include re-fracture stimulation and in-field or well head compression for which the primary air quality impacts would comprise equipment emissions and emissions from vehicle movements transporting equipment and staff to and from each site. These movements would primarily be isolated vehicles undertaking general maintenance activities and therefore, are not expected to cause significant impacts.

Emissions have the potential to occur through re-fracture stimulation operations, however, these impacts are anticipated to be infrequent, minor occurrences, for short periods of time where a production issue is identified. Re-fracture stimulation and infield compression are only relevant to the Concept application component of the Project and would be subject to a more detailed assessment in subsequent project approvals.

Closure and Final Rehabilitation

Closure and final rehabilitation of the well surface locations would result in disturbance of surfaces for landscaping and additional vehicles and equipment to remove infrastructure. These activities would occur when the productive life of a well surface location is finished, which is estimated to be approximately 10 to 15 years depending on the geology and the reservoir.

Closure and final rehabilitation activities are located within areas where final land uses have not yet been determined and as a result it is difficult to predict long term impacts. Due to the intended planned future growth of the subject areas and associated increase in vehicle use, it is anticipated that increases in emissions within the local area will occur. However, the emissions associated with the closure and rehabilitation activities are considered to be relatively minor and due to the fact that this period would be short term and temporary and would occur during daytime hours, adverse impacts upon air quality as a result of closure and rehabilitation works are not expected.

8.3.3 Mitigation Measures

Potential air emissions and pollutants are primarily associated with the construction stage, and the potential to cause dust through the disturbance of soils. The following mitigation measures would be implemented to ameliorate potential impacts at the site.

Construction

- Earthworks, vegetation clearing and soil disturbance would be minimised at sites wherever possible;
- Disturbed surfaces would be remediated as soon as practical after disturbance with minimal lag time between clearing and remediation;
- Construction activities shall be monitored to identify excessive dust generation. Dust control measures (such as the use of water carts) shall be implemented in the event of excessive dust generation;
- Stockpiles and unsealed surfaces would be sprayed with water to minimise excessive dust generation (if necessary);
- During high wind conditions, activities likely to generate dust would be minimised or ceased wherever possible;
- Machinery, plant and equipment would be serviced, in good working order and would be fitted as required with appropriate exhaust emission control devices;
- Unnecessary traffic movements would be eliminated or minimised;
- All welding procedures would be undertaken in accordance with relevant Australian Standards and guidelines;
- Annual leak detection services would be undertaken by a third party operator; and
- Surrounding residents would be notified prior to the start of construction activities and contact details would be provided for reporting and further information.

Production

- Gas well surface locations would be monitored remotely from the control room at the gas plant and inspected regularly for gas leaks and emissions; and
- The release of gas into the atmosphere produced during the production testing phase would be controlled. This is to be achieved through the undertaking of appropriate venting options (controlled venting of gas, venting of gas to a mobile flame or an immediate link-in to the gas gathering system) in order to significantly reduce or eliminate the need for venting.

Post Development

- Activities would be designed and monitored to ensure emissions are in accordance with relevant guidelines and requirements.

Closure and Final Rehabilitation

- During high wind conditions, activities likely to generate dust would be minimised or ceased wherever possible; and

- Machinery, plant and equipment would be serviced, in good working order and would be fitted with appropriate emission control devices.

Measures to mitigate the cumulative impact of increased exhaust emissions on the regional air quality include:

- Regular maintenance of all equipment and trucks associated with the proposed operation in an efficient manner and monitoring of service records; and
- If visible smoke can be seen from a vehicle or equipment for longer than 10 seconds, the equipment would be taken out of service and appropriately repaired.

8.3.4 Residual Impacts

Residual impacts as a result of the Project include a minor increase in potential emissions from vehicles, well surface locations and gas gathering installation largely during construction and will therefore be temporary. The minor anticipated increase is not considered to significantly impact upon air quality in the region or the local area. It should be noted that current background air conditions will significantly change as future urbanisation of the area occurs.

8.3.5 Conclusion

The potential impacts associated with the project are primarily associated with the construction phase of the development and are therefore generally short-term and temporary. Provided the proposed mitigation measures are effectively implemented, the proposed works are not expected to result in significant adverse impacts on air quality of the region.

The Spring Farm and Menangle Park areas have been earmarked for future urban (residential, commercial, industrial development), which would result in development being located in close proximity to the well surface locations. The construction of well surface locations and associated infrastructure within these areas is expected to be completed prior to the land release of the area, thereby minimising the potential impacts on amenity resulting from minor air quality impacts during construction.

Based upon observation of existing well fields and AGL's previous experience, operational activities are expected to have minimal impacts on air quality. Mitigation measures, ongoing continuous improvement and notification would further minimise potential impacts throughout life cycle of the project.

8.4 Landform, Geology and Soils

8.4.1 Existing Environment

Landform

The Stage 2 Concept Plan area of the CGP is located in the southern Sydney area of the NSW east coast within the Cumberland lowlands, approximately 65km from the Sydney CBD. The landform of the area is characterised by low lying, gently undulating plains and rolling low hills and rises with the Nepean River a dominant feature of the landscape (Hazelton and Tille, 1990). The region comprises a mix of semi-rural and urban development scattered between green belts and isolated areas of remnant vegetation. Much of the Camden area has been cleared of natural vegetation with grazing practices common in the landscape (Hazelton and Tille, 1990).

The proposed Spring Farm Project area is located on the northern terraces of the Nepean River and on the western slopes of the low hills which form part of the Mount Annan Botanical Gardens and the William Howe Reserve (CC, 2000). The Spring Farm well surface locations have a predominantly south western aspect with views across the extensive Nepean River floodplains. Landform is gently undulating with steeper sections to the east of the area reaching elevations of up to 170m Australian Height Datum (AHD). The banks of the Nepean River, south of Spring Farm Project Area are relatively steep, whereas the opposite bank within EMAI is fairly low.

The drainage lines within the proposed Spring Farm gas field flow in a westerly direction in meandering patterns joining the Nepean River at the western boundary. Several modifications have occurred to the landscape since European settlement including the formation of large dams, roadways, sand and coal mining sites and residential areas. Much of the area has been cleared of vegetation for grazing and farming purposes with a noted remnant vegetation corridor in the vicinity of the Nepean River and extending along Jacks Gully (Hazelton and Tille, 1990). Mining and intensive agriculture activities have altered the landscape creating depressions, exposed areas and gully systems. The project area does not contain any distinctive landform features (i.e. prominent hills) with roadways, mining activities and river flats providing the variability to the undulating landscape.

The proposed Menangle Park Project area is located on the eastern floodplain and terraces of the Nepean River. The area has a predominantly westerly aspect with relatively low lying landform. Generally the Menangle Park Project area falls within the Nepean River floodplain.

Geology

The Wollongong – Port Hacking Geological Series Sheet (reference 9029 – 9129) and Penrith Geological Series Sheet (reference 9030) indicate that the Stage 2 Concept Plan area is underlain by Triassic Age Bringelly Shales of the uppermost formation of the Wianamatta Group (Hazelton and Tille, 1990). Quaternary alluvium gravels, deposits and sands are present around the Nepean River flats and lower slopes, comprising mainly silica sand with high clay content. The quaternary deposits provide evidence of landscape forming features when the Nepean River was flowing at higher levels. A few small locations of Tertiary Sand mineral deposits are scattered around the Stage 2 Concept area with the most prominent location to the north of the Spring Farm site.

The coal bearing strata of the Sydney Basin are concentrated within two relatively shallow major sequences of terrestrial sediments, informally known as the upper and lower coal measures and are separated by a thick interval of marine strata (Sydney Gas, June 2003). The upper coal measures in the Southern Coalfield are defined as the Illawarra Coal Measures, and contain significant CSM resources.

The Illawarra Coal Measures were deposited in lower delta plain conditions interrupted by a marine incursion known as the Erins Vale Formation. Coal measure development was terminated by rapid climate change and renewed basin uplift at the end of the Permian age. The Illawarra Coal Measures are comprised of shale, quartz-lithic sandstone, conglomerate, chert, sporadically carbonaceous mudstone, coal and torbanite seams of late Permian age (DPI, 2006). The coal measures have an approximate thickness of 350m in the Concept Area with four main coal seams traditionally targeted;

- Bulli seam, which occurs at the top of the Illawarra Coal Measures;
- Balgownie seam below it;
- Wongawilli seam below the Balgownie seam; and
- Tongarra seam, the lowest, below the Wongawilli seam.

Many seams lie between the Bulli and Tongarra seams, but are too thin to have economic significance. The average seam thicknesses of the Bulli, Balgownie, Wongawilli and Tongarra seams are 2.01 m, 1.25 m, 9.75 and 3.1 m respectively (Hansen 2006).

The sediments which overlay the Bulli coal seam belong to the Hawkesbury Tectonic Stage which comprises three stratigraphic divisions:

- Narrabeen Group – varies in thickness up to 450m and is subdivided into a series of interbedded sandstone and claystone units. Ranges in age from Lower to Middle Triassic;
- Hawkesbury Sandstone Group – overlays the Narrabeen Group and comprises a series of bedded sandstone units of up to 185 m in thickness, dating from the Middle Triassic; and
- Wianamatta Group – overlays the Hawkesbury Sandstone Group and consists predominantly of shales and siltstones with occasional sandstone interbeds. Varies in thickness up to 90 m across the Stage 2 area.

Soils

A review of the Soil Landscapes of the Wollongong – Port Hacking 1: 100 000 Sheet indicates that the two main natural soil landscapes occurring on the Stage 2 Concept area are Blacktown and Theresa Park, with pockets of Luddenham, Monkey Creek and Hawkesbury Landscapes and isolated areas of disturbed terrain. The relevant Soil Landscapes are summarised in **Table 8-5** below.

Table 8-5: Soil Landscapes

Soil Landscape	Characteristics	Areas Affected	Limitations
Blacktown	• Residual Landscape • Gently undulating rises on Wianamatta Group shale • Broad round crests and ridges with gently inclined slopes • Local relief 10-30 m • Slopes generally <5% but up to 10% • Almost completely cleared of vegetation • Red and Brown Podzolic Soils on crests, upper slopes and well drained areas • Yellow Podzolic and Soloths on lower slopes and in drainage lines	• Stage 2 • Spring Farm • Menangle Park	• Moderately reactive • Highly plastic subsoils • Low soil fertility • Moderate erodibility • Seasonal waterlogging • High capability for urban development

Soil Landscape	Characteristics	Areas Affected	Limitations
Theresa Park	- Fluvial Landscape - Floodplain and terraces of the Nepean River - Local relief up to 60m - Slopes generally <5% but up to 10% - Almost completely cleared of vegetation - Red Earths and Red Podzolic Soils on terraces and Prairie Soils on the floodplain	- Stage 2 - Spring Farm - Menangle Park	- Localised flooding - Seasonal waterlogging - Very high soil erosion hazard - Low soil fertility - High capability for urban development
Luddenham	- Erosional Landscape - Undulating to rolling low hills on Wianamatta shale - Local relief 50-80m - Slopes 5-20% - Narrow ridges, hillcrests and valleys - Extensively cleared open forest - Brown Podzolic and Massive Earthy Clay on crests - Red Podzolic Soils on upper slopes - Yellow Podzolic and Prairie Soils on lower slopes and near drainage lines	- Small areas of Stage 2 - Small pocket of east Spring Farm - Small pockets of east Menangle Park	- High soil erosion hazard - Localise impermeable highly plastic soils - Moderately reactive subsoils - Potential mass movement hazard - Low soil fertility - High water holding capacity - Low to moderate capability for urban development
Hawkesbury	- Colluvial Landscape - Rugged rolling to very steep hills - Local relief 100-200m - Slopes >25% - Surface rock >50% - Narrow crests and ridges - Narrow incised valleys - Steep sideslopes with narrow rocky benches - Lithosols / Siliceous Sands associated with rock outcrop - Earthy Sands and Yellow Earths on benches - Yellow and Red Podzolic Soils on valley flats	- Stage 2 - Menangle Park around the Nepean River	- Extreme soil erosion hazard - Mass movement hazard - Steep slopes - Rock outcrops - Shallow, stony, highly permeable soil - Very low soil fertility - Generally not capable of urban development

Soil Landscape	Characteristics	Areas Affected	Limitations
Monkey Creek	- Fluvial Landscape - Floodplains, valley flats and drainage depressions of the Cumberland Plain - Yellow Podzoic Soils and Solodic Soils on floodplains and valley flats - Alluvial Soils and Gleyed Podzolic Soils in poorly drained depressions	South western areas of Stage 2	- Low permeability - Reactive soils - Flood hazard - Low soil fertility - Permanently high water tables - Seasonal waterlogging - Not capable of urban development
Disturbed Terrain	- Occurs within other landscapes and has been disturbed through human activities - Original soils have been removed - Most areas are levelled	Isolated areas of Stage 2	Limitations are dependant on the nature of the fill material (mass movement, poor drainage, low fertility)

The limitation characteristics of individual soil types may influence the range of activities possible at any site. Possible limitations to the undertaking of the proposed works may include:

- reactive soils, which are a foundation and structure hazard due to soil shape and soil structure changes;
- plastic soils, which do not support loads well and have poor trafficability when wet;
- erodible soils, which, if disturbed can increase sedimentation potential;
- flooding/ waterlogging, which has implications for access and useability of the site; and
- mass movement, which provides limitations to excavation and landscape alteration potential.

Acid Sulphate Soils

Soils can contain iron pyrite in an unoxidised state and when air comes in contact with them they oxidise forming Acid Sulphate Soils (ASS). When water passes through the ASS, sulphuric acid leaches out and passes into waterways. ASS were formed in the Holocene geological period (<11 000 years before present) where marine sediment was deposited. These soils generally occur below and up to 5 m Australian Height Datum (AHD) in estuaries, rivers, floodplains, backswamps and sand dunes and are therefore typically associated with low-lying coastal areas, including estuarine flood plains, rivers and creeks.

The elevation of the Stage 2 Concept area is greater than 5 m AHD, and the location is distant from coastal areas, therefore, the likelihood of ASS occurring is considered low. Previous soil assessments within the locality have not identified the presence of ASS.

Previous testing by Harvest Scientific Services (2001) in the area identified that the soils in the Blacktown Soil Landscape are strongly acidic (4.5 – 5.0) with a non-saline to slightly saline character (1.7 – 2.7 dS/m). The soils were reported to vary significantly in fertility. No known

elevated acidity levels have been recorded in the Theresa Park or Luddenham Soil Landscapes (Sydney Gas, June 2003).

Saline Soils

Areas that are underlain by shale with a shallow water table are generally classified as high probability for salinity impacts. Within the Blacktown and Theresa Park Soil Landscapes localised recordings of saline soils have been recorded.

Reference to the Salinity Potential in Western Sydney 1:100,000 sheet (DIPNR, 2003), indicates that the Stage 2 Concept area has a moderate to high salinity potential. In the western Sydney area, salinity is generally associated with the Wianamatta Group shales and is predominantly associated with drainage systems of the Blacktown and Theresa Park Soil Landscapes (DNR 2006).

Potential impacts of salinity on the proposal may include:

- deterioration of road and concrete surfaces; and
- excavation of saline soil resulting in an increased saline load in surface runoff.

Contaminated Soils

The proposed works within the Stage 2 Concept Area have the potential to disturb contaminated soils that exist from previous activities. There has been a high occurrence of poultry farming and sand mining practices within the area, increasing the likelihood of contamination. Known contaminated sites occurring in the locality include the former night soil depot located centrally to the proposed Spring Farm site on the southern side of Springs Road. This area has been identified as only suitable for active and passive recreational use.

The design and location of the project is not expected to encounter known sources of contaminated soil. Should contaminated lands with the potential to be impacted by the project be identified, a Contaminated Lands Management Plan (CLMP) would be prepared (if required).

It is anticipated that other sources of contamination would be localised and minor in nature.

8.4.2 Potential Impacts

Construction

Construction activities associated with the project would involve the excavation and disturbance of soils to allow for the construction of gas well surface locations with additional trenching for installation of gas gathering lines and water pipes. Minor landform alteration would occur during site preparation, including levelling and grubbing activities (where required) and construction of access roads, with excavated materials being stockpiled on site.

Activities likely to disturb soils within the area include:

- removal of topsoil material;
- levelling of each site in preparation for drill rigs and machinery (where necessary);
- introduction of shale for hardstand well pad;
- drilling of wells;
- excavation of drill pits and trenching; and
- access road construction or upgrade where necessary.

Disturbance of soils during construction would temporarily increase potential erosion and sediment loads within the vicinity of the activity with the potential to impact on waterways and drainage lines near the sites. Additionally, excavation activities have the potential to disturb existing ASS and saline soils and contaminated soils at well surface locations and within gas gathering line construction sites, should they be present.

There is the potential for soils to be contaminated through fuel, chemical and oils spillages from vehicles and machinery on site.

Potential for geotechnical impacts to the surface land as a result of the drilling and fracture stimulation operations include:

- changes to stability along cut and filled areas;
- soil erosion on unprotected cut and filled areas;
- vibration associated with drilling and well development, with potential to impact on nearby structures; and
- potential for sterilisation of coal seams for future coal mining activities.

Landform alteration would occur through the initial setup stages of the construction phase including, access ways and minor earthworks for site preparation. This would involve minor clearing and levelling if necessary to establish a stable, level drill pad for the drill rig set up and also the implementation of erosion and sedimentation controls. Soils would be temporarily stockpiled with appropriate erosion controls, as noted in Section 4, during the construction phase then used in the initial rehabilitation of the well surface location

Production

Production will involve the potential disturbance of soils through existing access roads to the well surface locations for maintenance and monitoring purposes. This is considered to be negligible given the frequency of maintenance activities. These activities would be mainly undertaken using light vehicles as required.

Subsidence

Potential impacts in relation to subsidence were raised by the community during consultation in respect of the Project. Despite the fact that significant surface subsidence has not been detected during previous gas extraction activities in the area, a specialist report has been prepared by Mine Subsidence Engineering Consultants (MSEC) to examine the potential for subsidence to occur as a result of the extraction of gas as proposed under the Stage 2 expansion (included as **Appendix E** to this EA).

The MSEC report states that surface subsidence will not occur unless:

- Large voids are created in the strata by the mining or extractive activity, leading to subsequent collapse, consolidation and subsidence of the overlying strata.
- Large voids are created in the strata by the mining or extractive activity, leading to subsequent failure of remnant pillars and subsidence of the overlying strata.
- Unconsolidated beds of strata are present, which can subsequently be consolidated by the weight of the overburden, following the removal of interstitial fluids.

The proposed extraction of gas will not create large voids in the strata, nor leave remnant pillars. The strata within the coal measures are not unconsolidated and in fact are hard and well consolidated rocks. The conditions for significant subsidence to occur are not therefore present

and it is concluded that the potential for subsidence to occur as gas is extracted is considered to be negligible.

The report finds that there could be some shrinkage of the coal seam due to the extraction of the gas, but that such shrinkage would be in the order of a few millimetres and therefore subsidence that might occur at the surface due to shrinkage of the coal seam would be negligible.

Closure and Final Rehabilitation

Closure and final rehabilitation works have the potential to disturb surfaces through additional vehicles, removal of infrastructure, plantings and landscaping works. Proposed activities likely to cause disturbance include:

- landscaping and planting;
- restoring/ shaping of landform to original state; and
- soil ripping and site rehabilitation.

The disturbance of soils would temporarily increase potential erosion and sediment loads, however, on completion of works the well surface locations would be restored to a condition equal to or generally better than to that of the original landscape. Erosion and sedimentation controls would be installed and routinely checked to minimise potential impacts in the locality.

Steel cased gas wells potentially present a danger to future coal mining activity if left in the coal seam as the longwall may strike the casing causing a significant safety risk potentially resulting in damage to equipment or spark and explosion. Similarly, there is some risk of losing drill tools down the hole with similar potential consequences.

As indicated in **Sections 4.7 and 8.14**, the conditions of titles and guidelines issued by the DPI require the removal of casing from coal seams to prevent underground safety issues and coal sterilisation. Once drilled and again at the time of final closure of a well, the Proponent is required to log the location of the well and lodge that information with the DPI and dial before you dig. Therefore, the potential for sterilisation as a result of the proposed activities is not considered to be a significant issue.

8.4.3 Mitigation Measures

The following mitigation measures would be implemented to minimise the potential for impacts to occur on the landform, geology and soils of the Spring Farm and Menangle Park Project areas. As the potential impacts in terms of landform, geology and soils are expected to be largely the same in respect of the Stage 2 Concept area, it is anticipated that similar mitigation measures could be implemented in respect of these works in order to ensure that potential impacts are minimised.

Construction

- A Soil and Water Management Plan (SWMP) would be prepared for the earthworks and construction activities associated with the CGP. The SWMP would identify:
 - Property description;
 - Origin of levels;
 - Location of site boundaries and adjoining roads (where applicable);
 - Approximate grades and indications of direction of fall;

- Approximate location of mature trees;
 - Location of access roads and gates;
 - Nature and extent of earthworks including cut and fill and drill pit location;
 - Location of all soil stockpiles; and
 - Location and type of proposed erosion and sediment control measures.
- The SWMP would be developed at the site planning stage in consultation with the construction leaders. Prior to commencing earthworks, all necessary erosion and sediment control measures would be installed. These would then be inspected on a daily basis during construction to ensure that they remain functional;
 - Contaminated lands with the potential to be impacted by the Project would be identified and a Contaminated Lands Management Plan (CLMP) created (if required);
 - Erosion and sediment control measures shall be implemented where necessary to prevent erosion and water contamination and shall be in place prior to the commencement of works with the potential to cause erosion. Measures would include, but are not limited to, surface drains and berms and sediment traps such as silt fences and straw bales;
 - Erosion control berms and drains shall be designed and constructed so as to ensure that runoff water does not result in off-site effects of erosion or sedimentation;
 - Areas designated for ground disturbance, including well surface locations and vegetation clearing would be clearly marked on site plans and on the ground surface and would be minimised wherever possible;
 - Works (including stockpiling of gas gathering line sections) shall be confined to identified areas within the gas gathering system route, designated parking and lay down area and access routes;
 - The period between clearing, trenching and rehabilitation would be minimised;
 - Soil stockpiles would be located at least 40m away from drainage lines and shall be designed to minimise runoff. Soil stockpile sites would be enclosed within a bunded area to reduce the likelihood of sediment entering drainage lines;
 - Graded soil and cleared vegetation shall not be stockpiled where it has the potential to disrupt surface water flow;
 - Erosion and sedimentation controls would be checked and cleaned weekly to ensure effective operation;
 - Refuelling of vehicles, plant and machinery would be undertaken by suitably trained personnel within a levelled area with a spill kit present, preferably on a hardstand area, to minimise contamination from spills;
 - Fuels, chemicals and liquids would be stored in a bunded area to minimise the potential for spills to escape off site; and
 - A spill kit would be located on site at all times.

Production

- Where erosion does occur, the area shall be stabilised as soon as practicable and measures taken to rehabilitate the site;
- Refuelling of machinery would be undertaken by suitably qualified personnel within a levelled area, preferably on a hardstand area with a spill kit present, to minimise contamination from spills; and
- A spill kit would be located in all production vehicles.

Post Development

No specific mitigation measures are required in respect of the post development phase of the proposal.

Closure and Final Rehabilitation

- Rehabilitation of disturbed areas would be undertaken as soon as practical with the restoration of site to natural contours wherever possible;
- Stockpiled top soil and seed stock shall be respread across the work areas from which it was removed;
- Compacted areas shall be deep ripped or scarified for relief as required; and
- Routine inspections of the site would be undertaken to ensure rehabilitation and regeneration activities are successful and to identify areas of subsequent erosion.

8.4.4 Residual Impacts

Residual impacts as a result of the Project include the disturbance of soil due to trenching, drilling and excavation for the construction of well surface locations and gas gathering systems, including associated materials and minor alterations to landform through site preparation. However, these impacts are expected to be minor and are anticipated to have a negligible effect on the area. Erosion and sedimentation controls will be implemented to minimise potential impacts to the locality with disturbed areas rehabilitated as soon as practical after works.

8.4.5 Conclusion

It is not anticipated that the operation of the well surface locations would result in significant adverse effects on the landform, geology or soils within the Spring Farm or Menangle Park Project areas. Potential impacts associated with the proposed works within the Stage 2 Concept area are expected to be largely the same. Minor impacts are expected during the construction and closure and rehabilitation stages, however, the safeguards proposed above would considerably minimise the potential for these activities to significantly impact on the landform, geology and soils of the locality. The potential for subsidence to occur at the surface is considered to be negligible.

8.5 Noise and Vibration

8.5.1 Overview

A Construction and Operational Noise Assessment was undertaken by Wilkinson Murray to assess potential noise impacts resulting from the proposed works in the Stage 2 Concept and Project Areas. The assessment considers the full range of potential noise impacts associated

with the proposal including noise from construction of gas well surface locations, gas gathering systems, water drainage lines, access roads, operational noise and traffic noise.

8.5.2 Existing Environment

The Stage 2 Concept Area and Spring Farm and Menangle Park Project Areas are generally rural to semi-rural in character. At most residences within these areas, the noise is considered to be characteristically “semi-rural” with some influence from major roads and railway lines. Housing density increases to the north of the Spring Farm and Menangle Park project areas, where higher ambient noise levels would be expected.

Long-term unattended noise measurements were taken at five monitoring locations (refer **Figures 8.2** and **8.3**) throughout the Spring Farm and Menangle Park project areas to determine existing ambient noise levels. These locations were considered to be representative of residences potentially affected by noise from proposed well surface locations. These locations were generally unaffected by other noise sources from industry or transportation. A summary of ambient noise monitoring results is provided in **Table 8-6**. The measured noise level given in **Table 8-6** represents the rating background level (RBL) for day time, evening and night time noise.

Table 8-6: Summary of Ambient Noise Monitoring

Location No.	Monitoring Location	Monitoring Period	Measured Noise Level – RBL (dBA)		
			Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
1	St Thomas Church, Elderslie	14/09/06-06/10/06	38	37	32
2	Gundungurra Reserve, Spring Farm	14/09/06-06/10/06	38	36	31
3	Glenlee House, Glenlee	14/09/06-06/10/06	35	38	35
4	44 Cummins Road, Menangle Park	14/09/06-06/10/06	37	37	35
5	Sugar Loaf Residence, Sugarloaf	18/12/06-22/12/06	44	42	36

Some residences in the area are exposed to noise from transportation – notably houses along the Southern Railway Line, near Menangle Road or the Southwestern Freeway/ Hume Highway. While transportation noise is generally perceived independently of industrial noise, its presence may mitigate industrial noise if the two have similar characteristics.

Existing ambient noise levels within both the Concept and Project Areas are expected to change significantly over the life of the proposed works due to the planned release of land at Spring Farm and Menangle Park for urban (residential, commercial and industrial) development. Ambient noise levels are likely to peak during the urban development construction period for these areas and are expected to remain at higher levels than those currently existing due to the change in character of the land from semi-rural to urban and subsequent increases in housing/ population density. It is expected that this transition in ambient noise character would occur during the operational life phase of well surface locations, and may result in reduced noise impacts from the operational and closure/ rehabilitation phases of the Project.

8.5.3 Noise Assessment Approach

Spring Farm and Menangle Park Project Areas

The Noise Assessment has assessed the potential noise impacts of the proposal through identifying activities that would contribute to the existing noise environment, and comparing predicted noise levels to noise level criteria. The assessment of noise impacts resulting from the proposal takes into consideration a number of project-related factors:

- A flexible approach to the final placement of well surface locations within the Spring Farm and Menangle Park Project Areas is required:
 - This would allow localised environmental constraints to be avoided during the detailed design and construction phases. Furthermore, adjustments to the layout of project activities may be required as a result of ongoing negotiations with landowners, and future urban (residential, commercial and industrial) development. Therefore, noise emissions should not be assessed at a single point source; and
 - As future land uses and boundaries have not been resolved, flexibility is required in determining final well surface location configurations, well types and the number of wells at each well surface location in order to minimise future land use conflicts without sterilisation of potentially significant parts of the gas resource. Different combinations of wellhead configurations at a surface location would have differing noise emissions.
- The final placement of well surface locations within the Concept Area requires flexibility to allow for the avoidance of environmental constraints as noted above. Furthermore, future land use boundaries within the Stage 2 Concept Area (excluding the Spring Farm and Menangle Park areas) have not yet been determined, and flexibility is necessary to minimise the potential for future land use conflicts;
- The final routes and alignment of gas gathering lines and access roads requires some flexibility to accommodate potential adjustments resulting from landowner negotiations and the finalisation of future urban design layouts, or to avoid site specific environmental issues (e.g. deviation of the route around trees or to avoid a heritage item discovered during construction);
- There are many phases involved in the construction works which have differing noise emissions and characteristics. The campaign nature of the proposed construction works means that a particular construction activity will be undertaken over the whole area and move from location to location within the Stage 2 area rather than construction works occurring consecutively at any one location. Therefore, the noise emissions from each well surface location would vary in duration and noise level dependent on the activity undertaken during the construction phase; and
- As urban design layouts have not been finalised, or in some cases have not yet been determined, the precise locations of noise receivers beyond the construction phase of the Project are undefined.

To accommodate the above complexities and still provide certainty in the understanding of potential impact, an environmental envelope approach to the assessment of noise has been adopted for the purposes of this project. The environmental envelope approach used for the noise assessment allows for flexibility in the final placement of well surface locations in accordance with environmental constraints, negotiations with surrounding landowners and consideration of future land uses while providing certainty of outcomes during the environmental

assessment process. In this respect, potential noise impacts from a source located anywhere within a 50 metre radius of the proposed well surface locations for Spring Farm and a 100 metre radius of those within Menangle Park have been assessed.

Park and reserve areas are also located proximate to proposed well surface locations. Park and reserve areas potentially affected by this project are described as 'passive' recreation areas for the development noise assessment criteria for this assessment.

The Noise Assessment established a noise contour surrounding each well surface location within which the potential noise impacts of the surface location would lie within the identified noise criteria for the Project. The well surface locations could therefore be placed anywhere within this envelope in the knowledge that noise impacts upon surrounding receivers would be acceptable. The contour may also be reduced in size with the implementation of appropriate mitigation measures. A similar approach has been adopted for the assessment of gas gathering line routes and access roads where noise impacts have been assessed based on an alignment which may be up to 25 metres either side of the identified proposed route, which in most cases follows existing tracks.

In order to accommodate the required flexibility in final well configuration (both type and number of wells) at each well surface location a worst-case scenario has been used for the purposes of assessing both construction and operational noise to provide a conservative approach.

Vibration from the construction sites rarely exceeds the criteria for human comfort at distances greater than 100m, even for the most impulsive equipment such as excavator mounted rock breakers and vibratory rollers. Due to the distance of the proposed construction sites to existing residences, vibration levels from construction sites will not be an issue, therefore a detailed assessment of vibration impacts is not considered to be warranted.

During the operational phase of the wells the main potential source of vibration would be pump assisted wells and generators wherever they are used, however, they would not cause vibration above the criteria for human comfort beyond the boundary of the well surface location. Therefore potential vibration will be satisfactory at any house before or after urban land releases.

8.5.4 Noise Assessment Criteria

Construction - Spring Farm and Menangle Park Project Areas

Construction noise criteria for the project were determined based upon the *NSW Environmental Noise Control Manual* (ENCM) (DEC Ref. 94/31). Whilst the ENCM is officially superseded, the guidelines for the assessment of construction noise at residences are still recognised and considered relevant.

As discussed previously in the EA, the proposed project works may involve the drilling of up to six wells at a single well surface location. In this case, drilling may take longer than 26 weeks at any one site. As a conservative measure and for the purposes of the noise assessment, drilling activities have been assessed as having a duration of greater than 26 weeks. The maximum construction period considered in the ENCM is 26 weeks, therefore there is no guideline provided for the assessed construction period. Further, it will be necessary for drilling to take place during night time hours for which the ENCM also does not provide a guideline or criterion.

In such cases, the construction noise criteria often adopted is that the L_{A10} should not exceed background (L_{A90}) level by more than 5 dBA. This criterion is based upon the intrusiveness criterion of the DECC's *Industrial Noise Policy* (INP) and has been adopted for the purposes of the noise assessment for well drilling of periods greater than 26 weeks and less than 12 months

and/or night time drilling. On the basis of the ENCM guidelines, the relevant construction noise assessment goals relevant to the project are given in **Table 8-7**.

Table 8-7: Construction Noise Goals

Construction Period	Acceptable Construction Noise Goal (L_{A10})
4 weeks and under	Background noise level L_{A90} plus 20 dBA*
4 weeks to 26 weeks	Background noise level L_{A90} plus 10 dBA*
26 weeks to 52 weeks [#]	Background noise level L_{A90} plus 5 dBA**

* Applicable between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturday. No construction work is to take place on Sundays or Public Holidays.

** Applicable for night time drilling, and well drilling during periods greater than 26 weeks and less than 12 months.

[#] Based in DECC's *Industrial Noise Policy*

With respect to the construction of gas gathering lines, the ENCM guidelines for construction noise of less than four weeks duration was used for the purposes of the noise assessment due to the transient nature of the trenching and laying process.

The construction noise criteria for the project are summarised in **Table 8-8** below.

Table 8-8: Project Construction Noise Criteria

Activity	Acceptable Construction Noise Goal (L_{A10})	
	Daytime	Night Time
Construction of gas gathering lines	Background noise level L_{A90} plus 20 dBA	-
Well drilling	Background noise level L_{A90} plus 5 dBA	Background noise level L_{A90} plus 5 dBA
Fracture stimulation	Background noise level L_{A90} plus 20 dBA	-
Work over	Background noise level L_{A90} plus 20 dBA	-

The ENCM does not provide a guideline for the impact of construction noise on parks and reserves. However the INP provides amenity criteria for areas reserved for 'passive' and 'active' recreation. Park and reserve areas potentially affected by this project are described as 'passive' recreation areas. The INP states that the acceptable and maximum noise levels for passive recreation areas are L_{Aeq} 50 and 55, respectively. The INP applies these criteria at the most affected point within 50 m of the area boundary when an area is in use. Considering the temporary nature of construction noise, it is considered that the maximum noise criterion of L_{Aeq} 55 is suitable for parks and reserves.

Operational Noise Criteria

Operational noise criteria for well surface locations have been derived from the INP. The INP regulates the noise emissions from industrial noise sources, such as gas wells, through its "intrusiveness" and "amenity" criteria. The intrusiveness criterion requires that the L_{Aeq} noise emission level of the combined proposed gas wells measured over a period of 15 minutes does not exceed the RBL by more than 5 dBA.

The amenity criterion sets an absolute limit on the value of the total L_{Aeq} noise level measured over a day, evening or night period. In this case, the subject receiver locations may generally be conservatively classified as being located in a “semi-rural” area. Consequently, the acceptable level of noise from all industrial noise sources for such receivers is 50, 45 and 40dBA for the daytime, evening and night time periods respectively.

The residences considered by this assessment are generally not presently exposed to any industrial noise sources, apart from the Glenlee Coal Washery and industrial area and the Jacks Gully Regional Waste Management Facility located between the Spring Farm and Menangle Park Project Areas. While the INP does not regard traffic as an industrial source, it is worth noting that the M5 Freeway and the main Southern Rail line pass through the Menangle Park Project Area. Hence, in the absence of other industrial sources, the total noise from the proposed well surface locations may be assessed directly against the amenity criteria (i.e. no allowance for the contribution from other industrial noise sources need be considered).

To assess operational noise at individual well surface locations, the noise criteria is set from the results at the nearest relevant noise monitoring site. The project-specific criteria result from the more stringent of either the amenity or intrusiveness criteria. In this case, the intrusiveness criterion is more stringent. The project-specific noise criteria for operational noise are given in **Table 8-9**.

Table 8-9: Project-Specific Noise Criteria for Well Operational Noise

Location No.	Monitoring Location	Nearby Well Surface Locations	L_{Aeq} Operational Noise Criterion (dBA)		
			Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
1	St Thomas Church, Elderslie	SF10	43	42	37
2	Gundungurra Reserve, Spring Farm	SF17, SF20, SF04, SF04A	43	41	36
3	Glenlee House, Glenlee	MP05, MP06, MP11	40	43	40
4	44 Cummins Road, Menangle Park	MP19, MP21, MP24, MP33	42	42	40
5	Sugar Loaf Residence, Sugarloaf	MP04, MP03, MP02, MP22, MP23	49	45	40

Sleep Disturbance Noise Criteria

As construction activities will take place during night time hours, sleep disturbance has been assessed. It is difficult to accurately predict the potential for sleep disturbance due to the instantaneous nature of noise events. The most conservative recognised criteria are set out in guidelines from the DECC's *Noise Guide for Local Government* (NGLG), which indicates that the L_{A1} noise level external to the façade of any residence from a construction event should not exceed the background noise level by more than 15 dBA. The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} for 99% of the time. The criterion for sleep disturbance from operational noise is the same as that for construction noise. However in addition, noise levels generated by the operation of proposed gas well surface locations are generally of a very steady and continuous nature and do not produce loud instantaneous noises with potential for sleep arousal and are well below

sleep disturbance criteria. Meteorological effects would not increase maximum noise levels more than steady state noise levels, and are not likely to lead to sleep disturbance events.

Meteorological Conditions

Meteorological conditions can affect noise propagation. During temperature inversions noise propagates further and can impact on more residences than would occur in the daytime. The prevailing conditions were measured at Camden Airport for the environmental assessment of the Coal Bed Methane Project – Stage II, June 2003, prepared by Environmental Resources Management Australia Pty Ltd. Those results are considered relevant to this assessment.

The data from Camden Airport show that the occurrence of temperature inversions during winter nights is greater than 30%. At this level of occurrence the INP requires assessment of noise during times of temperature inversion. In the absence of inversion data the default for this area would be a temperature inversion of 3 degrees Celsius per 100 m. The data show that the inversions are not accompanied by assessable winds on more than 30% of occasions. Hence concurrent assessment of inversions and prevailing winds is not required, in accordance with the INP.

8.5.5 Potential Impacts

Construction Noise – Well Drilling

In order to accommodate the required flexibility in final well configuration (both type and number of wells) at each well surface location a worst-case scenario has been used for the purposes of assessing both construction and operational noise to provide a conservative approach.

For construction noise, the worst-case scenario consists of the drilling of six SIS wells at a single location, and the fracture stimulation of wells, even though it is not likely to be required for all wells. An SIS well typically requires continuous 24 hour drilling, typically over a period of approximately 25 days per well. Under these conditions, the entire construction period could take between 6 to 12 months. Fracture stimulation (involving the injection of a slurry of sand and water at high pressure into the coal seam) may take up to one day per well. It should be noted that this is unlikely to be the final well configuration at every surface location, but by demonstrating that the construction of the worst case scenario can be undertaken within the noise criteria for all receivers, the assumption can be made that any chosen well configuration could be implemented within acceptable noise limits.

Construction at well surface locations will occur in phases. Well drilling is the phase of construction with the longest duration, hence the assessment of noise impacts is based upon this phase of construction. During other phases of construction, there may be short term noise levels above the noise criteria. These exceedances will usually be less than 3dBA. For short term construction noise this is considered a minor exceedance. Noise levels from fracture stimulation, if required, have the potential to exceed the criteria by up to 15dBA. However as fracture stimulation would only occur during daytime for up to one day at any one location, potential impacts are considered to be of a minor and temporary nature.

During construction, it is anticipated that some well surface locations will require the implementation of noise mitigation measures to meet relevant noise criteria. In order to provide a conservative assessment of potential noise impacts, a worst case construction scenario has been assumed at each well surface location. This scenario has assumed the drilling of up to six SIS wells at each location over a period of 12 months, including 24 hour operation of drills, mud pumps and generators. Potential options for noise mitigation include:

- Use of only one mud pump at well surface locations;
- Placement of mud pumps at ground level;

- Orientation of mud pumps away from sensitive receivers;
- Installation of temporary or permanent noise barriers;
- Acoustic treatment of pumps;
- Length of construction;
- Hours of construction; and
- Best practice, construction equipment and noise mitigation.

The level of noise reduction achieved by each of these mitigation measures would be generally in accordance with the noise reductions as described in Table 8-10 below.

Table 8-10: Noise reduction achieved through implementation of design mitigation measures

Design Option	Noise Reduction Achieved (dBA)
Use of only one mud pump	3
Placement of mud pumps on the ground	3
Orientation of mud pumps away from sensitive receivers	3
Temporary or permanent noise barriers (generally placed 10 m from the drill rigs)	5 - 10
Acoustic enclosures on mud pump(s)	10

To determine the noise impacts at residential receivers, a computer model covering the study area was created. The *Environmental Noise Model* (ENM) program was used to calculate noise contours around each well surface location. The model takes account of a range of variables including meteorological conditions. Further details of the modelling process used are provided in the noise assessment report included as **Appendix F** to this EA. The results of the assessment of construction noise for each well surface location are summarised in **Table 8-11**. A number of measures would be implemented on a site-by-site basis to achieve compliance with project specific noise criteria, which are identified in **Table 8-11** and described in **Table 8-12**.

Table 8-11: Construction Noise Assessment - Menangle Park Project Area

Compliance Measure		Weekday (7am-6pm) & Sat (7am – 1pm)	Evening (6-10pm)	Night (10pm-7am)	Sat (1pm-6pm) & Sun (7am-6pm)
MP02					
Project Specific Noise Criteria (dBA)		49	47	41	47
1	Barriers to the south	x	x	x x	x
2	Compliance measure 1 and operation of one mud pump only, oriented to the north	x	x	x	x

Compliance Measure		Weekday (7am-6pm) & Sat (7am – 1pm)	Evening (6-10pm)	Night (10pm-7am)	Sat (1pm-6pm) & Sun (7am-6pm)
3	Compliance measure 1 and acoustic enclosure on both mud pumps	✓	✓	✓	✓
MP03					
Project Specific Noise Criteria (dBA)		49	47	41	47
1	Barriers to the south and east	✓	✓	✗	✓
2	One mud pump only, oriented to the west	✓	✓	✓	✓
3	Compliance measure 1 and acoustic enclosure on both mud pumps	✓	✓	✓	✓
MP04					
Project Specific Noise Criteria (dBA)		49	47	41	47
1	Barriers to the east	✓	✓	✗	✓
2	One mud pump only, oriented to the north west	✓	✓	✓	✓
Note: Acoustic enclosures on both pumps would allow operation of two mud pumps at night. Well surface location may potentially impact parks and reserves – this has been taken into consideration in compliance measures					
MP05					
Project Specific Noise Criteria (dBA)		40	40	40	40
1	Barriers to south west	✗	✗	✗ ✗	✗
2	One mud pump only, oriented to the north east	✓	✓	✓	✓
Note: Well surface location may potentially impact parks and reserves – this has been taken into consideration in compliance measures					
MP06					
Project Specific Noise Criteria (dBA)		40	40	40	40
1	Barriers to the south and east	✗ ✗	✗ ✗	✗ ✗	✗ ✗
2	Compliance measure 1 and acoustic enclosure on mud pumps	✓	✓	✓	✓
MP11					
Project Specific Noise Criteria (dBA)		42	42	40	42
1	Barriers to the south east, orient pumps to north west	✓	✓	✗	✓
2	One mud pump only oriented to the north west	✓	✓	✓	✓

Compliance Measure		Weekday (7am-6pm) & Sat (7am – 1pm)	Evening (6-10pm)	Night (10pm-7am)	Sat (1pm-6pm) & Sun (7am-6pm)
MP19					
Project Specific Noise Criteria - at receiver location 3		40	40	40	40
Project Specific Noise Criteria - at receiver location 25		49	47	41	47
1	Barriers to north west and north east, oriented towards the south east	✓	✓	✗	✓
2	One mud pump only, oriented to the north west	✓	✓	✓	✓
MP21					
Project Specific Noise Criteria (dBA)		49	47	41	47
1	Barriers to the north east, oriented south west	✓	✓	✗ ✗	✓
2	One mud pump only, oriented north west	✓	✓	✓	✓
MP22					
Project Specific Noise Criteria (dBA)		49	47	41	47
1	Barriers to the north	✓	✓	✗ ✗	✓
2	One mud pump only, oriented to the north west	✓	✓	✗	✓
3	Compliance measure 1 and acoustic enclosure on both mud pumps	✓	✓	✓	✓
MP23					
Project Specific Noise Criteria (dBA)		49	47	41	47
Complies with noise criteria		✓	✓	✓	✓
MP24					
Project Specific Noise Criteria (dBA)		42	42	40	42
1	Barriers to north and south, orient mud pumps west	✓	✓	✓	✓
MP33					
Project Specific Noise Criteria (dBA)		42	42	40	42
Complies with noise criteria		✓	✓	✓	✓

✓ Complies with noise criteria

✗ Non-compliance (<5 dBA over criterion)

✗ ✗ Non-compliance (>10 dBA over criterion)

Table 8-12: Construction Noise Assessment - Spring Farm Project Area

Compliance Measure		Weekday (7am-6pm) & Sat (7am – 1pm)	Evening (6-10pm)	Night (10pm-7am)	Sat (1pm-6pm) & Sun (7am-6pm)
SF04					
Project Specific Noise Criteria (dBA)		43	42	37	42
1	Barriers to north, orient mud pump to south	✗	✗✗	✗✗	✗✗
2	One mud pump only	✗	✗	✗	✗
3	Acoustic enclosure on mud pumps	✓	✓	✓	✓
SF04A					
Project Specific Noise Criteria (dBA)		43	42	37	42
Complies with noise criteria		✓	✓	✓	✓
SF10					
Project Specific Noise Criteria (dBA)		43	41	36	43
1	Barriers to the north, orient mud pumps south	✗	✗	✗✗✗	✗
2	One mud pump only, oriented to the north west	✗	✗	✗	✗
3	Acoustic enclosure on mud pumps – barrier to north west required maximum 5 m from rig	✓	✓	✓	✓
Note: Well surface location may potentially impact parks and reserves – this has been taken into consideration in compliance measures					
SF17					
Project Specific Noise Criteria (dBA)		43	41	36	43
Complies with noise criteria		✓	✓	✓	✓
SF20					
Project Specific Noise Criteria (dBA)		43	41	36	43
1	Barriers to the north and east	✓	✗	✗	✗
2	One mud pump only oriented to the south	✓	✓	✓	✓
Note: Well surface location may potentially impact parks and reserves – this has been taken into consideration in compliance measures					

✓ Complies with noise criteria

✗ Non-compliance (<5 dBA over criterion)

✗✗ Non-compliance (5-10 dBA over criterion)

✗✗✗ Non-compliance (>10 dBA over criterion)

Simultaneous drilling at more than one well surface location may create cumulative noise impacts at some residences. The sum of noise levels would depend on the residence and the location of the well surface locations. In general cumulative noise impact will be minimised if a distance of 1 km is maintained between well drilling locations. This distance is conservative and does not take into account any natural shielding provided by topography. There may be combinations of wells that can be drilled at closer distances. There may be rare instances of coincidental adverse meteorological conditions that apply to more than one site and increase noise levels marginally above the criterion at some residences.

Construction Noise – Gas Gathering Line

The noisiest component of construction of the gas gathering line is the trenching machine. Typical L_{A10} sound power level for the equipment used for excavation of trenches and pipe laying is 110dBA. Gas gathering line construction works, including trenching, pipe laying and backfill, move at a rate of between 300-400m per day depending on the terrain. The noise is transient, it will only occur once during construction, and it is not constant noise. The criteria for this activity is background noise level L_{A90} plus 20 dBA. As the background noise level varies across the study area, so will the noise criteria.

As the gathering construction site will cover distances of between 300-400m per day, any one receiver will only experience temporary exceedances of the criterion for part of one day. Throughout most of the Spring Farm Project Area and the western part of Menangle Park Project Area the daytime background noise level is between 35-38 dBA. As the trencher approaches houses in these areas the noise would exceed the noise criterion if the construction site is within 120 to 180m of the houses for a very short time. While the exact location of this infrastructure may move up to 25m either side of the proposed routes, the preliminary designs show no receivers within a 120 to 180m distance of the gathering lines in the Spring Farm Project Area (i.e. gathering lines for SF04/A, SF10, SF17 and SF20).

In the western part of the Menangle Park Project Area there will be one residence marginally impacted by the gathering line joining MP11 to the existing line near MP14. As the line goes within 150m of the residence the noise would be approximately 60dBA, or 3dBA above the noise criterion. Such an exceedance is likely to last for only several hours during one day time period. Noise from the construction of the line along the Highway between MP03 and MP04 would exceed the criterion at one house. The exceedance would be less than 5dBA for a limited period of time.

In the eastern part of Menangle Park the daytime background noise level is 44dBA. Here the noise criterion will be exceeded if the trenching site approaches closer than 70m to any residence. Only two houses would be impacted by noise from laying of the gathering lines in this area. The exceedances are less than 5dBA, and the duration of the exceedances less than one day time period. Due to the speed with which the construction site moves, noise mitigation is best done by selection of the quietest machinery and best work practices. Residences where noise impact is expected will be notified in an appropriate time frame in accordance with the EHSMP.

Operational Noise

It is anticipated that the Spring Farm and Menangle Park Project Areas will change substantially during the lifetime of this project from semi-rural to residential, industrial and commercial. In relation to the Spring Farm Project Area, the distance of residential boundaries to eventual well surface locations can be predicted with reasonable certainty due to the advance master planning that has been undertaken. It is anticipated that future residential boundaries will be approximately 30-40m from the SF04(A) surface locations, 80-100m at SF17 and SF20, and 120m at SF10.

The planning for urban release at Menangle Park is less developed and the distance between future development and well surface locations cannot be reasonably predicted. As noted in previous chapters, both the Spring Farm and Menangle Park areas are earmarked for future residential, commercial and industrial subdivisions. The change from the current semi-rural character will increase the background noise level at the operational stage of the project. As the background noise level increases with the progress of this development, the noise criteria could increase, especially during construction of the new suburbs and industrial precincts, hence the impact of the same operational noise from this project would be reduced.

Given the uncertainty surrounding final placement of well surface locations and proximity to future receivers, a worst case assessment was undertaken to provide a conservative approach to the assessment of operational noise. Four worst case scenarios were assessed to demonstrate appropriate mitigation requirements to meet operational noise assessment criteria. These are described in **Table 8-13** below.

Table 8-13: Scenarios for Operational Noise Assessment

Operational Noise Assessment Scenarios
Scenario 1 - A medium producing well surface location at 40m from residences A medium producing well surface location would have a total sound power level from 6 wells of 65 to 85dBA. At 40m from the boundary of the site the noise level would be 25 to 45dBA. If it is assumed that the night time criterion at the residence is 36dBA, then the typical required noise reduction is 9dBA. This reduction could be achieved by an acoustically treated 2m boundary fence. If the closest houses were two storey houses, then the pumps may require individual treatment to reduce noise further and achieve criteria. Occasionally a work over rig will come onto the site for maintenance works. Depending on the actual site, the criterion for the work over rig will be approximately 55dBA (that is background +20dBA as discussed earlier). A work over rig with sound power level (SWL) of 106 will have a noise level of approximately 66dBA at 40m. Any barrier around the site would reduce noise levels to below the criterion at ground floor residences.
Scenario 2 - A high producing well surface location with pumps 40m from residences This presents the worst case scenario for any of the well locations, and is unlikely to occur. A high producing well surface location with pumps would have a total sound power level from six well heads of 80 to 100dBA. At 40m from the boundary of the surface location the noise level would be 40 to 60dBA. If it is assumed that the night time criterion at the residence is 36dBA, then the maximum required noise reduction is 24dBA. It is extremely unlikely that all six wells would be pump assisted from an operational perspective, as high producing wells do not typically require pumps and it is also unlikely that pumps would be required at all wells at the same time. This scenario has been modelled to generate the highest possible operational noise impact in order demonstrate the criteria can be met. Therefore this scenario assumes a pump at each well head with the pumps powered by diesel generators. The noisier wells at this surface location would require enclosures designed to achieve 24dBA noise reduction. This reduction could be achieved by a 2m boundary fence. If the closest houses were two storey houses, then some pumps may need individual treatment to reduce noise to achieve compliance. This could be easily achieved with, for example, 2m steel (Colorbond) structure lined internally with plasterboard, the use of barriers for individual well heads, the use of electric generators, well head enclosures or acoustic treatment of generators. Also, the well noise levels could be reduced by using electric pumps if necessary. Occasionally a work over rig will come onto the site for maintenance works. Depending on the actual site, the criterion for the work over rig will be approximately 55dBA (that is background +20dBA as discussed earlier). A work over rig with sound power level (SWL) of 106 will have a noise level of approximately 66dBA at 40m.

Operational Noise Assessment Scenarios	
Scenario 3 - A high producing well surface location at 120m from residences	
A high producing well surface location would have a total sound power level from 6 well heads of 80-95dBA. At 120m from the boundary of the compound the noise level would be 30 to 45dBA If it is assumed that the night time criterion at the residence is 36dBA, then the typical required noise reduction is 9dBA. This reduction could be achieved by a 2m boundary fence. If the closest houses were two storey houses, then some of the noisier wellheads might need individual treatment to reduce noise to upper floor bedrooms. Occasionally a work over rig will come onto the site for maintenance works. Depending on the actual site, the criterion for the work over rig will be approximately 55dBA (that is background +20dBA as discussed earlier). A work over rig with sound power level (SWL) of 106 will have a noise level of approximately 56dBA at 120m.	
Scenario 4 - A medium producing well surface location at 300m from residences	
A medium producing well surface location would have a total sound power level from 6 wellheads of 65 to 85dBA. At 300m from the boundary of the compound the noise level would be at most 28dBA. No further noise reduction is required for this scenario. At this distance the noise would be increased during times of temperature inversion, but still would not exceed the noise criterion of 36dBA. Occasionally a work over rig will come onto the site for maintenance works. Depending on the actual site, the criterion for the work over rig will be approximately 55dBA (that is background +20dBA as discussed earlier). A work over rig with sound power level (SWL) of 106 will have a noise level of approximately 48dBA at 120m. This will meet the criterion at all sites.	

The distances between future development and well surface locations cannot be reasonably predicted, especially in the case of Menangle Park, nor can the noise level of the producing well surface location. Therefore, the design of the project has included a two stage process whereby design measures were incorporated into the well heads before the wells become operational in order to achieve compliance with anticipated noise criteria, as set out in scenarios in the table above.

The assessment concluded that each of the well surface locations would be compliant with the criteria. The implementation of monitoring during the production phase would confirm the assessment and indicate whether or not further mitigation measures would be required to ensure that the operational noise would be maintained at an acceptable level for current and future residents of the area.

Closure and Final Rehabilitation

The decommissioning and final rehabilitation stage would require similar equipment to the work over stage. Hence the sound power level of the site would be approximately L_{A10} 106dBA. The decommissioning activities would take place during daytime hours and a Noise Abatement Plan would be prepared in advance of decommissioning.

The final rehabilitation stage will require use of earthmoving machinery. Depending on the work required, the L_{A10} of the surface location would be 105 to 115dBA. The final site rehabilitation will also take place during daytime hours and a Noise Abatement Plan would be prepared prior to commencement of the final rehabilitation activity.

Stage 2 Concept Area

Noise levels associated with the construction and operation of wells within the Stage 2 Concept Area cannot be accurately determined until further details of the proposed location of wells, and the ultimate distance to residences are known. Further, future background noise levels within this area cannot be accurately predicted due to the substantial changes to the character and density of development in the area likely to occur during the life of the Stage 2 Concept works. It is therefore difficult, if not impossible to definitively assess the noise impacts of the Concept works at this stage.

The detailed noise assessment undertaken in respect of the Spring Farm and Menangle Park Project Areas would be used to inform well surface locations within the Stage 2 Concept area and further detailed noise investigations will be undertaken in association with future separate assessment and approvals processes for this component of the project to confirm predictions in this EA.

Based upon the results of the noise assessment undertaken for the Spring Farm and Menangle Park Project Areas, the noise impacts associated with the Stage 2 Concept Area are expected to be manageable within acceptable limits with the application of appropriate mitigation and design measures. The noise assessment for the Project Areas indicates that even under worst case conditions, the noise impacts of the proposed works would be manageable through the implementation of appropriate mitigation and design measures. A range of mitigation options will be considered and applied to each specific well surface location to ensure that noise criteria are met once background noise levels, construction and operational noise levels and distance to receivers is more accurately known.

8.5.6 Environmental Safeguards

Construction

Appropriate design and mitigation measures have been incorporated into the configuration of well construction compounds in order to ensure noise is maintained at an acceptable level. The extent of design and mitigation measures required has been determined on a site by site basis, but options for noise mitigation during construction, particularly drilling, include:

- Use of only one (of two) mud pumps;
- Electricity supply for equipment (rather than generators);
- Placement of mud pumps on the ground;
- Orientation of mud pumps away from sensitive receivers;
- Placement of temporary or permanent noise barriers;
- Acoustic treatment of mud pumps; and
- Best practice, construction equipment and noise mitigation.

The Proponent will utilise a combination of these measures at well construction sites as required (refer to **Section 8.5.5** for identified mitigation measures at each site) to ensure that noise impacts during the construction period are minimised. In addition, the Proponent will implement the following measures during the construction period to further manage potential noise impacts:

- Preparation of a Construction Noise Management Plan (CNMP) to consider the following issues:
 - Identification of noise goals;
 - Identification of residential receivers;

- Length of construction;
 - Hours of construction;
 - Best practice, construction equipment and noise mitigation;
 - Noise monitoring;
 - Community consultation and notification; and
 - Complaints handling.
- Notification of the local community in accordance with the CNMP;
 - Complaints handling in accordance with the CNMP; and
 - Source and site specific noise mitigation measures such as silencers and noise barriers are to be investigated and implemented as necessary on a site by site basis.

Operation

There are a variety of mitigation measures available for operating gas well surface locations which could be used to minimise the potential noise impacts associated with the proposal. The first is the use of design and mitigation measures in order to achieve compliance with noise criteria. Further mitigation measures (if required) would be applied on a site by site basis, as determined by the results of noise monitoring, to ensure that operational noise is maintained at an acceptable level. The design and mitigation options include:

- Noise barriers for individual well heads and/ or other surface equipment;
- Noise barriers for well surface locations (i.e. fence enclosing the entire well surface location thus mitigating noise from all well heads);
- Enclosure of well heads;
- Enclosure of other surface equipment; and
- Where pumps are required, replacement of diesel pumps with electric pumps.

In addition, the Proponent shall undertake noise monitoring during the production phase in order to confirm the assessment and to evaluate whether further mitigation is required for operating well surface locations.

While there is uncertainty surrounding future development within the Concept and Project Areas proximate to well surface locations, the examination of worst case operating scenarios provided in **Section 8.5.5** demonstrates that even under worst case conditions, design and mitigation measures will be sufficient to reduce noise emissions to within acceptable limits set by the INP. Noise monitoring during operation would confirm whether design and mitigation measures are sufficient, and allow further mitigation measures to be implemented, if necessary.

Closure and Final Rehabilitation

Noise mitigation measures during the well closure and final rehabilitation phases of the development will be determined on a site by site basis closer to the commencement of these phases of the Project. As these phases of the project are not expected to take place for some 10 to 15 years and given the extensive planned changes to the character of the area (from semi-rural to urban), it is impossible to accurately predict the potential noise impacts of these phases of the development and therefore to recommend appropriate mitigation.

Stage 2 Concept Area

As discussed previously, it is not possible at this stage to accurately assess the noise impacts and required mitigation for works subject of the Stage 2 Concept application. A range of

mitigation options will be considered and applied to each specific well surface location to ensure that noise criteria are met once background noise levels, construction and operational noise levels and distance to receivers is more accurately known.

As a guide, the following general principles would be considered when identifying potential well surface locations for the Stage 2 Concept works:

- Well surface locations would be chosen in consideration of the proximity to nearest sensitive receivers and would take account of local topography and meteorological conditions which may affect the extent of noise impacts;
- The potential for noise impact would be considered in the preliminary planning phase of the project such noise minimisation will be built into the inherent project design;
- The full range of available mitigation measures would be considered and applied where necessary to ensure that noise impacts can be maintained at an acceptable level.

8.5.7 Residual Impacts

The implementation of appropriate mitigation measures during the construction period of the project will minimise potential noise impacts and generally maintain noise levels within project specific noise criterion. However, it is possible that exceedences will be experienced at certain residences on an infrequent and short-term basis. Community notification, along with the use of a complaints procedure should minimise the impacts of these minor exceedences on existing surrounding land uses.

The character and density of surrounding land use is expected to change significantly from the construction to the operational phases of the Project with subsequent implications for background noise levels and potential noise impacts. In this respect, all well heads would be designed to minimise noise. Noise monitoring and assessment will be undertaken once well surface locations are operational in order to accurately establish appropriate mitigation measures. Furthermore, proposed mitigation measures have been designed to minimise noise impacts to parks and reserves proximate to well surface locations.

The noise assessment demonstrated that mitigation measures are available that would be sufficient to reduce noise emissions from producing well surface locations to within acceptable limits such that residual impacts in terms of noise should be minimal. A similar approach will be taken to the decommissioning and rehabilitation phases of the project such that residual impacts are expected to be minimal, with any exceedences expected to be minor, temporary and short-term.

8.5.8 Conclusion

The most significant potential noise impacts of the project are related to the construction phase of the development and these will be temporary and in most cases short-term. Whilst construction noise has been conservatively assessed on the basis of a 6-12 month construction period, this is a worst-case scenario and is unlikely to be the case at all well surface locations. Further, given the nature of surrounding land use and development, residential receivers are few and mitigation measures will be implemented to ensure that the impacts upon these receivers are minimised and maintained within acceptable limits.

The potential noise impacts of the operational, decommissioning and final rehabilitation phases of the project are expected to be manageable with the implementation of appropriate mitigation

and should not result in significant adverse impacts upon the amenity of nearby residential development.

With regard to the broader Stage 2 Concept area, impacts are expected to be manageable within acceptable limits. The detailed noise assessment undertaken in respect of the Spring Farm and Menangle Park Project Areas will be used to inform the well surface locations within this area and further detailed noise investigations will be undertaken in association with future separate assessment and approvals processes for this component of the project to confirm predictions in this EA.

It should be noted that AGL currently has existing well surface locations within 75 m of residential properties, such as MT10 in the Mount Taurus well field, and this gas infrastructure has been integrated into the urban landscape.

8.6 Social Impact

The proposed Stage 2 Concept area comprises Campbelltown, Camden and Wollondilly LGAs with the Menangle Park Project area located wholly within Campbelltown LGA and the Spring Farm Project area located wholly within the Camden LGA. This section provides information on the social environment within the Stage 2 Concept area, the Menangle Park Project area and the Spring Farm Project area. Within Campbelltown and Camden LGAs, sub-areas are identified for the purpose of the community profiles. The Menangle Park Project area is located within a sub-area identified as 'Rural Residential' while the Spring Farm Project area is located within a sub-area identified as Elderslie/ Spring Farm. Social characteristics of these two sub-areas are also provided in this section.

8.6.1 Campbelltown LGA

Part of the Stage 2 Concept area and the entirety Menangle Park Project area are located within the Campbelltown LGA.

Campbelltown LGA is located in Sydney's outer south west and is bounded by Liverpool LGA to the north, Sutherland and Wollongong LGAs to the east, Wollondilly LGA to the south and Camden LGA to the west. Campbelltown LGA comprises an area of some 311.5 km² and has a population density of approximately 4.66 persons per hectare (Campbelltown City Council Community Profile www.campbelltown.nsw.gov.au, accessed 26.7.07).

Campbelltown LGA is divided into several sub-areas for the purpose of Council's community profile. As previously identified, the proposed Menangle Park Project area is located within a sub-area identified as 'rural residential' which has a total land area of some 213.4 km² and a current population density of around 0.14 persons per hectare (Campbelltown City Council Community Profile www.campbelltown.nsw.gov.au, accessed 26.7.07). The rural residential area is two thirds of the total LGA and has a population density some 30 times lower than the LGA which is largely due to areas of high population density in certain locations within the LGA.

Campbelltown LGA experienced a slight increase in population between 1996 and 2001. While there has been an increase in the number of new dwellings, the average number of persons living in each dwelling has declined. Many of the smaller areas within Campbelltown LGA experienced population decline during the period 1996 to 2001.

Summary of Social Characteristics

Table 8-14 below summaries the social characteristics for Campbelltown LGA and the 'rural residential' sub-areas in comparison to the New South Wales average (where relevant). The table includes characteristics of population and dwellings.

Table 8-14: Summary of Social Characteristics for Campbelltown LGA.

Characteristic	Campbelltown	Rural Residential	NSW (average)*
Population			
Population (total)	145,294	2,899	6,311,168
Infants (0-4)	11,608	127	422,341
Children (5-17)	34,532	566	-
Adults (18-64)	90,060	1,854	-
Mature Adults (65 +)	9,095	376	2,370,878
Dwellings *			
Dwellings (total)	48,748	879	2,571,540
Owned	13,309 (28.5%)	411 (49.1%)	963,231 (41.1%)
Purchasing	16,357 (35.0%)	226 (27.0%)	546,195 (23.3%)
Renting	14,150 (30.3%)	103 (12.3%)	645,319 (27.5%)

Note: * % is of the total dwellings within LGA, sub-area and NSW.

Source: www.campbelltown.nsw.gov.au Community Profile where information is based on the 2001 Census of Population and Housing, Australian Bureau of Statistics

8.6.2 Camden LGA

Part of the Stage 2 Concept area and the all of the Spring Farm Project area are located within the Camden LGA. Located in the south west of Sydney, Camden LGA is bounded to the east by Campbelltown LGA, Liverpool LGA to the north and Wollondilly LGA to the south and west. Camden LGA has a total land area of some 201 km² with a population density of around 2.2 persons per hectare. Camden LGA comprises a mix of agricultural lands, country towns and new residential areas with associated commercial and industrial developments. Camden is renowned for its significance in the origins of Australia's wool industry and is commonly referred to as the "Birthplace of the Wealth of the Nation" (Camden Council Community Profile www.camden.nsw.gov.au accessed 26.7.07).

Camden LGA has experienced rapid growth since 1981 with an annual growth rate of approximately 7.8% (Camden Council Community Profile www.camden.nsw.gov.au, accessed 16/08/06). Due to the future development of existing release land areas, it is expected that Camden LGA will continue to experience significant growth.

The Spring Farm Project area is located within the Elderslie/ Spring Farm sub-area within Camden LGA. Residential development has occurred in the Elderslie/ Spring Farm area since the 1980s and 1990s. It is anticipated that the area will experience significant growth over the next 10 years with remaining areas of Elderslie/ Spring Farm to be released for further residential development. The Elderslie/ Spring Farm area comprises some 11.5 km² with a current population density of around 2.6 persons per hectare. (Camden Council Community Profile www.camden.nsw.gov.au, accessed 26.7.07).

Summary of Social Characteristics

Table 8.15 below summaries the social characteristics for Camden LGA and the Elderslie/ Spring Farm sub area in comparison to the NSW average (where relevant). The table includes characteristics of population and dwellings.

Table 8.15: Summary of Social Characteristics for Camden LGA.

Characteristic	Camden	Elderslie/ Spring Farm	NSW (Average) *
Population			
Population (total)	43,799	2,940	6,311,168
Infants (0-4)	4,003	226	422,341
Children (5-17)	9,542	581	-
Adults (18-64)	26,869	1,795	-
Mature Adults (65 +)	3,365	308	2,370,878
Dwellings *			
Dwellings (total)	14,929	1,142	2,571,540
Owned	4,526 (31.7%)	403 (37.4%)	963,231 (41.1%)
Purchasing	6,330 (44.3%)	368 (34.2%)	546,195 (23.3%)
Renting	2,546 (17.8%)	270 (25.1%)	645,319 (27.5%)

Note: * % is of the total dwellings within LGA, sub-area and NSW.

Source: www.camden.nsw.gov.au Community Profile where information is based on the 2001 Census of Population and Housing, Australian Bureau of Statistics

8.6.3 Wollondilly LGA

The Stage 2 Concept area is also partially within the Wollondilly LGA. Wollondilly LGA is located at the south western fringe of the Sydney Metropolitan Area, approximately 75 km from the Sydney CBD. Wollondilly LGA is bounded by the Blue Mountains and Penrith LGAs in the north, Liverpool, Camden, Campbelltown City and Wollongong LGAs in the east, Wingecarribee LGA in the south and Goulburn Mulwaree and Oberon LGAs in the west. Wollondilly Shire comprises an area of approximately 2,560 km² with a current population density of around 0.04 persons per hectare (Wollondilly Council Community Profile www.wollondilly.nsw.gov.au, accessed 26.7.07).

The Wollondilly LGA predominately comprises National Parks and rural areas with scattered urban areas. The rural land is mainly used for agricultural purposes, with coal mining also being a major industry in the area.

Summary of Social Characteristics

Table 8-16 below summaries the social characteristics for Wollondilly LGA in comparison to the NSW average (where appropriate). The table includes characteristics of population and dwellings.

Table 8-16: Summary of Social Characteristics for Wollondilly LGA.

Characteristics	Wollondilly	NSW (average) *
Population (% of population)		
Population (total)	36,953	6,311,168
Infants (0-4)	2,835	422,341
Children (5-17)	8,554	-
Adults (18-64)	22,598	-
Mature Adults (65 +)	969	2,370,878

Characteristics	Wollondilly	NSW (average) *
Dwellings *		
Dwellings (total)	12,948	2,571,540
Owned	4,802 (39.4%)	963,231 (41.1%)
Purchasing	4,776 (39.2%)	546,195 (23.3%)
Renting	1,668 (13.7%)	645,319 (27.5%)

Note: * % is of the total dwellings within LGA, sub-area and NSW.

Source: www.wollondilly.nsw.gov.au Community Profile where information is based on the 2001 Census of Population and Housing, Australian Bureau of Statistics.

8.6.4 Population Characteristics Summary

Within the Stage 2 Concept area, there are some differences in the social characteristics of the three LGAs; Campbelltown, Camden and Wollondilly.

Wollondilly LGA is significantly larger in area than both Campbelltown and Camden and has a significantly lower population and population density.

Campbelltown LGA has a significantly larger population and population density than both Wollondilly LGA and Camden LGA. However, the sub-areas for the Menangle Park Project area and the Spring Farm Project area (rural residential and Elderslie/ Spring Farm respectively) are relatively similar in population size with the Spring Farm Project area located in a smaller sub-area with a lower population density.

The future development of these areas, particularly the Menangle Park and Spring Farm Project areas, would significantly change the social characteristics of these sub-areas. Within the Stage 2 Concept area, there is potential for around 10 000 new lots within these land release areas. The Elderslie/ Spring Farm area has the potential for approximately 6,000 lots and the Menangle Park area has the potential for 4,200 lots.

8.6.5 Potential Impacts

The proposed development represents a social benefit through the provision of gas to an already constrained NSW gas market. The extraction of gas as part of the CGP maintains the current supply and ensures security of supply to future urban (residential, commercial and industrial) development in the area and in the State. As stated in **Section 3.1**, natural gas (including CSM) produces around 55% of greenhouse gas emission per gigajoule of energy relative to coal, making it the cleanest fossil fuel. A competitively priced gas supply from the CGP will reduce reliance on more greenhouse intensive fuels, which in accordance with the principles of BASIX for new developments.

As previously mentioned, the future development of urban (residential, commercial and industrial) land release areas within the Spring Farm and Menangle Park Project areas would significantly alter the existing social characteristics. The assessment of potential social impacts as a result of the proposed project has taken this future development into account based on information currently available from Council and landowners.

The potential social impacts of the proposed Project relate largely to impacts on general amenity such as visual, noise and traffic as well as hazard and risk impacts. Due to the nature of the proposed Project, the potential social impacts would be largely limited to the construction phase.

Potential visual impacts would be most significant during the construction phase due to the scale of plant and equipment and the proposed construction footprint required for the construction of the well surface locations. However, construction works would be temporary and relatively short term in nature and would not be expected to be significant. In regard to future land release areas within the Menangle Park and Spring Farm Project areas, the construction phase would be completed prior to the commencement and occupation of urban (residential, commercial and industrial) development, therefore construction impacts would not impact on the land release areas.

For the construction of the gas gathering lines construction activities would be temporary and mobile, and would not be located in one place for significant periods of time, reducing the overall potential impact. Upon completion of the construction of the gas gathering, visual impacts would be removed as the infrastructure would be located underground and the surface land returned as close as possible to its pre-production condition or better. Therefore potential visual impacts related to the gas gathering are expected to be minimal during construction.

During the production and operation phase, an enclosure would surround the wellhead infrastructure using fencing and materials that would integrate with the surrounding urban form. Landscape planting would be undertaken surrounding the well surface locations in order to soften the potential visual impact and provide screening of the development (refer to **Section 8.10**). Visual impacts are discussed further in **Section 8.10** of this EA and provided the recommended mitigation measures are implemented, these potential impacts are expected to be minimal.

Potential traffic impacts resulting from the proposed Project would include a slight increase in vehicle movements mainly during the construction phase of the project, including heavy vehicles, transport machinery and personnel to and from the sites. Peak traffic movements as a result of the proposed Project would occur during the construction phase. During the production, post-development and closure and rehabilitation phases of the proposal, there would be intermittent vehicle activity over a relatively short period of time. As discussed in **Section 8.13** of this EA, traffic impacts are considered to be generally of a minor and temporary nature, and provided the recommended mitigation measures are implemented, no significant adverse impacts are expected.

Hazard and risk impacts associated with the gas well surface locations are generally related to flammable events which could occur due to a loss of containment of gas and followed by an ignition event. There are a range of technical safety features built into the design of the wellheads to ensure that potential impacts associated with the proposal in terms of hazard and risk are minimised (discussed in **Section 8.2**). In addition, separation distances between sensitive land uses and well surface locations to ensure that these potential risks are maintained at an acceptable level would be implemented. With the application of these separation distances and the mitigation measures identified in **Section 8.2.4**, the potential impacts of the proposed well surface locations on both human health and the environment are expected to be minimal.

Refer to **Sections 8.2, 8.10 and 8.13** for recommended mitigation measures for potential hazard and risk, visual, and traffic impacts associated with the proposed Project.

8.6.6 Residual Impacts

Whilst the presence of the well head and enclosure would represent a residual impact to future residential receptors located within land release areas which are to be developed in the future, the residual impacts are considered to be relatively minor and temporary and transient in nature.

The residual impacts relating to hazard and risk, noise, visual and traffic are considered in **Sections 8.2, 8.5, 8.10 and 8.13** respectively and are considered to be generally minor and for the most part of a temporary nature, therefore the proposed Project is considered to be acceptable in terms of the social environment.

8.6.7 Conclusion

There are currently no exceptional social circumstances within the Stage 2 Concept area, the Menangle Park or Spring Farm Project areas. However, the future development of urban (residential, industrial and commercial land) release areas within the Menangle Park and Spring Farm Project Areas would alter the social characteristics of these areas over the life of the proposed project. The assessment of potential social impacts as a result of the proposed project has taken this future development into account.

Due to the identification of potential social and amenity impacts with respect to visual, noise, traffic and hazard and risk, the design and planning of the Project would implement measures to ensure these impacts are minimised. Provided the recommended management and mitigation measures are implemented the potential social impacts of the proposed development are expected to be minimal.

In addition to the recommended mitigation measures, ongoing community consultation will keep the local community up-to-date and informed about works in their area. A telephone hotline is also provided for the reporting of complaints or emergencies and any complaints are recorded and immediately addressed.

8.7 Economic Impact

8.7.1 Introduction

Currently in the USA, approximately 10% of all natural gas is sourced from coal seams, as proposed by the concept and project applications subject of this EA. It is considered that given the projected increased demand for natural gas and the push for more environmentally acceptable forms of energy, that a similar trend could soon be established in Australia.

It has been estimated by the Warren Centre at Sydney University that the Sydney Basin may contain up to 130,000 petajoules (PJ) of total gas-in-place in all coals (Weber C. & Bocking M., 1993, as cited by Camden Gas Project Joint Venture, 2005). Within the CGP, gas recovery rates have been shown to be very positive and based upon performance to date, it is predicted that the resource within this area should generate economic flow rates for at least 21 years. Given the substantial size of the resource, the proposed expansion is seen to be an opportunity for the Proponent to further develop a world-class energy asset on the doorstep of the major growth areas of Sydney.

In support of this, the DPI has stated that:

“New South Wales has major coal-bearing basins with very extensive resources of coal seam methane. That methane resource has the potential to be an important source of energy on regional, State and national levels”.

(as cited by CGPJV, December 2005).

An analysis of the proposed expansion of Stage 2 of the CGP has been undertaken to assess the potential impacts of the activity on the surrounding economic environment. The analysis

describes the existing economic situation of the Camden, Wollondilly and Campbelltown areas including the Macarthur Region, the NSW economic situation and considers the potential impacts of the CGP on this position.

Statistical information primarily taken from the 2001 census information issued by the Australian Bureau of Statistics (ABS) has been analysed, incorporating trends from previous census data. Information from regional statistical analysis, local council State of the Environment Reports and analyses of gas supply and demand has also been incorporated into the assessment.

8.7.2 Existing Environment – Economic Profile

Employment

Employment data from the ABS 2001 census is provided in **Table 8-17** below. Data shows that employment rates are comparable across the three local government areas (LGA) and the State with minor differences in unemployment levels which can be attributed to the number of people within each LGA workforce.

Table 8-17: Employment data from 2001 ABS census

Employment Status	Campbelltown LGA	Camden LGA	Wollondilly Shire	NSW
Full time	41,968 (62.2%)	14,758 (65.5%)	11,122 (62.0%)	1,805,433 (61%)
Part time	17,620 (26.1%)	6,187 (27.5%)	5,340 (29.8%)	858,483 (29%)
Employed Not stated	2,225 (3.3%)	661 (2.9%)	566 (3.2%)	84,480 (2.9%)
Employed (total)	61,819 (91.5%)	21,606 (95.9%)	17,028 (95.0%)	2,748,396 (92.8%)
Unemployed (total)	5,709 (8.5%)	929 (4.1%)	897 (5.0%)	213,196 (7.2%)

Employment data across the three LGAs and the State are comparable, with Camden and Wollondilly LGAs exhibiting marginally lower unemployment rates than the state average.

Personal Income

Personal income data for the Macarthur Region is provided in **Table 8-18** below demonstrating that income is fairly evenly distributed across the income bands. Approximately 50% of the Macarthur population surveyed by the 2001 census earn less than \$500 per week. Weekly income data is fairly evenly spread across the income brackets.

Table 8-18: Weekly income for the Macarthur Region based on ABS 2001 census

Weekly Income	Number of Persons	Percentage
Negative/Nil income	7,178	7.47
\$1-\$39	1,354	1.41
\$40-\$79	2,522	2.62
\$80-\$119	2,805	2.92
\$120-\$159	4,093	4.26
\$160-\$199	6,669	6.94
\$200-\$299	9,514	9.90

Weekly Income	Number of Persons	Percentage
\$300-\$399	7,656	7.96
\$400-\$499	7,749	8.06
\$500-\$599	7,994	8.32
\$600-\$699	6,860	7.14
\$700-\$799	5,806	6.04
\$800-\$999	7,452	7.75
\$1,000-\$1,499	7,904	8.22
\$1,500 or more	2,619	2.72
Not stated	7,560	7.86
Overseas visitors	391	0.41
Total	96,126	100.00

Economic Structure

The economic structure of the Macarthur Region is reasonably diverse with the highest employment being in the manufacturing and retail trades with mining and the electricity, gas and water supply sectors being the lowest employers of the region with less than 2% of the workforce population (refer to **Table 8-19**).

Table 8-19: Employment distribution (%) based on ABS 2001 census

Sector	Macarthur Region	Camden LGA	Campbelltown LGA	Wollondilly LGA
Agriculture, Forestry and Fishing	1.39	1.92	0.46	4.08
Mining	0.25	0.42	0.11	1.58
Manufacturing	15.89	14.20	17.78	14.45
Electricity, Gas and Water Supply	0.66	0.61	0.63	0.92
Construction	8.64	9.59	7.23	11.19
Wholesale Trade	6.15	6.73	5.94	5.41
Retail Trade	15.59	15.14	15.29	13.90
Accommodation, Cafes and Restaurants	3.55	3.05	3.97	3.28
Transport and Storage	6.16	6.45	6.14	5.55
Communication Services	1.97	1.75	2.29	1.32
Finance and Insurance	4.41	4.06	5.16	2.50
Property and Business Services	9.08	8.86	9.44	8.12
Government Administration and Defence	3.40	3.14	3.81	3.01
Education	6.69	7.61	5.86	7.28
Health and Community Services	8.04	8.17	8.01	8.72
Cultural and Recreational Services	1.76	1.94	1.67	1.70

Sector	Macarthur Region	Camden LGA	Campbelltown LGA	Wollondilly LGA
Personal and Other Services	3.80	4.30	3.50	4.21
Non-classifiable economic units	0.64	0.59	0.66	0.93
Not stated	1.92	1.47	2.03	1.84
Total	100.00	100.00	100.00	100.00

Significant differences across the employment sectors occur in Agriculture, Forestry and Fishing and Mining with Wollondilly LGA considerably higher than the other regions. Wollondilly LGA also has a comparatively lower proportion of workers in the Finance and Insurance sector than the other LGAs.

8.7.3 Existing Environment – Gas Market

The NSW Minerals Sector

The NSW minerals industry is an important contributor to the NSW economy, generating business activity, investment, regional development, direct and indirect employment and export revenue. In 2005/06 the NSW mining industry directly employed more than 18,000 people and was valued at \$11.7 billion (DPI website, 05/03/07).

Existing Gas Market

According to statistics provided by the Department of Energy and Utilities (2001), natural gas constituted around 11% of energy usage in New South Wales in 1998-99. About 70% of this is used by industry, with the remainder used by domestic and commercial customers. Most of New South Wales's supply is currently provided from the Cooper Basin in South Australia via the Moomba-to-Sydney pipeline. In 2000, the Eastern Gas Pipeline was completed, which runs up the New South Wales east coast from the landfall of the Bass Strait fields at Longford (Victoria), and provides an alternative source of gas primarily to the Sydney industrial market.

In 1998-99, AGL supplied around 93% of the State's natural gas market, however, this market share has since declined due to the opening up of the NSW energy market to competition on 1 January 2002.

Energy produced from coal seam gas generates 55% less greenhouse emissions than conventional coal electricity generation. The Camden Gas Project is already a substantial indigenous gas supply to the NSW energy market.

NSW relies heavily on imported gas from Bass Strait in Victoria and Moomba in South Australia. There are significant coal seam gas reserves in NSW, which can provide greater security of supply in times of interstate disruption.

Projected Demand for Natural Gas

Gas is being increasingly relied upon as a fuel source for power generation during peak demand periods. Additionally, with natural gas seen as the cleanest and most environmentally acceptable of the fossil fuels, and the recent push for more environmentally friendly forms of energy, the demand for natural gas is expected to increase substantially into the future.

The Australian Bureau of Agriculture and Resources Economics (2001, as cited by CGPJV, 2005) predicts that consumption of natural gas in NSW will increase from levels around 140PJ per annum to 230PJ per annum by the year 2015. Based upon these predictions, it is anticipated that there will be a shortfall of natural gas within the next few years with subsequent pressures on suppliers and prices.

Royalties

The majority of mineral assets within NSW, including petroleum and gas, are owned by the Crown, or in other words the people of NSW, and therefore, royalties are payable to the Crown to transfer the rights to extract a mineral resource. The price paid for mineral royalties had progressively increased up to 2003-04 with the 2004-05 royalty revenue experiencing a 'boom' with over \$395 million paid as a result of substantially higher coal and mineral prices. Of this, approximately 90% was from coal and 10% from other minerals. (www.minerals.nsw.gov.au)

There are generally three separate types of royalty exist in NSW for non-coal mineral assets:

- Quantum Royalty which is levied at a flat rate per unit of quantity with the rate of royalty depending on the mineral being extracted.
- Ad valorem Royalties which are levied as a percentage of the total value of minerals recovered, or the ex-mine value. The ex-mine value refers to the value of the mineral once it is mined and brought to the surface. The current base rate applicable for most minerals is 4% of 'ex-mine' value.
- Profit-based Royalties apply only to specific mining operations located at Broken Hill. Royalty profit is substantially different from corporate profit or tax profit.

Royalty rates are governed through the *Petroleum (Onshore) Act 1991* (POA Act) No. 84 Clause 85 which states

"The royalty is payable at the rate for the time being prescribed by the regulations (being not more than 10 per cent of the value at the well-head of the petroleum) unless the holder of the title, in his or her application for the title, nominated a higher rate, in which case royalty is payable at that higher rate."

The Petroleum (Onshore) Regulation 2002 Part 7 – Royalty Clause 22 defines the prescribed annual rate of royalty for the purposes of section 85 (2) of the POA Act, as follows:

- *for the first 5 years of commercial production—nil,*
- *for the 6th, 7th, 8th and 9th years of commercial production—6%, 7%, 8% and 9%, respectively, of the value at the well-head of the petroleum,*
- *for the 10th and subsequent years of commercial production—10% of the value at the well-head of the petroleum*

8.7.4 Potential Impacts

The potential economic impacts of the proposal are largely related to the broader impacts of provision of an additional natural gas supply into the existing market, and the more localised impacts in terms of employment generation as a result of the construction and operational phases of the proposal.

Provision of Additional Gas Supply

As discussed previously in this EA, the proposed expansion of Stage 2 of the CGP will allow for the further development of a significant gas resource in the Sydney Basin.

Projections of natural gas usage in New South Wales estimate an increase of some 90PJ over existing levels by the year 2015, thus placing additional pressure on suppliers and prices. Based upon the future projected energy demand and increasing interest in pursuing more environmentally acceptable forms of energy, the importance of securing a cost-effective energy

supply, with lower greenhouse emissions is considered vital to the social and economic growth of the project area and the State.

Currently, the majority of energy consumed in the State is generated from the combustion of black coal. Natural gas (including CSM) produces around 55% of greenhouse gas emissions per gigajoule of energy relative to coal, making it the cleanest fossil fuel. Gas typically costs more per gigajoule than coal but it is a more efficient fuel, so a competitively priced gas supply from the CGP will reduce NSW reliance on more greenhouse gas intensive fuels. By further developing NSW gas reserves, local communities and industry will have access to competitively priced gas and the opportunity to create more jobs in NSW due to lower input costs.

The proposed Stage 2 expansion will provide the next step in ensuring that supply to Sydney and NSW is maintained in the future to underpin the growing economy.

The Australian Gas Association (AGA) is less optimistic than ABARE about Australia's future gas supply and demand balance. In AGA's view, the delivery of gas from new sources is required much earlier than ABARE envisages if Australia is to ensure that competitively priced gas is available when major contracts come up for renegotiation later this decade.

Analysis of Australia's future natural gas reserves and production have been reported by ABARE and show that based on current gas demand forecasts, reserves in the Cooper-Eromanga, Bass, Bowen-Surat and Adavale Basins will be all but depleted by 2019, with only the Gippsland Basin maintaining a significant reserve.

It is therefore considered vital that current Australian supplies of gas are supplemented from additional sources sooner rather than later. The main Moomba - Sydney and Eastern Gas Pipelines both run through the CGP, consequently, the proposed expansion project is well placed to assist in bringing this additional gas supply to the market.

The expansion of the CGP will also assist in the achievement of several State and Regional energy objectives and initiatives which are formulated to provide safe efficient and secure energy supplies into the future.

The potential broader economic impacts of the Project are perhaps best described by considering the impacts should the Project not proceed. Should this be the case, the opportunity to develop a convenient and competitive natural gas supply within the Sydney Basin would be lost, and there would be no flow of resulting economic and social benefits to the NSW community. The likely future shortfall in the gas supply to the growing NSW market may in turn lead to an increase in the use of less efficient alternative fossil fuel sources and increased gas prices for NSW consumers in an already constrained NSW gas market.

Impacts during the Construction Phase

The construction phase of the development would have a positive economic impact on the Macarthur region and the local area through the direct flow of construction expenditure to contractors and suppliers. Implementation of the proposal would generate approximately \$35 million in expenditure and approximately 70 temporary direct contract employees related to the drilling of wells, the installation of gas gathering lines and general construction works for roads and well compounds. Indirect employment would also be generated through demand for goods and services by staff and contractors associated with the CGP expansion, with further details provided below.

Where possible, construction equipment, goods and services and technology is sourced from local or regional suppliers, benefiting both local and regional economies. Approximately 45% of the CGP suppliers are local to the Macarthur Region.

It is generally accepted that the total impacts of economic activity are larger than the direct impacts of that activity. This is the result of the “multiplier” or flow-on effect, whereby every direct addition to economic activity within a defined regional economy has an additional stimulatory effect on overall levels of demand. Every **direct** increase in demand within one sector of the economy in turn stimulates additional **indirect** demand (via production-generated effects as businesses required goods and services in order to meet that increased demand) and also **induced** effects (via the household expenditure of those individuals employed in business involved in both the direct and the indirect demand increases).

Based on studies in other areas (see, for example, studies prepared by the Hunter Valley Research Foundation and others examining the role of the mining industry in the economy of the Hunter Region) multiplier values of around 2 can be considered relevant to the Camden operation. A multiplier of 2 means that for every \$1 of increased demand in one sector, another \$1 of demand is stimulated in the various sectors linked via production and consumption generated effects. The **total** impact of the Camden operations could therefore be in the order of double the **direct** impacts.

The CGP is providing a significant addition to economic activity in the region, and is an important source of employment, as well as demand for local goods and services. This activity is consistent with the existing economic environment, and is a local source of value-adding which will contribute jobs and demand for goods and services, both directly and indirectly, to an area which has a demonstrated need for economic stimuli to match the population growth which is occurring.

Impacts during the Operational Phase

The estimated capital investment for the CGP is in the order of \$35 M for the proposed Spring Farm and Menangle Park activities.

The Project would utilise the existing 35 contractor staff for the majority of the operational requirements of the CGP expansion. The anticipated employment increase for CGP as a direct result of the operational stage of the project is expected to be three new positions and the development of the project would help to secure these positions into the future as well as securing the future contract positions.

8.7.5 Environmental Safeguards

Given that the overall economic impacts of the proposal are considered to be positive, no specific environmental safeguards are considered necessary.

8.7.6 Residual Impacts

The residual economic impacts of the proposal are considered to be positive. The proposed Project would contribute to the local, regional and State economies through provision of a valuable and much needed energy resource to meet existing and future predicted demand. The creation of approximately 35 additional contract and servicing jobs during construction and approximately 3 new jobs in the operational phase of the development. The CGP expansion would also provide opportunities for local and regional recruitment of personnel and subsequent flow-on income within the locality and the region.

8.7.7 Conclusion

Natural gas (including CSM) produces around 55% of greenhouse gas emissions per gigajoule of energy relative to coal, making it the cleanest fossil fuel. The likely future shortfall in the gas supply to the growing NSW market may in turn lead to an increase in the use of less efficient

alternative fossil fuel sources and increased gas prices for NSW consumers in an already constrained NSW gas market.

The proposed expansion of Stage 2 of the CGP provides economic benefits for the local, regional and State economies through taxes, charges and other indirect revenues as well as through the supply of a valuable energy resource to meet existing and predicted future demand. The supply of such a resource would support development in other important sectors including industry, manufacturing and construction.

The project design and approach to valuation and pricing of environmental resources allows the extraction of a strategically valuable and important energy resource in an already constrained NSW gas market, while still allowing future development of the land.

The local community would benefit economically from the consumption of disposable income generated directly and indirectly through the CGP through the provision of improved gas infrastructure as a direct result of the Project.

The Project would contribute positively to Government initiatives such as the development of coal seam methane resources, the National Greenhouse Strategy, petroleum exploration in New South Wales, and the deregulation of energy markets in Australia.

The provision of additional natural gas to the NSW market to meet existing and future demand may in turn lead to a decrease in the use of less clean fossil fuels such as coal with subsequent benefits for the environment.

The project would utilise and assist in securing the jobs of the existing 35 staff and would ensure the availability of approximately 35 contractor positions for the construction phase.

8.8 Water Quality

The potential for surface and groundwater quality impacts resulting from the proposal were assessed to determine appropriate management and mitigation measures that would be required. As the Stage 2 Concept Area has a history of coal seam gas well development, previous assessments of impacts to surface and groundwater from previous well developments were reviewed for the purpose of this assessment. These include:

- Environmental Impact Statement: Camden Gas Project Stage II, Sydney Gas Operations, 2003;
- Environment, Health and Safety Management Plan: Drilling, Completion and Testing Operations, Sydney Gas Operations, 2006;
- Camden Council Spring Farm Urban Release Area Local Environmental Study, Issue No. 7a, October 2000, Patterson Britton & Partners (PBP, 2000);
- Menangle Park Preliminary Local Environmental Study, September 2004, MG Planning (MG Planning, 2004);
- Environmental Assessment: Razorback Drilling Program, Camden Gas Project Wells RB04 – RB12 PPL4, AGL Gas Production and Sydney Gas Operations, 2006; and
- Environmental Assessment: EMAI Stage II Drilling Program Camden Gas Project Joint Venture Wells EM23 – EM37 PPL1 / PPL4, AGL Gas Production (Camden) and Sydney Gas Operations, 2006.

8.8.1 Existing Environment

Stage 2 Concept Area

The Stage 2 Concept Area is located in the Upper Nepean River Catchment, a sub-catchment of the Hawkesbury-Nepean River Catchment System. The Upper Nepean River Catchment area contains the Nepean, Avon, Cordeaux and Cataract dams and supplies the majority of Sydney's drinking water. The hydrological characteristics of the Stage 2 Concept Area are described below.

Surface Water Quality – the Stage 2 Concept Area has a drainage pattern generally toward the west, with surface flows either directly entering the Nepean River or through creeks and tributaries flowing into the Nepean River. Maximum elevation occurs to the north of the Stage 2 Concept Area, with drainage to the south-east directly into the Nepean River.

Flooding – Flooding events from the Nepean River are relatively common in the Camden region. The land directly to the east of the Nepean River within the Stage 2 Concept Area is relatively low-lying and prone to flooding. Widespread inundation of the local floodplain occurs within a 1 in 3 year flood event, while the 1 in 100 year flood level extends to the border of the Menangle Park Township in the centre of the Stage 2 Concept Area, causing widespread inundation of rural areas surrounding the township.

Groundwater Quality – Hawkesbury sandstone aquifers are located within the Stage 2 Concept Area and are separated from the Illawarra Coal Measures by the Narrabeen Group. The Narrabeen Group contains thick, regionally significant and continuous low permeability shale and claystone units, which effectively forms a hydraulic barrier between the Hawkesbury Sandstone aquifers and the Illawarra Coal Measures, acting as an aquitard. The presence of this natural barrier and the inherently low horizontal permeability of the coal measures themselves are responsible for the low water yield of the coal seam methane extraction process. Previous groundwater data reviewed in respect of previous well developments have stated that the water quality of coal formation waters in the Camden region has been brackish in nature. Fresher water is generally located within the Hawkesbury Sandstone or alluvia, located at a significant distance above the proposed total well depth and isolated by the presence of the Narrabeen Group shales.

Spring Farm

The Spring Farm Project Area is located on the northern bank of the Nepean River floodplain. Drainage lines within the Spring Farm project area flow in a westerly direction joining the Nepean River at the western boundary of the project area. As the Spring Farm Project Area is situated within the Stage 2 Concept Area, the groundwater characteristics are considered to be the same as those described above for the Stage 2 Concept Area. The surface water and flooding characteristics of the Spring Farm Project Area are described below.

Surface Water Quality – A natural creek line runs through the Spring Farm Project area, which is referred to as Spring Creek in previous Local Environmental Studies for the Spring Farm land release area. Spring Creek has two main tributaries with headwaters adjacent to the Camden Bypass and to the north of Richardson Road. The two main tributaries connect just upstream of Springs Road and flow into a large dam, before discharging to the Nepean River. There are also a number of smaller farm dams on the creek (PBP, 2000).

Flooding – The proposed well surface locations within the Spring Farm Project Area are located on the northern bank of the Nepean River. The Spring Farm LES (PBP, 2000) states that the floodplain is located on the southern bank of the River, and as such the proposed well surface locations are not considered to interact with the flood regime of the area.

Menangle Park

The Menangle Park Project Area is located south-east of the Spring Farm Project Area, on the eastern floodplain of the Nepean River. A number of drainage lines are present within the Menangle Park Project Area draining roughly east to west and discharging into the Nepean River. As the Menangle Park Project Area is situated within the Stage 2 Concept Area, the groundwater characteristics are considered to be the same as those described above for the Stage 2 Concept Area. The surface water and flood regime characteristics are described below.

Surface Water Quality – Surface water quality within the Menangle Park Project Area has previously been found to have high faecal coliform counts, likely to be the result of effluent from onsite sewage systems and horses grazing in the area. Turbidity and salinity levels have also been shown to be high (MG Planning, 2004).

Flooding – All creeks and the Nepean River within the Menangle Park Project Area exhibit local flooding. The Project Area is located in close proximity to high hazard floodway areas which extend approximately 350 m from the bank of the Nepean River. Well surface locations are likely to be located within the Howes Creek Floodplain.

8.8.2 Potential Impacts

Operations within the Stage 2 Concept Area, and Menangle Park and Spring Farm Project Areas would be of a similar nature, and therefore potential surface and groundwater quality, and flooding are likely to be similar in both Project and Concept Areas. Potential impacts with respect to water quality have therefore been assessed in relation to phases of development (i.e. construction, production, post development, closure and final rehabilitation).

Surface Water Quality

Potential impacts to surface water quality surrounding well surface locations, gas gathering lines and access roads would be most likely to occur during the construction and production phases of development. Potential impacts during each phase of development are identified in **Table 8-20**.

Table 8-20: Potential Surface Water Quality Impacts

Development Phase	Potential Impacts
Construction	Activities during construction with the potential to impact upon surface water quality in the vicinity of the Project and Concept Areas include earthworks, stockpiling of sediment, drilling and fracture stimulation works. Potential impacts resulting from these works may include: - Increased turbidity of surface waters resulting from erosion and sediment laden runoff as a result of earthworks and construction traffic; - Increased turbidity of surface waters as a result of water and wind erosion of stockpiles, access roads, gas gathering lines and well surface locations; - Contamination of surface waters as a result of accidental spillage of fuel from drilling rigs, support vehicles and passenger vehicles; and - Increased salinity of surface waters resulting from accidental release of saline drill, frac and formation waters during drilling, and from drill pits.

Development Phase	Potential Impacts
Production	Potential impacts to surface water during production may include: • Contamination of surface water caused by flooding of components of infrastructure (such as the metering facility and instrumentation) at proposed well surface locations; • Increased turbidity of surface waters resulting from sediment-laden runoff from well surface locations and access roads; • Contamination of surface waters as a result of accidental spillage of fuel from rigs, support vehicles and passenger vehicles; and • Increased salinity of surface waters resulting from accidental release of saline drill, frac and formation waters from storage tanks.
Post Development	No additional potential impacts to surface water quality have been identified for the post development phase to those already noted above. The potential impacts previously identified are expected to be the same for this phase of the proposal.
Closure and Final Rehabilitation	During the closure and rehabilitation phase, potential impacts to surface water quality may result from the release of sediment-laden runoff, resulting in increased turbidity. Erosion and sedimentation could potentially result from stockpiles of soil and exposed surfaces during the rehabilitation of well surface locations.

Potential impacts associated with the release of saline drilling, frac and formation waters would be minimised by operational and design measures. Drilling and fracture stimulation water required to stimulate the coal seam would be delivered from previous drilling and fracture stimulation campaigns, other approved sources or from licensed stand-pipes in the local area. The delivered volume required for fracture stimulation a well is generally in the order of 200 kL, depending on the frac design and geological parameters. Following fracture stimulation, the waters would be removed from the coal seam and be either reused in future drilling and fracture stimulation campaigns, or transported to licensed disposal facilities if the waters have become too saline during interaction with the coal seam. Disposal at licensed facilities would be in accordance with Department of Environment and Climate Change (DECC) guidelines.

The proposal also includes the installation of a water distribution network co-located within the gas gathering line trenches, where necessary, to allow water to be moved to centralised storage pits or tanks that can act as offsite transport points. The produced water from the wells would be collected at storage points located at well surface locations that are easily accessible. These storage points are the lined drill pits utilised during drilling and fracture stimulation, or storage tanks. The waters would then be transported to future drilling/fracture stimulation operations, disposed of to licensed facilities or other appropriate measure.

In addition, well surface locations would be situated at a minimum distance of 40 m from creeks. Where gas gathering lines and access routes cross a creek bed, one of the following approaches would be taken:

- an appropriate crossing location would be selected across dry creek beds, with gas gathering lines installed and excavated trenches, and the overlying area appropriately rehabilitated; and
- where creeks have permanent flows, underboring would be carried out to install gas gathering lines beneath the creek bed.

Groundwater Quality

Potential impacts to groundwater quality as a result of the proposal include cross-contamination of aquifers during the drilling and operation of wells. However the potential for cross-contamination of groundwater aquifers would be minimised through the use of a pressure-rated steel casing that would provide assurance that communication between aquifers is unlikely as a result of operations. This would also prevent migration of methane into shallow aquifers. All wells are cased-off and cemented in accordance with the requirements of the Department of Primary Industries. The steel casing ensures that aquifers within the other geological formations would thus remain isolated and groundwater cross-contamination would not be likely to occur, which is in accordance with requirements from the NSW Government.

Furthermore, the underlying geology of the region is such that a hydraulic barrier (the low permeability formations of the Narrabeen Group) lies between the Hawkesbury Sandstone aquifers and the Illawarra Coal Measures. The presence of this natural barrier and the inherently low horizontal permeability of the coal measures results in a low water yield from the extraction process, and isolates the two groundwater aquifers inhibiting groundwater flow between the two. Gas production would be severely compromised if water inflow from other formations were to occur, therefore it is best environmental practice is to ensure that no communication is established from the producing zone and the over or underlying water bearing formations.

Flooding

Given the location of parts of the Stage 2 Concept Area on the floodplain of the Hawkesbury Nepean River, there is potential for well surface locations, access roads and gas gathering lines to be located in areas prone to flooding. Potential impacts to the flood regime, and as a result of flooding in the locality may include:

- Localised disruptions to the flow of flood waters resulting due to the presence of plant and infrastructure at well surface locations; and
- Loss of containment of saline formation waters from drill pits during a flood event or following heavy rainfall.

During all phases of development, it is considered that there would be sufficient warning prior to the occurrence of a significant flood event, thereby allowing mobile plant and equipment, if on-site, to be removed from the flood zone. Furthermore, once commissioned generally only permanent plant and equipment would be present at well surface locations during the production phase of development. Equipment at the well surface locations would be minimised during this period. Design measures would allow the wellhead, separator and meter run to be safely submerged for an extended period of time with no risk to the environment or to the infrastructure.

There are also potential impacts associated with loss of containment of saline formation waters from drill pits during a flood event or following heavy rainfall. The volume and quality of water maintained in drill pits would be continuously monitored and bunding would be in place to minimise loss of saline water contained within the drill pit. Drill pits (nominally 25 x 25 x 2-3 metres polyethylene lined) would have a capacity of some 750 kL to allow free space for rainfall events. Drill pits would be constructed with an upslope diversion drain around the site to divert rainwater surface runoff around the pit. This would ensure that only direct rainfall enters the pit. All pits would be lined and designed with adequate capacity to accommodate the water associated with construction and natural rainfall events.

The gas gathering system would be buried to a minimum depth of 750 mm and up to 1,200 mm in some areas below the ground surface. Overlying disturbed areas would be rehabilitated to minimise the likelihood of piping and infrastructure becoming exposed. In addition, design

measures would also be incorporated to ensure that isolation valves on the gathering system would close, isolating each well field and shutting off gas flow to prevent uncontrolled release.

All plant and infrastructure would be inspected and audited following a flood event to ensure that all elements are operating effectively, and necessary rehabilitation works are carried out immediately.

8.8.3 Environmental Safeguards

Surface Water Quality

Potential impacts to surface water quality would be minimised through design measures incorporated into the construction and operational procedures. Drill and frac water management at well surface locations would be carried out generally in accordance with the measures described in **Section 4**, which would be further detailed in EHSMPs prepared for operations. The following mitigation measures would also be implemented specifically to minimise potential surface water impacts as a result of the proposal:

- Soil and Water Management Plans (SWMPs), Emergency Response Plan, Flood Management Plan (where necessary) and EHSMPs would be implemented or updated to minimise impacts on water quality throughout all phases of the development;
- A water management system, including a water distribution network where necessary, would be employed to enable collection, management and appropriate reuse of water produced as a result of the drilling and fracture stimulation processes. The water management system would incorporate the following safeguards:
 - Drill pits would be constructed with an upslope diversion drain around the site to divert rain water surface runoff around the excavation;
 - Drill pits would be constructed with a polyethylene lining to prevent seepage of brackish formation waters to underlying soil;
 - All pits would be designed with adequate capacity to accommodate water associated with construction as well as rainfall events; and
 - Pipelines for the water distribution network where required would be laid alongside the gas gathering pipelines. This would allow for water transfers to centralised storages from drill pits with this water to be reused at other well surface locations for the fracture stimulation process. Excess waters would be disposed of to a licensed disposal facility.
- Produced formation water would be collected into a lined drill pit or storage tank for future reuse in drilling/ fracture stimulation of other wells. Ultimate disposal would be to a licensed disposal facility;
- The exposure of the ground surface to erosion is to be limited to disturbance caused by vehicles using access routes and exposed drill pads. The removal of vegetation shall be avoided wherever possible; and
- At identified creek crossings, such as Howes Creek, the Proponent would construct a crossing to an acceptable standard.

Groundwater

The potential for cross-contamination of groundwater aquifers would be minimised through the use of a pressure-rated steel casing that would provide assurance that communication between aquifers is unlikely as a result of operations. This would also prevent migration of methane into

shallow aquifers. All wells are cased-off and cemented in accordance with the requirements of the Department of Primary Industries, therefore all aquifers within the other formations would thus remain isolated and groundwater cross-contamination would not be likely to occur, which is in accordance with requirements from the NSW government.

Decommissioned and abandoned wells would be filled with cement to further avoid cross-contamination of groundwater once production has ceased. By cementing the wellhead casing to the surface, inundation of the well with water is unlikely to have an impact upon well integrity. Similarly, the risk of water entering the well bore and contaminating groundwater is extremely low.

Flooding

Design measures have been incorporated to ensure that in the event of flooding, operational processes would be set in place effectively isolating the meter run from the gathering system which is operated remotely from the gas plant control room. The wellhead, separator and meter run would be safely submerged for an extended period of time with no risk to the environment or the infrastructure. Warning of significant flooding events would be issued to enable operations on flood-prone land to be made secure.

8.8.4 Residual Impacts

Upon implementation of mitigation measures, residual impacts would be limited to the construction and rehabilitation phases and is not expected to be significant given the distance of the wells from the Nepean River, and the ground cover available to filter soil from surface water flows.

The minimisation of water use is proposed through the re-use of the water from drill pits at other well surface locations, however, excess waste water is likely to be generated and would require disposal to a licensed disposal facility. This is not considered to be a significant impact.

8.8.5 Conclusion

The desktop assessment of surface and groundwater identified that impacts as a result of the proposed development would be limited to surface water impacts from erosion during the construction phase and during rehabilitation of the site. The existing operation of the CGP and potential surface water and groundwater issues associated with the CGP have been managed through SWMPs, Emergency Response Plan, Flood Management Plan and EHSMPs. The assessment considers that potential impacts to be minimal and would be mitigated with the preparation (or update) of the aforementioned documents.

Water use would be minimised through the recycling of drill and frac water for use at other well surface locations before being disposed of according to requirements of the DECC. As such, the issues identified are not considered to represent a significant constraint to the proposed development.

8.9 Flora and Fauna

8.9.1 Overview

HLA ENSR undertook an ecological assessment relating to the proposed development activities within the Spring Farm and Menangle Park Project Areas.

The field investigations focussed on the proposed well surface location, gas gathering lines and access road locations. The study area for each proposed well surface location comprised a circle with a 200 m radius, centred on the well surface location. In cases where the study area was intersected by a road, property boundary or railway line, the study area was reduced to fit within these borders as the final well location would not be placed beyond these barriers. Investigations were also undertaken 25 metres either side of the proposed locations for the gas gathering lines and access roads. Wells and associated infrastructure could therefore be located anywhere within these assessed areas in the knowledge that ecological impacts upon surrounding flora and fauna would be acceptable.

The full details of the assessment are provided in **Appendix G** of this EA and a summary of the key findings is provided in the following sections.

A number of previous reports relating to the Project areas were reviewed as part of the assessment, including:

- *Spring Farm Urban Release Area Local Environment Study*, Camden Council, 2000;
- *Vegetation Assessment: Spring Farm Urban Land Release Area*, Anne Clements and Associates Pty Ltd, 2002;
- *Conservation Implementation Strategy: Spring Farm Urban Land Release Area*, Anne Clements and Associates Pty Ltd, 2002;
- *Fauna and Fauna Habitat Study: Spring Farm Urban Release Area*, Conacher Travers, 2002;
- Environment, Health and Safety Management Plan: Drilling, Completion and Testing Operations, AGL Gas Production (Camden) Pty Limited, 2006;
- Environmental Assessment: Razorback Drilling Program, Camden Gas Project Wells RB04 – RB12 PPL4, AGL Gas Production and Sydney Gas Operations, 2006; and
- Environmental Assessment: EMAI Stage II Drilling Program Camden Gas Project Joint Venture Wells EM23 – EM37 PPL1 / PPL4, AGL Gas Production (Camden) and Sydney Gas Operations, 2006.

8.9.2 Existing Environment

Stage 2 Concept Plan

The CGP Stage 2 area, shown in **Figure 1.2**, has undergone extensive clearing resulting from past and present land uses which include agriculture, residential, infrastructure and quarrying. This has resulted in a modified landscape, with much of the remaining native vegetation degraded and occurring in patches. Stands of native vegetation, including EECs occur scattered throughout the area. Remnants in varying condition of the following EECs occur in the area:

- Shale / Sandstone Transition Forest (Low Sandstone Influence);
- Shale / Sandstone Transition Forest (High Sandstone Influence);
- Cumberland Plain Woodland – Shale Hills Woodland;
- Cumberland Plain Woodland – Shale Plains Woodland;
- River-flat Eucalypt Forest;
- Riparian Forest;
- Moist Shale Woodland; and

- Elderslie Banksia Scrub.

Although much of the remnant vegetation is degraded, it provides habitat for a range of native species. This is particularly the case in the larger vegetation patches and the vegetation lining the Nepean River, which runs through the CGP Stage 2 area.

Project Areas

The existing environments of the Spring Farm and Menangle Park Project Areas are relatively similar. Although located in different LGA's, the Menangle Park Project Area is situated just a few kilometres south east of the Spring Farm Project Area. The study areas for Spring Farm Project Area and Menangle Park Project Area are shown in **Figures 8.5, 8.6 and 8.7**.

Significant vegetation communities identified within the Project Areas include:

- Elderslie Banksia Scrub (EBS);
- River-flat Eucalypt Forest; and
- Cumberland Plain Woodland.

The majority of both project areas have been subject to significant vegetation clearing as a result of past and present farming and quarry activities. In the case of Spring Farm, a vegetation corridor remains along the Nepean River and there are scattered vegetation stands throughout the area as well as a few isolated remnant trees. The remaining vegetation within the Menangle Park Project Area is fragmented and isolated from any significant areas of remnant native vegetation, reducing its habitat value. In both project areas, there are very limited areas in which a diverse native groundcover, shrub and canopy layer occurs. The vegetation stands comprise both native and weed species and the majority of structural layers are dominated by one or two species.

The fragmented nature of the vegetation in both project areas makes it more susceptible to edge effects, such as invasion of weeds, rubbish dumping and polluted stormwater. Polluted stormwater increases the levels of nutrients in soil, affecting native vegetation, which is accustomed to low nutrient levels. In both project areas, there is a strong presence of rabbits, as evidenced by observation of numerous individuals, scats and burrows. Rabbits and other exotic fauna species compete with native species for food and habitat.

Within the Spring Farm Project Area two of the well surface locations are proposed for Camden Council's Gundungurra Reserve, which has been set up to balance the open space and recreational needs with conservation of natural and cultural heritage values of the area. The reserve is proposed to play a role in the ongoing development of the Spring Farm Bush Corridor (SFBC); however, it has not been mapped as part of the corridor (Camden Council, 2004).

8.9.3 Survey Methodology

Desktop Review

A review of online information was undertaken of the following databases prior to field investigations:

- The Department of Environment and Water Resources (DEW) online Protected Matters Search Tool to identify whether matters of National Environmental Significance (NES) occur in the area;
- The DECC online Wildlife Atlas to identify threatened species listed under the *Threatened Species Conservation Act 1995* (TSC Act) previously recorded within a 20 km x 20 km grid centred on the two project areas.

Fauna Habitat

The fauna values of the Survey Areas were assessed based upon habitat quality and condition, including the following:

- The extent of fragmentation of habitat;
- The presence of key habitat features such as hollow-bearing trees, fallen logs, water bodies and the presence of shrub layers; and
- An assessment of whether the preferred habitat for listed threatened species (under TSC Act and EPBC Act) was present.

Trapping and spotlighting was not undertaken as part of the survey.

Flora

The flora investigation was based on an assessment of the following:

- Structural characteristics of the vegetation (based on life forms, approximate height and canopy cover);
- Groundcover characteristics;
- The condition of the vegetation, based on a subjective assessment of the degree of naturalness, level of disturbance and proportion of exotic flora present;
- Extent of weed species; and
- Dominant species in each structural component of the vegetation.

8.9.4 Survey Results

A search of the above mentioned online databases was undertaken as part of the assessment. Database searches for the both Project Areas indicate the following:

- For the Spring Farm Project there are 35 threatened fauna species and 10 threatened flora species that occur within a 20 km x 20 km area centred on the site. A list of these species is provided in the flora and fauna assessment included as **Appendix G**.
- For the Menangle Park Project Area there are 35 threatened fauna species and 10 threatened flora species occurring within a 20 km x 20 km area centred on the site. A list of these species is provided in the flora and fauna assessment included as **Appendix G**.

Table 8-21 provides a list of flora and fauna species for which preferred habitat occurs within the project area.

Table 8-21: EEC, Listed Flora and Fauna Species recorded within the Search Area and for which Preferred Habitat is present within the Project Area.

Common Name	Scientific Name	Status	Preferred Habitat	Project Area which contains Species Preferred Habitat
Endangered Ecological Communities				
Cumberland Plain Woodland		TSC Act: E EPBC Act: E	Occurs on soils derived from Wianamatta Shale, and throughout the driest part of the Sydney Basin. Well adapted to drought and fire, and the understorey plants often rely on underground tubers or profuse annual seed production to survive adverse conditions.	Spring Farm Menangle Park
Elderslie Banksia Scrub		TSC Act: E	Occurs only on sand deposits on the old terraces deposited by ancient river systems of what is now the Nepean River, and requires deep sand soil to fully regenerate.	Spring Farm
River-Flat Eucalypt Forest		TSC Act: E	Found on the river flats of the coastal floodplains. Can occur on smaller floodplains and river flats.	Spring Farm Menangle Park
Flora				
Matted Bush-pea	<i>Pultenaea pedunculata</i>	TSC Act: E1	Grows in dry sclerophyll forest and disturbed sites on a variety of soils on the South Coast and edge of the Southern Tableland, but with disjunct restricted populations on Wianamatta Shale on the Cumberland Plain in N.S.W.	Spring Farm Menangle Park

Common Name	Scientific Name	Status	Preferred Habitat	Project Area which contains Species Preferred Habitat
Small-flower Grevillea	<i>Grevillea parviflora subsp. parviflora</i>	TSC Act: V EPBC Act: V	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks.	Spring Farm Menangle Park
	<i>Persoonia hirsuta subsp. hirsuta</i>	TSC Act: E1	From Gosford to Royal National Park, below 300 m altitude.	Spring Farm Menangle Park
Spiked Rice-flower	<i>Pimelea spicata</i>	TSC Act: E1 EPBC Act: E	Found on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark.	Spring Farm Menangle Park
Fauna				
Gastropods				
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	TSC Act: E1	Cumberland Plain Woodland, grassy open woodland. Under litter of bark, leaves and logs, soil around grass clumps.	Spring Farm Menangle Park
Birds				
Bush Stone-curlew	<i>Burhinus gallarius</i>	TSC Act: E1	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights.	Spring Farm Menangle Park
Glossy Black-cockatoo	<i>Calyptorhynchus lathami</i>	TSC Act: V	Forests and woodlands with abundant casuarina trees, any of about five species.	Spring Farm Menangle Park

Common Name	Scientific Name	Status	Preferred Habitat	Project Area which contains Species Preferred Habitat
Diamond Firetail	<i>Stagonopleura guttata</i>	TSC Act: V	Feeds on the ground. Grassy eucalypt woodland. Also open forest, mallee, Natural Temperate Grassland and secondary grassland derived from other communities. Often found in riparian areas, sometimes in lightly wooded farmland.	Spring Farm Menangle Park
Hooded Robin	<i>Melanodryas cucullata</i>	TSC Act: V	Dry forests, woodlands, mallee, shrublands.	Spring Farm Menangle Park
Barking Owl	<i>Ninox connivens</i>	TSC Act: V	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts.	Spring Farm Menangle Park
Powerful Owl	<i>Ninox strenua</i>	TSC Act: V	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well.	Spring Farm Menangle Park
Mammals				
Yellow-bellied Sheathtail-bat	<i>Saccolaimus flaviventris</i>	TSC Act: V	Forages in eucalypt forests, mallee and open country. Roosts in tree hollows and has been found in the abandoned nests of Sugar Gliders.	Spring Farm Menangle Park

Common Name	Scientific Name	Status	Preferred Habitat	Project Area which contains Species Preferred Habitat
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	TSC Act: V	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures.	Spring Farm Menangle Park
Koala	<i>Phascolarctos cinereus</i>	TSC Act: V	Inhabit eucalypt woodlands and forests.	Spring Farm Menangle Park

TSC Act: V: Vulnerable - the species is likely to become endangered if threats continue, .E1: Endangered Species - the species is likely to become extinct in nature if threats continue, or its numbers are reduced to a critical level, or its habitat is reduced.

EPBC Act E: Endangered – the species is facing a very high risk of extinction in the wild in the near future.

V: Vulnerable – the species is facing a high risk of extinction in the wild in the medium term future

¹ Source: NPWS Online Atlas of NSW Wildlife

Eucalyptus tereticornis is a koala feed tree listed in Schedule 2 of SEPP 44 – Koala Habitat Protection. It was noted during the field inspection that the species is scattered throughout the Project Area, occurring only as isolated individuals. As such, the Project Area does not contain potential or core koala habitat, as defined by SEPP 44.

A summary of the key observations in terms of flora and fauna habitat identified during the field investigation at each proposed well surface location is provided in the table below, with vegetation communities shown on **Figures 8.5, 8.6 and 8.7**.

Table 8-22: Key Findings at each proposed Well Surface Location/ Gas Gathering Line/ Access Route

Study Area	Flora	Fauna Habitat
SF04/ SF04A (NB. Both in the same Study Area)	Largely cleared of vegetation due to previous land use activities (quarry operations). The only significant vegetation stand, Elderslie Banksia Scrub (EBS), lies to the south east of SF04 and to the east of SF04A. EBS is an EEC and described as critically endangered (NPWS, 2006). EBS vegetation connects to a large vegetation corridor to the south, which runs along the Nepean River. Surrounding clear land makes it susceptible to edge effects, particularly weeds. Vegetation stands largely comprise regrowth with some scattered remnant trees. Shrub layer largely comprises regrowth and there is little groundcover.	Much of the canopy layer comprises regrowth or trees which do not generally form hollows. Certain key habitat features are present such as fallen logs and leaf litter, potentially providing shelter for animals such as reptiles and molluscs. The vegetation stands are a potential source of food and shelter for species. The connectivity to a large tract of vegetation (comprises EBS, which is listed as critically endangered (NPWS, 2006)) enhances its habitat value potentially enabling a variety of species to access the area and use its resources. Some isolated regrowth in the cleared areas provides limited foraging and shelter opportunities, mainly for birds.
AR* from Glenlee Road West to SF04/ SF04A and GG** from SF04/SF04A to GL06	Largely cleared to accommodate quarrying activities. AR and majority of GG will follow existing dirt road from Glenlee Road West. The small section of vegetation intersected by GG comprises EBS. Vegetation occurring at the eastern end the Study Area comprises River-flat Eucalypt Forest.	Largely cleared therefore limited habitat value for native fauna. Contains some vegetation which has potential habitat value. Key habitat features including fallen logs and leaf letter.

Study Area	Flora	Fauna Habitat
SF10	Degraded, largely comprising cleared areas with some stands of vegetation. Canopy layer accounts for approximately 30% of Study Area and includes some remnant Eucalypts. The shrub layer covers approximately 60% of the Study Area and is dominated by <i>Bursaria spinosa</i>, a native shrub typical to Cumberland Plain Woodland (CPW) communities. Groundlayer is highly modified majority consists of exotic species. It is fragmented and does not connect to any significant areas of remnant vegetation. Shrub layer is dominated by the native shrub <i>Bursaria spinosa</i>. The assemblage of native species indicates it is CPW, although it is in a degraded state. Due to its degraded state and the presence of exotic species it is not considered likely to regenerate to achieve a 'characteristic native understorey' (Anne Clements and Associates Pty Ltd, 2003).	Habitat value is mainly concentrated around the larger remnant trees, some of which contain hollows and have scattered logs and leaf litter around their bases. The isolated and fragmented nature of the vegetation reduces its value, making it less likely to support viable populations of native species. Lack of connectivity of the vegetation to significant areas of native vegetation means habitat value is reduced.
SF17	The Study Area has been completely cleared of native trees and shrubs and comprises open pasture. Few shrubs present comprise of weed commonly known as African Olive (<i>Olea europaea</i> subsp. <i>Africana</i>). Groundcover contains some native grasses such as <i>Themeda australis</i> (Kangaroo Grass).	Habitat value of the Study Area is very limited. Some species may forage in the grass and the African Olive, such as grassland birds. A small dam within the Study Area is likely to provide a water source for native animals but its habitat value is limited as there is no vegetation within or surrounding it.

Study Area	Flora	Fauna Habitat
SF20	Vegetation includes some regrowth <i>Eucalyptus amplifolia</i> (Cabbage Gum) and <i>Eucalyptus moluccana</i> (Grey Box), covering approximately 10% of Study Area. Shrub layer is dominated by African Boxthorn, a declared noxious weed under the Noxious Weed Act 1993. Ground layer is a continuous cover of exotic grasses. Other species mainly comprise weeds such as Blackberry and Scotch Thistle. Vegetation identified in a previous report as being degraded CPW (Anne Clements and Associates, 2003). The report describes the CPW as being in a degraded state with the presence of exotic species making it unlikely to regenerate to achieve a 'characteristic native understorey' (Anne Clements and Associates Pty Ltd, 2003).	Contains little key habitat features such as included fallen logs, a thick groundcover and native and exotic plant species bearing fruit. May provide foraging opportunities and shelter for native birds, reptiles and small mammals. The habitat value is reduced as a result of the fragmented nature of the vegetation and its isolation from areas of significant remnant vegetation.
AR from Jacks Gully Waste Management Facility road (running north south) to SF17 and SF20.	Existing road, part of the road is dirt comprising some sections of gravel. The remainder is less developed and is visible but overgrown with grass. Majority of AR passes through cleared paddocks. With the exception of some tree and shrub stands, majority of vegetation comprises pasture grasses. AR passes through a patch of shrubs that comprises both <i>Bursaria spinosa</i> (a native) and African Boxthorn, a declared noxious weed under the Noxious Weed Act 1993. A stand of four remnant <i>Corymbia gummifera</i> (Red Bloodwood) is located immediately adjacent to the existing road.	Shrub patches and the remnant eucalypts provide potential habitat. The isolated nature of this vegetation reduces its quality as habitat, with only highly mobile species able to make use of it. May be some foraging value for grassland birds.

Study Area	Flora	Fauna Habitat
AR and GG: SF17 to SF20 and SF10	The identified route for the AR will follow an existing fence line where there is an existing track. The identified route for the GG will fit in with a future arterial road. Majority of vegetation on either side of the cleared track comprises African Olive and African Boxthorn, a declared noxious weed under the Noxious Weed Act 1993. Some Eucalypt species are located immediately adjacent to the proposed track and further afield within the Study Area.	Contains little habitat value in terms of key habitat features. Thick groundcover is present which may provide foraging opportunities and shelter for birds, reptiles and small mammals. The native canopy species and exotic shrub species provide foraging opportunities for birds, arboreal mammals and bats when flowering.
GG (running north west - south east) from SF17 to Jacks Gully Waste Management Facility.	The identified route passes through undulating, cleared paddocks. Vegetation comprises pasture grasses and some scattered African Olive.	Limited habitat value, use restricted to common birds and reptiles which may pass through the area.
MP02	Overall, vegetation is degraded, dominated by weeds with some regrowth of native tree and shrub species. Lacks canopy cover (approximately 15%) comprising a line of eucalypts and a stand of <i>Acacia decurrens</i> (Sydney Green Wattle). Shrub layer is dominated by African Olive, with some <i>Bursaria spinosa</i> also present. Continuous grass cover containing both native and exotic species. The species assemblage suggests that the vegetation in the area was CPW, however is now highly modified.	Lacks key habitat features. Some scattered fallen logs were observed as well as birds in the tree canopy. Some weed species provide a source of food and shelter for birds. Grass areas also provide foraging and sheltering opportunities for some birds, small mammals and reptiles. Habitat value is reduced due to its fragmented and modified state. May support mobile species. It would be difficult for the Study Area and its surrounds to support viable populations of species due to its degraded nature and the presence of a barrier to animal movement in the form of the railway line.

Study Area	Flora	Fauna Habitat
MP03	Study Area has been cleared in the past. Existing vegetation is disrupted by the presence of an existing access road and the underground high pressure gas pipeline and its associated right of way. Canopy species cover is approximately 5% of the Study Area. Contains some scattered Acacia species. African Olive dominates the shrub layer of the Study Area. Ground cover comprises native and exotic grasses.	Habitat features are very similar to those of the MP02 Study Area, with habitat quality even further reduced due to the presence of the railway line and the road. The trees and shrubs present, along with the thick ground cover, would provide foraging, roosting and shelter opportunities for a variety of species. Lack of connectivity of the vegetation to other areas of significant vegetation restricts the species use of the area to those more mobile, such as birds.
MP04	Forms part of a large paddock in which horses are kept. Remnant trees and stands of regrowth cover approximately 40% of the Survey Area. The Study Area lacks structural diversity, comprising only a canopy layer and a degraded ground layer. Canopy trees include <i>Eucalyptus crebra</i> (Narrow-leaved Ironbark), Cabbage Gum and Grey Box. Shrub layer lacks native species and is dominated by African Boxthorn, a declared noxious weed under the Noxious Weed Act 1993.	Degraded key habitat features are present, and may provide habitat for birds, arboreal mammals, reptiles and bats. However, their isolated nature precludes them from supporting viable populations of a diverse range of species.
AR: MP04 to Glenlee Road East	Existing dirt road and remaining areas are completely cleared with the exception of pasture grasses. Proposed AR would pass around the existing vegetation and south of Glenlee Road. Once past the vegetation within the MP04 Study Area, vegetation is limited to isolated paddock trees within 25 metres of either side of the proposed road.	Limited habitat value within 25 m of each side of proposed AR.

Study Area	Flora	Fauna Habitat
GG: MP04 to MP05	Largely cleared with some vegetation stands remaining which contain remnant native species. Stands of regrowth have occurred in the vicinity of the remnant trees. Shrub layer is degraded, comprising various weed species. Ground layer is also degraded, comprising pasture grasses.	Contains key habitat features (generally concentrated around the remnant Eucalypts) which may provide habitat for lizards, birds, bats and arboreal mammals. Habitat value is reduced due to the lack of connectivity with other areas of significant remnant vegetation.
MP05	Size of Study Area significantly reduced as it is located within a triangle bounded by three railway lines. Highly degraded as it has been cleared, levelled and filled. Very little vegetation exists and that which does comprises weed species such as African Olive.	Habitat value of the Study Area is extremely limited.
MP06	Vegetation is restricted to the vicinity of water bodies comprising eucalypts and <i>Casuarina glauca</i> (Swamp Oak). A stand of eucalypts exists in the western section of the Study Area mainly comprising Cabbage Gum. Very little structural diversity as a result of clearing, with the exception of some remnant Cabbage Gum from which the regrowth has occurred. The few shrubs in the Study Area are African Olive.	Remnant trees and the water bodies contain key habitat features which provide potential habitat for a variety of species. Vegetation surrounding and within the small dam and the drainage line provides foraging and sheltering opportunities. The dam itself provides habitat for frogs, reptiles and aquatic birds. The quality of the habitat is somewhat reduced due to its isolation, making it difficult for viable populations to establish.
AR and GG: MP06 to MP05	The proposed AR and GG are to be located along an established gravel and dirt road. The area has been cleared and remaining vegetation comprises groundcover with some scattered African Olive.	African Olive may provide foraging opportunities and shelter for small birds.
AR MP06 to MP11	Located along existing gravel road. Study Area has been cleared with some scattered African Olive present.	None present.

Study Area	Flora	Fauna Habitat
MP11	Majority of Study Area has been cleared with groundcover comprising pasture grasses. Various weed species in the cleared area including Paterson's Curse, Fireweed and Scotch Thistle. A stand of vegetation is located in the south west of the Study Area and lining the creek line. Canopy layer covers approximately 5% of Study Area and comprises Swamp Oak and Willow. Shrub layer is sparse and is entirely comprised of weed species. Highly degraded groundlayer.	Very limited habitat value due to the lack of key habitat features. Species likely to use the Study Area for foraging or sheltering purposes are restricted to birds which feed and shelter in the Blackberry and the Swamp Oak.
AR and GG: Racecourse Avenue to MP11	Proposed located is along an existing dirt road, adjacent to the railway line. Area has been cleared with remaining vegetation consisting of a degraded groundcover of mainly weed species.	None present.
MP19	Vegetation is restricted to the creek line, with the remainder of the area being cleared paddocks with one isolated paddock tree. Canopy layer covers approximately 25% of the Study Area, exclusively comprising Swamp Oak. Shrub layer comprises weed species. Vegetation along the drainage line is in good condition, however the lack of structural and species diversity indicates that overall, it is degraded.	The small dam containing weeds and the dense tree cover close to its edge provides potential habitat, mainly for birds, reptiles and frogs. This dam does not constitute the habitat for threatened species listed in Table 8-21. The Swamp Oak lining the drainage line may provide foraging and shelter opportunities for some bird species.
AR Glenlee Road East to MP19	This AR is one of two options for accessing MP19. Highly degraded area as it has been cleared and horses are kept in the paddock. Also a strong rabbit presence. Degraded groundcover with some scattered African Olive and Boxthorn.	The groundcover and the shrub species may provide limited foraging opportunities and shelter for small birds.

Study Area	Flora	Fauna Habitat
AR and GG MP11 to MP19	Proposed to follow an existing dirt road. The area has been cleared and vegetation remaining is limited to a degraded groundcover of exotic species.	None present.
MP22	Vegetation in the vicinity of the drainage line contains structural and species diversity, with remnant and regrowth canopy species present, along with a shrub layer and a continuous groundcover. In other sections of the Study Area there are vegetation stands are isolated paddock trees including species such as Grey Box and Cabbage Gum. Canopy species covers approximately 50% of the Study Area and include Grey Box and Swamp Oak. The species assemblage indicates the vegetation is CPW. The canopy layer is in good condition, however, the shrub and ground layers are degraded. The vegetation community towards the eastern section of the Study Area, along the drainage line, is likely to have once comprised River-flat Eucalypt Forest, however, it is now highly degraded with very limited species and structural diversity.	Canopy species provide potential habitat for birds, arboreal mammals and bats. Fallen logs and patches of leaf litter provide potential habitat for reptiles and potentially for <i>Meridolum corneovirens</i> (Cumberland Plain Land Snail). The small dam in the Study Area may provide habitat value for frogs, reptiles and aquatic birds, however, its habitat potential is reduced as vegetation is not present within or surrounding it. The canopy layer provides foraging and sheltering opportunities and, particularly in and around the large remnant eucalypts, there are fallen logs, branches and scattered patches of leaf litter.
MP23	Study Area contains both cleared areas, with native and exotic groundcover and stands of native vegetation. The native vegetation stands comprise Grey Box and Cabbage Gum and cover approximately 40% of the Study Area. Canopy comprises some remnant trees with the remainder being regrowth. Shrub layer contains some Acacia species, but mainly comprised of weeds. The species assemblage indicates the vegetation is CPW, however, it is highly degraded, particularly in the shrub and ground layers.	Habitat value is fairly limited as there are few remnant trees in which features such as hollows have developed. Native vegetation provides foraging and shelter opportunities for birds, bats and arboreal mammals. Weed species, such as Blackberry, also provide food and shelter for bird species.

Study Area	Flora	Fauna Habitat
MP21	The majority of the Study Area has been cleared, containing only a grassy cover and scattered weeds. Vegetation in the vicinity of the drainage line contains structural and species diversity, with remnant and regrowth native canopy species present, along with a shrub layer and a continuous groundcover. Canopy species covers approximately 50% of the Study Area and include Grey Box and Swamp Oak. The species assemblage indicates the vegetation is CPW. The canopy layer is in good condition, however, the shrub and groundlayer are degraded. The vegetation community towards the eastern section of the Study Area, along the drainage line, is likely to have once comprised River-flat Eucalypt Forest, however, it is now highly degraded with very limited species and structural diversity.	Canopy layer provides foraging and shelter opportunities and, some key habitat features exist particularly in and around the large remnant eucalypts. These features provide foraging and shelter opportunities for various species.
AR and GG: MP19, MP21, MP22 and MP23	Sections of vegetation contain structural and species diversity, with remnant and regrowth canopy species present, along with a shrub layer and a continuous groundcover. Other sections contain a canopy of remnant trees scattered amongst regrowth and a weedy shrub layer. In some sections, the species assemblage indicates the vegetation is CPW. The canopy layer is in good condition, however, the shrub and groundlayers are degraded. Sections of the access road will be located within the vicinity the drainage line that runs through this area, affecting both cleared land and stands of vegetation.	Canopy species provide potential habitat for birds, arboreal mammals and bats. Presence of key habitat features provides potential habitat for reptiles and for <i>Meridolum corneovirens</i> (Cumberland Plain Land Snail). Habitat value is reduced due to its lack of connectivity with significant patches of remnant vegetation, making it unlikely to support viable populations of native species. Swamp Oak that lines the drainage line would provide foraging and shelter opportunities for some bird species. The Glossy Black-cockatoo (threatened species under TSC Act) may feed on Swamp Oak occasionally.
MP24	Completely cleared of vegetation with only a degraded groundcover remaining.	The habitat value is extremely limited. Grassland birds may visit the area to forage in the grass, although this is quite degraded and unlikely to provide much food.

Study Area	Flora	Fauna Habitat
AR: Cummins Rd to MP21 and MP23	Majority of Survey Area comprises cleared paddocks with grassy groundcover. Isolated mature eucalypts exist, along with stands of healthy vegetation covering less than 10 percent of the Survey Area. Stands of vegetation lack structural diversity. Species assemblage indicates the vegetation is CPW, however, it is degraded, particularly in the shrub and ground layers.	Isolated mature eucalypts and the canopy trees within the vegetation stands provide foraging and shelter opportunities. Remnant eucalypts are likely to contain key habitat features such as tree hollows, fallen logs and leaf litter. These features provide foraging and shelter opportunities for common birds, bats and arboreal mammals. Features such as tree hollows are the preferred habitat of threatened species such as the Yellow-bellied Sheath-tail-bat and the Eastern Freetail-bat.
AR and GG: Menangle Road to MP24	Part of this route is proposed to be located along an existing dirt road. The remainder of the proposed route will be located over two paddocks that is completely cleared of vegetation, with only pasture grasses remaining.	None present.
MP33	Majority of area has been cleared and is used for horse agistment. Small patches of vegetation exist however these are comprised of weed species such as <i>Ligustrum lucidum</i> (Large-leaf Privet), <i>Ligustrum sinense</i> (Small-leaf Privet) and Blackberry. Vegetation stands are dominated by Large-leaf Privet.	Very little fauna habitat. Stands of Large-leaf Privet are used by birds for foraging and shelter; however, they would not support any viable populations within themselves.
AR: Menangle Road to MP33	The proposed access road is located in a cleared paddock along an existing dirt road. Vegetation consist of some isolated paddock trees and stands of Large-leaf Privet as a drainage line which the access road will cross.	None present.

Note: *Access Roads, **Gas Gathering line.

8.9.5 Potential Impacts

In determining the potential ecological impacts associated with the well surface locations, gas gathering lines and access roads, the following factors have been assessed:

- The potential impact on species that are listed under the provisions of the TSC Act and EPBC Act;
- The potential impact on populations that are listed under the provisions of the TSC Act;
- The potential impact on ecological communities that are listed under the provisions of the TSC Act and EPBC Act; and

- Key threatening processes.

Potential impacts can include direct disturbance or removal of native flora, fauna and ecological communities. It can also include more indirect impacts in which habitats are disturbed or modified, affecting the ability of flora and fauna to maintain viable populations. Disturbances to habitat include clearing of native vegetation, particularly hollow bearing trees, removal of logs and leaf litter and allowing contaminated runoff to enter water bodies.

Well Surface Locations

Potential impacts in the proposed well surface locations are likely to be minimal as the final well locations will generally be chosen to avoid significant areas of vegetation and would be located in areas that are already cleared and degraded wherever possible. AGL has indicated that even within the construction footprint, which is up to 10,000m² mature trees would not be felled and the majority of the ground cover will remain. Thus, impacts to the factors outlined above are expected to be minimal. In addition, other constraints such as archaeological or geological issues may also require the well surface locations to be shifted within the 200 m radius of the Study Area. In this event, identified constraints will be considered and the well surface location shifted within the Study Area accordingly. It is considered that given the existing environment of the area, in that it has been subject to extensive clearing and degradation resulting from previous land uses, it is likely that there is significant scope to avoid adverse impacts.

The major impacts to the factors outlined above are already apparent within the two Project areas. This is due to the isolated and fragmented nature of the remaining vegetation, making it prone to further degradation resulting from edge effects, encroachment of weed and pest species and increased nutrient levels from urban runoff. Some clearing of introduced flora primarily African Boxthorn, a declared noxious weed under the Noxious Weed Act 1993, from the understorey would be required at SF20 and potentially at the creek crossing(s) for gathering at Menangle Park, however, will be of a minor nature. The works associated with well installation are unlikely to significantly add to these impacts as clearing of native vegetation would be minimal. The initial rehabilitation of the well surface locations with native species following the construction phase is likely to improve the area.

Access Roads and Gas Gathering Lines

The potential impacts associated with the construction and operation of the access roads and gas gathering are very similar to those associated with well installation. Ecological impacts are likely to be minimal as the majority of the roads and gas gathering are proposed to be located along existing roads and tracks or in a few cases in existing cleared areas. Thus, clearing of native vegetation is unlikely to be required. If the removal of some trees is unavoidable, it is considered that this would not pose a significant impact to the ecological communities present in the project areas.

Where access roads and gas gathering lines deviate from existing roads and tracks or are proposed to cross drainage lines or swampy areas, SWMPs and EHSMPs would be prepared to minimise potential impacts to drainage lines surrounding habitat.

Impacts to Threatened Species, Populations and Endangered Ecological Communities

Table 8-21 identifies the species for which habitat occurs in the Spring Farm and Menangle Park Project Areas. While potential habitat occurs in the Study Area for a variety of species, it is unlikely that viable populations of native species are supported as the vegetation is fragmented and lacks connectivity to areas of significant remnant vegetation. Furthermore, as the proposed works would occur in areas that are already disturbed, further disturbance to areas containing potential habitat for threatened species would be avoided.

There are no threatened populations which occur in the Project Areas.

Three Endangered Ecological Communities (EEC) have been identified as occurring in the Project Areas; EBS, Cumberland Plain Woodlands (CPW) and River-flat Eucalypt Forest. The proposed works at MP21, MP22 and MP23 have been situated to avoid areas of vegetation and as such, areas containing EBS, CPW and River-flat Eucalypt Forest will be avoided. Clearing of mature trees and other vegetation occurring within the construction footprint would not be required and as such, impacts to EECs are likely to be avoided.

Key Threatening Processes

The proposed works do not constitute a Key Threatening Processes (KTP) and are unlikely to increase the impact of an existing KTP. Existing KTPs at the Spring Farm and Menangle Park Project Areas include:

- Clearing of native vegetation; and
- Competition and grazing by the feral European rabbit.

The occurrence of these KTPs has resulted in the degraded nature of the vegetation and landscape in the project areas. The proposed works will be undertaken in areas that are already disturbed and where further clearing is unlikely to be required. The works are also unlikely to increase the impact of the feral European rabbit, which is already well established in the area.

Stage 2 Concept Area

Ecological impacts associated with the Stage Concept Area will be the same as those identified for the Menangle Park and Spring Farm Project Areas. Based on ecological studies undertaken in respect of the Menangle Park and Spring Farm Project Areas, it is anticipated that impacts to flora and fauna as a result of the proposed activities within the Stage 2 Concept Area can be minimised through the careful siting of well surface locations, gas gathering lines and access roads based upon detailed ecological assessments to be undertaken in the Stage 2 Concept Area as part of subsequent project applications.

The locating of future well surface locations would follow a staged process. The first stage would be to site well surface locations in disturbed areas in the first instance. Should this siting not be available to the Proponent, the second stage of siting would be to liaise with relevant landowners regarding an acceptable well surface location. The third stage of locating well surface locations would be to implement general locational guidelines.

The location guidelines are as follows:

- Well surface locations are to be generally sited in areas which are already cleared of vegetation or have been subject to previous disturbance wherever possible;
- Well surface locations are to be chosen to avoid areas of significant vegetation or potential habitat including threatened species, threatened populations and endangered ecological communities;
- Well surface locations are to avoid further fragmentation/ isolation of existing remnant vegetation wherever possible;
- Well surface locations are to avoid areas of riparian vegetation and other areas of identified environmental sensitivity wherever possible;
- Minimisation of creek crossings;
- Gas gathering line and access routes are to follow existing tracks and disturbed areas and generally are to be sited in areas already cleared or disturbed wherever possible;

- The routes of gas gathering lines and access roads are to be chosen to avoid further disturbance and any areas of significant vegetation or potential habitat including threatened species, threatened populations and endangered ecological communities; and
- Determination of well surface locations, gas gathering line and access routes are to be informed by detailed ecological investigations carried out in the Stage 2 Concept Area.

8.9.6 Mitigation Measures

It is anticipated that the ecological impacts associated with the proposed works will be minimal provided that final well surface locations are chosen to avoid areas of significant vegetation. In order to manage the works to prevent further degradation to the remaining native vegetation and habitats within the Spring Farm and Menangle Park Project areas, the following mitigation measures are recommended:

- Construction footprint to be kept to a minimum;
- Avoid spread of weeds by ensuring vehicles remain on designated roads;
- If an animal is inadvertently injured, call WIRES or a local wildlife care group;
- Rehabilitate the construction footprint using endemic species; and
- Enhance local environmental values by rehabilitating in accordance with best practice guidelines such as *Recovering Bushland on the Cumberland Plain* (DEC, 2005) and applicable local management plans such as the *Gundungurra Reserve Plan of Management* (Environmental Partnership Pty Ltd, 2004).

As the degree of potential disturbance for the proposed development was found to be higher at certain Study Areas, additional mitigation measures to be implemented for these areas have been provided.

The mitigation measures to be implemented at specific sites, in addition to those identified above, are provided in the table below.

Table 8-23: Study Areas for Which Additional Mitigation Measures Apply

Further Mitigation Measure	Applicable Study Areas
Avoid clearing of native vegetation, particularly remnant trees, EBS and CPW.	SF04, SF04A, SF10, SF20, MP02, MP03, MP04, MP06, MP19, MP22, MP23, MP21
	Access Road and Gas Gathering Line: SF04/SF04A to GL06
	Access Road: Jacks Gully Waste Management Facility road to SF17 and SF20
	Access Road: MP04 to Glenlee Road
	Gas Gathering Line: MP05 to MP04
	Access Road and Gas Gathering Line: MP19, MP22, MP23, MP21
Install erosion and sediment control measures around all construction work and (where appropriate) adjacent to roads to prevent contaminated runoff entering water bodies and affecting their health	Around all construction work

Further Mitigation Measure	Applicable Study Areas
Clearly identify or fence off significant habitat trees and EECs.	SF10, SF20, MP02, MP03, MP04, MP06, MP19, MP22, MP23, MP21
	Access Road: Jacks Gully Waste Management Facility road to SF17 and SF20
	Access Road: MP04 to Glenlee Road
	Gas Gathering Line: MP05 to MP04
	Access Road: Cummins Rd to MP21 and MP23
	Access Road and Gas Gathering Line: MP19, MP22, MP23, MP21

8.9.7 Residual Impacts

The proposed well surface locations have been generally sited in areas that are already cleared and degraded, largely due to past and present agricultural and mining activities. Additional disturbances to flora and fauna and potential habitats directly resulting from the proposed development are expected to be minimal.

General mitigation measures have been identified to minimise further degradation and disturbance of habitats resulting from the proposed activities. The potential degree of degradation is higher at certain proposed well surface locations. In order to manage this issue, additional mitigation measures have been provided for these sites.

The ecological assessment has found that with the appropriate mitigation measures in place, as described in this chapter, the proposed development will not impact significantly upon remaining vegetation or habitats within the Study Areas.

8.9.8 Conclusion

The ecological assessment undertaken in respect of the proposed works within Spring Farm and Menangle Park, for which Project Approval is being sought, indicates that provided that the recommended mitigation measures are implemented, it is unlikely that the proposed activities will result in further degradation to vegetation or habitats within both the Spring Farm and Menangle Park Project Areas. For ecological impacts associated with the Stage 2 Concept area, the impacts on flora and fauna are generally the same as those identified in the Menangle Park and Spring Farm Project Areas. Location guidelines are to be used in consideration of the siting of well surface locations. These guidelines will be further detailed in an ecological assessment undertaken as part of subsequent project applications within the Stage 2 Concept Area and provided this is undertaken the proposed activities within Stage 2 Concept Area are not likely to result in significant adverse impacts on flora and fauna within the Stage 2 Concept Area.

8.10 Landscape and Visual Amenity

8.10.1 Introduction

The identified visual receptors in this chapter are applicable for both the Concept and Project applications. To address the requirements of both approvals being sought, a general visual

description of the region in which Stage 2 is located and the potential visual impacts arising from the proposed development are identified and addressed in this chapter. In addition, a detailed assessment on the proposed well surface locations within the Spring Farm and Menangle Park areas is also provided.

8.10.2 Existing Environment

Stage 2 Concept Area

The landscape of the Stage 2 area is predominantly gently undulating land with several locally dominant ridges including Razorback in the south west and Narellan Vale in the north-east. The Nepean River dissects the Concept Area in the northeast adjacent to Elderslie along the southern boundary of the Spring Farm Project Area and then it continues through the centre of the Concept Area and along the western and southern boundaries of the Menangle Park Project Area.

The Stage 2 Concept Area is currently largely comprised of rural-residential land uses with concentrations of residential development at the northern, north-eastern and north-western fringes of the site. Located within the rural-residential land use areas of the Concept Area are small farms and rural homesteads (some of which are heritage listed, see **Section 8.12**). Also located within these landuses and forming part of the visual landscape are existing producing gas wells and gas plants. These elements of gas producing infrastructure are located in the centre and south western portions of the Stage 2 Concept Area.

Other major infrastructure features located within the Stage 2 Concept Area include the Main Southern Rail Line and major roads such as the South-Western Freeway and Narellan Road with some sub-regional roads which include the Camden Valley Way, Camden Bypass, Remembrance Drive and Appin Road.

Mount Annan Botanical Gardens is also located within the Stage 2 Concept Area comprising 416 hectares of hills and lakes and is located north of the Menangle Park Project Area. The Botanical Garden is a popular event venue and a significant tourist attraction for the region.

Spring Farm Project Area

The Spring Farm Project Area is located within Camden LGA and situated within a rural-residential area which adjoins concentrated residential development areas to the northeast and northwest. The existing landscape characterisation is semi-rural, however, land has been earmarked for future urban (residential, commercial and industrial) development. Therefore it can be expected that the landscape character would change significantly in the future. The Project Area is located on a floodplain which rises to the northeast away from the Nepean River. The visual amenity of the Spring Farm Project Area itself is defined by previous and current agricultural operations consisting of cleared lands with small pockets of mature trees/ vegetation and rural homesteads (see **Section 8.9**). Riparian vegetation located along the banks of the Nepean River contributes to the rural visual setting of the Project Area and there are elements of major infrastructure located within the vicinity including the Jack Gully's Waste Management Facility and the Nepean Substation.

Menangle Park Project Area

The Menangle Park Project Area falls within the Campbelltown LGA and is located within the Nepean River floodplain. Similar to the Spring Farm Project Area, the existing landscape character is of a semi-rural nature, however, land has been identified as a future urban release area. Therefore it can be expected that the landscape character would change significantly in the future.

The majority of the land within the Menangle Park Project Area is generally flat and significantly cleared of vegetation as a result of previous and current land uses. The visual landscape is

characterised by agricultural operations amongst built form elements comprising of railway infrastructure running through the centre of the Project Area (Main Southern Railway Line), the township of Menangle Park (in the centre of the Project Area), the Menangle Park Raceway located between the Nepean River and the Menangle Park township, the Glenlee Coal Washery in the north west and the Menangle Park Sand and Soil operation located on the southern boundary of the Project Area. Additional areas within the Project Area will be subject to future sand mining activities prior to urban development. There are existing producing coal seam gas wells located in the Raceway in the west of the Project Area. Whilst the visual landscape largely comprises these agricultural and infrastructure elements, the riparian vegetation located on the banks of the Nepean River also contributes to the visual landscapes of the Project Area.

8.10.3 Potential Visual Impact

The proposed development involves a number of phases which include:

- Construction;
- Production;
- Post Development; and
- Closure and Rehabilitation.

The visual impact of each of these phases is described below.

Construction of Well Surface Locations

The construction footprint of the well surface location is generally up to some 10,000 m² which is later reduced to an area of up to around 45 metres by 45 metres during the first phase of production when the drilling and construction activities are complete. It may include structures such as water storage tanks. The worst case scenario assessed for construction activities at one well surface location is for a period of up to 12 months. Potential construction impacts relate to the preparation of the site and construction of the wellhead and drilling and fracture stimulation operations where required. Construction activities include earthworks such as topsoil stripping and excavation, drilling and associated processes and trenching associated with the establishment of gas gathering line as described in **Section 4**.

During various construction phases drilling and frac equipment (if required), along with general earthmoving equipment would be present at the well surface location when required. Some of this equipment is large in size, for example the drilling rig can be up to 30 m in height and therefore may be visible from surrounding areas. Given the scale of equipment, the size of the construction footprint and potential construction period, of the four phases of development, the visual impacts associated with the construction phase would be the most significant. However, construction activities will be temporary and finite and as such the impacts will not be permanent.

Construction of Access and Gas gathering

Construction activities related to the gas gathering system are mobile and will move between about 300 m and 400 m per day depending on the terrain of the area. Further the proposed well surface locations would be a minimum of 200 m from the existing nearest concentrated residential development at the time of construction.

Potential visual impacts associated with the access roads and gas gathering lines are directly related to the construction period. Whilst the laying of the gas gathering system would strive to avoid removal of vegetation, there may be some instances of vegetation removal. Wherever possible, existing access roads would be used, with the gas gathering system to be constructed along the existing road edge in order to minimise disturbance. Where this is not possible, the

proposed route has taken into account previous disturbance of the land so that further disturbance and clearing is minimised.

Construction activities for the additional access roads and gas gathering line would be mobile and would not be present at one location for an extended period of time. Upon completion, the gas gathering system would be below ground and the surface of the land returned to its pre-production condition or better. Pipeline warning signs would be located at regular intervals along the gathering system and only visible at close range.

The construction or upgrade of the access roads where necessary, would typically involve a grader and an excavator. Upon completion of the road, this construction equipment would be removed from the site.

Production

Upon completion of construction, the commissioning of the well surface location requires a 45m x 45m footprint. The footprint of a producing well surface location would typically be up to some 20m by 20m with the well head generally being secured by normally 2 m high fencing or in some cases an enclosure. Depending on acoustic attenuation for the proposed well surface locations, the most appropriate fencing or enclosure material would vary between surface locations and would be consistent with the other existing wells scattered throughout the Stage 2 Concept Area. It is also considered that the fencing or enclosure is consistent with rural infrastructure such as sheds and outhouses.

Within the Spring Farm Project Area, the nearest residential development to a well surface location is anticipated to be between 30 to 40 m based on currently available plans with the exception of SF04A. The enclosure of the well will be designed to form part of the future urban landscape in consultation with the landowner.

For Menangle Park, as the planning of future urban (residential, commercial and industrial) land release areas is not as advanced as Spring Farm, little residential development is predicted to occur within 200 m of a well surface location during the lifetime of the majority of the well surface locations.

Landscaping and vegetation planting would commence at the end of the construction phase with the initial rehabilitation works undertaken in consultation with the landowner. These plantings will continue to be monitored and maintained throughout the life of the well surface location. This would provide screening of the surface location and would also be consistent with the surrounding environment and as such, design and use of materials for the enclosure and/ or fencing would vary. For example in open rural areas, wire mesh fencing may be most appropriate when in areas near residential development, solid steel fencing or an enclosure may be required similar to that shown in **Figure 4.6**.

Work over and maintenance activities would generally require the use of purpose-built, trailer-mounted rig structures and associated equipment such as generators and heavy vehicles, which may be visible from surrounding areas, however, these activities would be infrequent.

Generally, the work over and maintenance activities are short-term and would only be visible to receptors within the areas designated for future urban (residential, commercial and industrial) development or open space due to the contrast in landscape character and potential close proximity. Work over maintenance would involve the use of a rig that has a telescopic mast of approximately 30 m. However, work over activities generally require a team of up to ten personnel and would typically vary between one day and one week.

During production, as the footprint size is reduced and landscaping and vegetation planting is underway, visual impacts of the development are also reduced. The visual impacts are not

considered significant given the existence of forms of the same scale in the existing visual context, provided the appropriate materials are used and landscaping (where required) is undertaken. Materials used would be consistent with the existing landscape character and would be selected following landowner consultation.

Post-development

Re-fracture stimulation and infield compression would require the use of rigs and associated equipment such as generators and heavy vehicles. These may be visible from surrounding areas however, these activities would be infrequent.

Generally, the short-term post development activities would be visible to receptors within the areas designated for future residential development and/ or open space, due to the contrast in landscape character and relatively close proximity.

Closure and Final Rehabilitation Phase

The closure and final rehabilitation of a well surface location is expected to occur after some 10 - 15 years in the case of typical wells. Closure and final rehabilitation involves the removal of the wellhead infrastructure, cement capping of the wells and final rehabilitation of the site. Heavy vehicles and earthworks equipment would be utilised and may be visible from surrounding areas, however, the works would typically only take up to 3 weeks. Final rehabilitation activities would be designed to return the surface location to pre-production land use or better or to a condition agreed with the landowner.

8.10.4 Visual Receptors

Given the locations for the proposed well surface location development as shown in **Figures 4.1, 4.2 and 4.3**, the potential visual receptors, subject to distance and vegetation density and height, would include:

- Motorists travelling along surrounding major roads and sub-regional roads;
- Employees/ passengers associated with trains travelling on the railway line;
- Rural residents and their visitors;
- Future urban residents and future commercial/ industrial employees and their visitors;
- Employees and visitors associated with the sand mining activities in the area;
- Employees and visitors associated with the Jacks Gully Waste Management Facility;
- Future joggers/ walkers; and
- Employees and visitors associated with Mt Annan Botanical Gardens.

Due to the fact that the operational life of the proposed development is potentially in excess of 15 years, the future urban release areas of Menangle Park and Spring Farm require consideration for potential visual impacts from the proposal. The visual receptors would comprise future residents and their visitors within these future release areas.

MP02 and MP03 are located on land occupied by UWS (Campbelltown campus) where potential visual receptors would generally include students, staff and visitors associated with the University and related facilities including a gym and a driving range. As discussed in **Table 8-24**, significant variations in topography and relatively dense vegetation exists within the study area providing significant screening particularly to the north, north east and north west of the proposed well surface locations. In addition the proposed well surface locations are located

a reasonable distance from the University academic area, driving range and gym. Given the existing vegetation, varying topography and separation distances, it is considered that the proposed well surface locations and ancillary works are unlikely to be visible from the university and associated facilities. Therefore, students, staff and visitors associated with the University and related facilities are not further considered as a potential visual receptor for the proposed development.

8.10.5 Visibility Assessment

The potential for the proposal to impact upon the visual environment would be dependant on the visibility of the activities involved in the site preparation and construction of the proposed well surface locations and the impact of the production phase structure on the environment. The Visual Absorption Capacity of the landscape of the site affects the extent to which the proposal would impact upon the landscape.

Visibility

Visibility is a measure of the degree to which the construction activities and the final structure may be visible from the surrounding area, the relative number of viewers, the period of the view, the proximity of the view and the type of view. The following assumptions were made in undertaking an assessment of the visibility of the proposal:

- If the number of people who may see the proposal is low then the visual impact is lower than if a large number of people would view the proposal;
- The further away a viewer is would limit the impact the proposal would have on the viewer; and
- If a portion of the proposal is not visible from a particular location then the potential visual impact is considered to be zero.

It is also noted that atmospheric factors can affect the level of visibility of a feature in the landscape.

As previously discussed visual impacts are most significant during the construction phase. For the visibility assessment the sensitivity rating is based on all phases from construction to closure and final rehabilitation. However, it is important to note that as landscaping and initial rehabilitation works are completed at the end of the construction phase, visual impacts are reduced in subsequent phases. Another contributing factor to a reduction in visual impacts following construction is related to the size and scale of equipment required for a producing well footprint being considerably less than what is required during construction. Therefore as the footprint and scale of equipment decrease so too do the visual impacts. **Table 8-24** presents a worst case scenario (i.e. construction phase) sensitivity rating at each well surface location.

Visual Absorption Capacity

Visual Absorption Capacity has been defined as:

An estimation of the capacity of the landscape to absorb developments without its character being significantly changed or its scenic quality reduced (Gosford City Council, Development Control Plan No.89, Scenic Quality, Nov.1996).

Visual Absorption Capacity is for the most part dependent on the landform and vegetation cover in the immediate area. For example, it is usually considered that coastal areas have a low Visual Absorption Capacity due to their potential for water views, and flat or gently undulating open forest generally has a higher capacity to visually absorb development than steeper cleared ridges or slopes.

Another element to be considered is the level of visual contrast between the existing components of the landscape and the proposed new project. For example, if an area is undeveloped then the capability of the area to visually absorb a prominent development is lower than an area that already contains similar forms of development.

HLA undertook a field inspection of the proposed well development sites and current surrounds within the Spring Farm and Menangle Park Project Areas, located within Stage 2 of the CGP. The inspection was undertaken in late October 2006 to determine the visual catchment of the area and viewpoints from which the proposed development and associated construction activities would potentially be visible.

Visibility Assessment

The visibility assessment considers the visibility and visual absorption capacity discussed above for each surface location and allocates each with a visual sensitivity rating of high, medium or low, where a high sensitivity rating indicates significant visibility of the proposed works and low indicates minimal to no visibility. In addition, as visual impacts to residents are considered to be the most significant, a proposed well surface location that is located within close proximity to residential development a higher sensitivity rating is likely to apply. The visibility assessment includes a worst-case scenario during construction with machinery and vehicles required on site simultaneously.

Table 8-24 provides the results of the visibility assessment.

Table 8-24: Visibility Assessment

Proposed Surface Location	Category of Viewer	Likely period of view	Level of Visibility	Sensitivity Rating
Menangle Park Project Area				
MP33	Motorists travelling along Hume Highway	Variable, depending on speed of vehicles	Limited due to the Hume Highway being located on elevated land, also some scattered vegetation along road edge provides some intermittent views	Low
MP24	Residents and their visitors located north-north east	Residents may have extended periods of view	Limited, due to distance from well surface location and vegetation surrounding the residence	Low - Medium

Proposed Surface Location	Category of Viewer	Likely period of view	Level of Visibility	Sensitivity Rating
	Residents and their visitors located south west	Residents may have extended periods of view	Limited, due to significant distance from well surface location and moderate vegetation surrounding the residence	Low
	Employees/passengers associated with trains travelling on Southern Railway Line	Variable depending on speed of train	Intermittent views due to existing vegetation along the railway line edge and distance to surface location	Low
	Employees and visitors associated with Sand and Soil Quarry south west of MP24	Employees/visitors may have extended periods of view	Limited, due to distance and some soil stacks related to quarry	Low
MP02	Employees/passengers associated with trains travelling on railway line to the south	Variable, depending on speed of train	Very limited, intermittent views due to topography and dense vegetation existing on and surrounding the surface location	Low
	Motorists travelling along Menangle Road, south of MP02	Variable, depending on speed of vehicle (speed limit in this area is 80km/hr)	Very limited, intermittent views due to topography and dense vegetation existing on and surrounding the surface location	Low

Proposed Surface Location	Category of Viewer	Likely period of view	Level of Visibility	Sensitivity Rating
	Residents of Glen Alpine south and south east	Residents may have extended periods of view	Limited, due to distance, topography and significant vegetation	Low
MP03	Residents (and their visitors) of Glen Alpine south and south east	May be periods of extended views by some residents	Limited, due to existing infrastructure, distance, topography and dense vegetation.	Low – Medium
	Employees/passengers associated with trains travelling on railway line to south	Variable, depending on speed of vehicle (speed limit in this area is 110km/hr)	Intermittent views due to existing vegetation along the railway line edge	Low
	Motorists travelling over Jim Affleck Bridge on Hume Highway	Variable with speed and height of vehicle on road overpass	Very limited due to dense vegetation and speed of motorists. Rail Line is below level of land.	Low
MP04	Employees/ passengers associated with trains travelling on railway line at north eastern boundary	Variable, depending on speed of train	Very limited, intermittent views due to dense vegetation along edge of railway line	Low
	Employees and visitors associated with Mt Annan Botanical Gardens to north west	Employees and visitor may have extended periods of view.	Dependent on location within the Gardens, but views would be limited.	Low-Medium

Proposed Surface Location	Category of Viewer	Likely period of view	Level of Visibility	Sensitivity Rating
MP05	- Employees/ passengers associated with trains travelling on railway line on the eastern side - Employees and visitors associated with Mt Annan Botanical Gardens to the north	Variable, depending on speed of train	Limited. As the site is located between three existing railway lines it would only be seen when train is immediately passing the site. Also, some vegetation along railway line provides for intermittent views from the train.	Low
MP06	Employees/ passengers associated with trains travelling on railway line to the east	Glenlee House may have extended periods of view	Limited views due to significant distance from site and olive grove that surrounds Glenlee house.	Low
MP11	Residents (and their visitors) associated with Menangle Park township to the south and Glenlee House to north east	Residents may have extended periods of view	May be uninterrupted views from the south-western side of Glenlee house. Potential uninterrupted views for residents of Menangle Park township, however would be limited due to distance.	Low - Medium

Proposed Surface Location	Category of Viewer	Likely period of view	Level of Visibility	Sensitivity Rating
	Employees/passengers associated with trains travelling on railway line	Variable, depending on speed of train.	Intermittent views due to existing vegetation of moderate density along railway line edge	Low
	Potential view for motorists travelling on Fitzpatrick Street	Variable, depending on speed of vehicle	Limited, due to distance, topography and significant vegetation	Low
MP19	Potential views for residents (and their visitors) associated with residence (550m to north-east) and Glenlee House (500m to the north)	May be extended periods of view from residence located to north east. Limited views for Glenlee House.	Uninterrupted views from the south western side of the house. However, the site is located greater than 500 m from the residence. Limited views, if any, from Glenlee House due to significant distance from site and olive grove that surrounds the house.	Low
MP21	Potential views for residents (and their visitors) to the west	Limited, due to significant distance from the site vegetation surrounding residence.	Interrupted views due to moderate vegetation surrounding residence.	Low
MP22	Potential view for motorists travelling on Hume Highway to the east	Variable, depending on speed of vehicle.	Intermittent views due to vegetation along road side	Low
MP23	Potential views for motorists travelling on Hume Highway located to east.	Variable, depending on speed.	Very limited due to dense vegetation along road edge.	Low

Proposed Surface Location	Category of Viewer	Likely period of view	Level of Visibility	Sensitivity Rating
	Potential views for residents (and their visitors) to the south	Limited due to significant distance and existing vegetation.	Interrupted views due to moderate vegetation surrounding residence.	Low
Spring Farm Project Area				
SF04	Employees and Visitors associated with sand and soil quarry to the north	Varies depending on angle, some views screened by existing vegetation	May be some uninterrupted views.	Low
	Glenlee Road users to the east	Variable, depending on speed.	Limited due to existing vegetation along road edge and within footprint.	Low
SF04A*	Motorists travelling along Glenlee Road, north of well surface location	Variable depending on speed of vehicle.	May be uninterrupted periods of view.	Low
	Employees and visitors associated with sand mining activities located immediately south east of well surface location.	Extended periods of view.	Uninterrupted views.	Low
	Employees and visitors associated with Nepean Substation located west of well surface location.	Limited views due to existing vegetation	Interrupted views due to vegetation	Low
SF10	Potential future walkers/ joggers in Gundungurra Reserve	Variable depending on speed of person and route taken.	Limited due to dense vegetation and vegetation surrounding SF10.	Low
SF20	Potential view from residents and their visitors north west of proposed well surface location	Limited due to distance and existing vegetation.	Interrupted views, area is fairly dense in vegetation at site and surrounding residences.	Low

Proposed Surface Location	Category of Viewer	Likely period of view	Level of Visibility	Sensitivity Rating
	Potential future walkers/joggers in Gundungurra Reserve	Variable depending on speed of person and route taken.	Limited due to dense vegetation and screening surrounding SP20.	Low
SF17	Employees and visitors associated with Waste Management Facility located south east of the surface location.	Limited due to topography, distance and some vegetation.	Potential slight uninterrupted views.	Low
	Motorists travelling along Richardson Road located west of proposal location.	Variable on speed and size of vehicle.	Limited due to topography.	Low
	Potential future walkers/joggers in William Howe Reserve	Variable depending on speed of person and route taken.	Limited due to dense vegetation and screening surrounding SF17.	Low

Note: * This is an alternative well surface location for SF04.

As indicated in the table above, the majority of the proposed well surface locations within the Project Areas are considered to have a low visual sensitivity rating. However, MP03, MP04, MP11 and MP24 were considered to have a low to medium sensitivity rating due to the relatively close proximity of residential properties to the proposed well surface locations.

Some well surface locations in Spring Farm (SF10, SF17 and SF20) are either located within or in close proximity to parks and reserves; namely William Howe Reserve and Gundungurra Reserve. The proposed works at the well surface locations involve minimal modification of the existing environment and would not result in a significant impact to the remaining ecological values of William Howe Reserve and Gundungurra Reserve.

The construction of well surface locations includes landscaping and initial rehabilitation works. The rehabilitation activities include rehabilitation, contouring, and revegetating of disturbed areas surrounding well surface locations using stockpiled soil. The visual assessment considered that these temporary and transient activities during construction would result in a low sensitivity rating to users of William Howe Reserve and Gundungurra Reserve.

Additionally, due to the density of vegetation surrounding the well surface locations and the rehabilitation of the well surface location to pre-production land use or better, the visual assessment of these well-surface locations post construction was considered to be low.

Visual Absorption Capacity

As discussed previously, the Visual Absorption Capacity of the proposal can be considered to be the level of visual contrast between the proposed well site development and the context in which it is placed. The topography of the area, where the well surface locations would be sited varies between gently undulating and flat land, which has undergone previous disturbance due to the introduction of existing infrastructure and rural land uses. Some proposed surface

locations are surrounded by modified bushland, while others are located in cleared paddocks. Therefore, the capacity of the area to visually absorb the proposed works varies depending on their location in relation to the surrounding land.

The capacity of the area to absorb the proposed works when surrounded by existing modified or remnant bushland is much higher than it is when located in cleared areas. In addition, similar well development has already occurred within both the Stage 2 Concept Area and in Menangle Park Project Area, and this has been taken into consideration for the assessment, as it would impact on the capacity of the area to absorb the proposed development. Where there is existing similar development, the capacity for the area to absorb the proposed development is much higher than in an area where similar development does not exist.

The visibility assessment undertaken in Table 8.20 and 8.21 concluded that four well surface locations are in areas rated as low to medium sensitivity for potential visual impacts. These four locations are MP03, MP04, MP11 and MP24 and these are discussed below with respect to their Visual Absorption Capacity and their overall potential visual impact.

For the identified four locations, the sensitive receivers are primarily related to nearby residences. In the case of MP03, MP24 and MP11, they are also located near the Southern Railway Line. For MP11 the nearby residential receiver is known as Glenlee House which is a listed heritage item under RNE, SHR and Campbelltown LEP (see **Section 8.12**) is situated north east of the proposed well surface location.

These four proposed well surface locations are some 200 m (minimum) from the nearest residences. However, potential views to MP03, MP04 and MP24 are limited due to relatively dense existing vegetation within the site and surrounding the nearest residence and Main Southern Railway Line in the case of MP24. With regards to MP11, the lack of existing vegetation surrounding the Glenlee House gives rise to potential uninterrupted views of the well surface location particularly during construction and maintenance activities.

The four proposed locations have been previously subject to rural land uses and construction of existing infrastructure such as the Hume Highway and Southern Railway Line. In addition, similar development exists within the Menangle Park area and the wider Stage 2 Concept Area. For these reasons, it is considered that the capacity for the area to visually absorb the proposed development is high.

Notwithstanding the high potential for the landscape to visually absorb the proposed development, MP11 is located some 450 m away from Glenlee House. However, given the temporary and infrequent nature of the activities of the proposed development which have the potential to alter the visual absorption of the proposal, the implementation of site specific mitigation measures would ensure the minimisation of potential visual impacts to Glenlee House.

Appropriate measures may include the installation of appropriate fencing surrounding the construction compound and planting of vegetation around the well surface location once in operation.

8.10.6 Mitigation Measures

The visual impact of the proposed works would be further reduced by the implementation of the following mitigation measures.

General

- A Landscape Management Plan would be prepared (or the existing Plan updated) in respect of the proposed Project to identify appropriate landscaping to be implemented at well surface locations along with a program of long-term maintenance for landscape works;
- Earthworks, vegetation clearing and soil disturbance would be limited to the construction and operational footprint as appropriate;
- Existing vegetation will be maintained wherever possible;
- Dust control measures would be implemented during construction and operation;
- Screening in the form of appropriate fencing and landscaping will be implemented at well surface locations as necessary and in accordance with the Landscape Management Plan for the Project;
- Initial rehabilitation of the well surface location is to be consistent with the established character of surrounding land;
- Construction activities for the gas gathering lines will be rehabilitated to be consistent with the established character of the land; and
- With regard to the future urban (residential, commercial and industrial) land release areas, where well surface locations are expected to be near residential development, material used for fencing or the enclosure will be chosen to integrate with the surrounding urban form.

Low – Medium Sites

- For well surface locations where residents may be exposed to extended periods of uninterrupted views during construction, green mesh or other appropriate fencing is to be erected around the construction compound.

8.10.7 Residual Impacts

Residual impacts associated with the proposed development include the short term alteration of landscape character in the immediate vicinity of the wellhead and temporary impacts to the land during construction. In the production phase, the potential residual impacts are the temporary work over and maintenance activities along with the presence of the landscaped and screened well surface location for some 10 – 15 years.

Given the existing nature of the area the visual impacts are considered to be minimal provided the recommended mitigation measures are implemented. Therefore the proposed development is considered acceptable in terms of visual impacts.

8.10.8 Conclusion

Of the sixteen (16) proposed well surface locations (including one optional location), four (4) were identified with a low-medium visual sensitivity rating, with the remainder of the well surface locations identified as low. Potential visual impacts would be most significant at the construction phase of the proposed development due to the size of the construction footprint and scale of plant and equipment required. As the footprint and scale of plant and equipment significantly reduces in later phases, the potential visual impacts are also reduced. This is also the case for the construction and occupation of future urban (residential, industrial and commercial) land release areas, which are expected to begin during the production phase of the project. At this stage in the life of the proposed project, the landscaping and screening is expected to mask and

screen the well surface locations, provided the mitigation measures above are implemented. Once construction is completed for the gas gathering system, they would be below the ground surface and the surface of the land returned to its original state, therefore removing the visual impact. Given the access roads are primarily pre-existing roads or tracks within the general area and that they are at ground level, visual impacts associated with the access roads are considered minor. Provided the recommended mitigation measures are implemented, significant adverse visual impacts are not expected to result from the proposed development.

8.11 Indigenous Heritage

8.11.1 Existing Environment

Stage 2 Concept Area

The Stage 2 Concept area of the CGP is located within the Cumberland lowlands of south-east NSW. The area's landform is characterised by low lying gently undulating plains and rolling low hills and rises with the Nepean River and Georges River being two dominant features of the landscape. The region offers a mix of semi-rural and urban (residential, industrial and commercial) development scattered between green belts and isolated areas of remnant vegetation. Much of the area has been cleared of the natural vegetation with grazing practises common in the landscape.

A number of archaeological studies have been undertaken in areas adjacent to and within the Stage 2 study area. Findings of these studies reveal sites to be dominated by isolated finds and low concentration artefact scatters, with lesser occurrences of scarred trees. Several Potential Archaeological Deposits (PADs) and areas of archaeological interest were also identified by these studies, including on low relief areas of the Nepean floodplain, Spring Creek banks, elevated point overlooking the Nepean River, the banks of the Nepean River, and the crest north of Jacks Gully Waste Management Facility. A full list of the sites identified in previous studies is provided in the *Indigenous Heritage Assessment: Camden Gas Project* (HLA 2007) in **Appendix H**.

HLA undertook a search of the AHIMS for all sites within a 20 km radius of the Stage 2 Concept Area on 28 August 2006. This revealed a total of 136 previously recorded sites within the area. Approximately 78 % (106) of sites are defined as open camp sites comprising stone artefact scatters or isolated finds. The few remaining archaeological site types are recorded as scar trees (10.3% or 14 sites), PADs (7.3 % or 10 sites), and rockshelter art and/or deposits (4.4% or 6 sites).

Within and in close proximity to the Stage 2 Concept Area, 48 sites have been previously recorded and entered onto the AHIMS database. Not included on the database are 12 sites recorded at Menangle Park in 2004 (HLA 2004: 57ff). All are artefact scatters or isolated finds. In total therefore, 60 sites were known to exist, or have previously existed, in the Stage 2 study area before the onset of the survey discussed in this report. Almost all are sites represented as stone artefactual material.

An archaeological field investigation was undertaken within the Stage 2 Concept Area in October and November 2006. The survey revealed 25 archaeological sites, of which four were probably recorded during earlier surveys. Discounting these four sites, the survey collected information on 21 previously unrecorded Aboriginal sites – 13 in Spring Farm (S1 to S13) and eight (8) in the Menangle Park area (M1 to M8). The location of previously recorded sites and those recorded during the HLA survey are shown in **Figures 8.8, 8.9 and 8.10**.

While the well surface locations within the Spring Farm and Menangle Park Project Areas were investigated in detail, the wider Stage 2 Concept Area was also considered during the field investigation to consider the types of landforms and areas archaeological sites may occur. Based on existing environmental information and the physical inspection, it was considered that sites routinely occurred upon elevated areas and major creek lines (typically second order or higher), with other low relief areas and lower order creeks having a lesser potential.

Spring Farm Project Area

The Spring Farm project area is located on the northern terraces of the Nepean River and on the western slopes of the low hills which form part of the Mount Annan Botanical Gardens and the William Howe Reserve (CC, 2000). The Spring Farm project area has a predominantly south western aspect with views across the extensive Nepean River floodplains. Landform is gently undulating with steeper sections to the east of the site reaching elevations of up to 170m AHD. Generally the land falls away to the Nepean River in the south with an extensive floodplain adjacent to the river.

Drainage lines of the Spring Farm project area flow in a westerly direction in meandering patterns joining the Nepean River at the western boundary. Several modifications have occurred to the landscape since European settlement including the formation of large dams, roadways, mining sites and residential and industrial areas. Much of the site has been cleared of vegetation for grazing and farming purposes with a noted remnant vegetation corridor in the vicinity of the Nepean River and extending along Jacks Gully. Mining and intensive activities have altered the landscape creating depressions, exposed areas and gully systems. The area does not contain distinctive landform features (i.e. prominent hills) with roadways, mining activities and river flats providing the variability to the undulating landscape.

A large portion of the Spring Farm Urban Release Area was surveyed by Byrne (1994). Two open camp sites consisting of artefact scatters and one PAD were identified. As part of the Spring Farm Urban Release Area Local Environment Study (LES) (Patterson Britton & Partners, 2000) additional artefact scatters were identified as well as a scarred tree.

Throughout the Spring Farm Urban Release Area, archaeologically sensitive areas or landscapes have been identified based on their association with second order (or higher) streams, prominently elevated areas, and prominently elevated areas close to the river. Based on these criteria the following areas were identified as potentially sensitive in regard to Aboriginal sites in the Aboriginal archaeological study as part of the LES:

- The central Spring Creek banks;
- The south eastern elevated points overlooking the Nepean River;
- The vegetated banks of the Nepean River;
- The crest just north of the Jacks Gully Waste Management Facility.

In addition to these sites, a PAD was identified as part of the LES study (Patterson Britton & Partners 2000). The PAD is located on an elevated spur of Nepean River alluvium to the east of the Spring Creek Dam. This area remains undisturbed and lies above flood-prone land along the river. It is considered to have moderate to high archaeological potential. All archaeological sites/items are located within relatively undisturbed areas, which are defined as archaeologically sensitive.

Generally it is considered that areas that have been subject to substantial mining activity or other activities associated with massive surface and subsurface disruption have no potential to contain significant undisturbed archaeological sites. In areas that have been partially mined or farmed, archaeological potential exists but at a lower scale. Sand mining activities particularly in

the southern half of the Spring Farm area have resulted in significant disturbance to the study area.

Menangle Park Project Area

The Menangle Park project area is located on the eastern floodplain and terraces of the Nepean River. The area has a predominantly westerly aspect with landform relatively low. Generally the Menangle Park area falls within the Nepean River floodplain.

Drainage within the area tends to the west joining the Nepean River. As in the Spring Farm landscape, modifications have occurred to the landscape since European settlement including the formation of large dams, roadways, mining sites and residential areas with much of the area cleared of vegetation for grazing and farming purposes. Remnant vegetation is primarily located in the riparian corridor of the Nepean River. Mining is not as prominent in the Menangle Park landscape as in the Spring Farm landscape with dominant landform feature restricted to roadways, floodplains and low hills.

A number of archaeological investigations encompassing land within the Menangle Park Project Area have recently been undertaken. An Aboriginal heritage assessment was undertaken by HLA in relation to the Menangle Park Release Area in 2004, with a total of 22 archaeological sites identified during the course of the survey. All recorded sites in the study area of that investigation were flaked stone artefact scatters and isolated finds of stone artefacts.

On the basis of the 2004 assessment, six zones were identified within terrain units according to the probability of surface and/or subsurface archaeological material existing. A rating of high, moderate, low or nil archaeological sensitivity was assigned to each zone. These ratings reflect the division of the landscape into two sections upon which the predictive model of landscape sensitivity is based. Areas of high sensitivity are restricted to the accretionary context of the extremely low relief slopes of the Nepean River floodplain while the stable and eroding slopes of the very low and low relief slopes contain zones of moderate sensitivity. Areas of low and nil sensitivity reflect the impact of recent land use on sections of all three terrain units rather than the original distribution of archaeological material. To assist in the selection of areas for conservation, aerial photography was used to identify areas of restricted land use impact where the probability for buried potential archaeological deposits (PADs) is high.

8.11.2 Field Investigation

The indigenous heritage assessment has used an “envelope” approach to the impact assessment which means that the highest impact activities are assessed even when these activities are not the most likely. Within the two Project Areas, the ecological assessment focussed on a circle with a 200 metres radius around each proposed well surface location (the study area) and 25 metres either side of the proposed locations of the gas gathering lines and access roads. The scope of the study area is far greater than the area required for each well surface location, gas gathering lines and access roads, therefore it allows for flexibility of construction and production operations, which would allow the selection of well surface locations to avoid areas of Indigenous heritage sensitivity.

The field investigation itself consisted of a pedestrian traverse of the proposed well surface locations, the proposed and existing access tracks, and the proposed gathering lines. This was done by reference to aerial photographs provided by AGL, with Aaron Clifton (AGL) providing on-the-ground instruction over the various routes and route options. Most proposed well surface locations were marked by wooden pegs which facilitated the inspection of these areas.

Dominic Steele Consulting Archaeology undertook an archaeological survey of part of the Stage 2 study area in February 2007, after the completion of the HLA ENSR assessment presented in this EA. This survey targeted proposed activity location at Menangle Park (MP24 and MP33)

and Spring Farm (SF04 and SF04A). The survey found no evidence of Aboriginal archaeological sites in the inspected areas of either Menangle Park or Spring Farm, and concluded that “the likelihood for substantial and intact Aboriginal archaeological deposits to survive at each site was considered to be relatively unlikely” (Dominic Steele Consulting Archaeology 2007: 29). The report resulting from the Dominic Steele Consulting Archaeology survey is appended to the Aboriginal Cultural Heritage Report.

8.11.3 Assessment of Archaeological Sensitivity

Assessments of archaeological sensitivity are considered standard in archaeological reporting in NSW. Assessments of this kind have previously been carried out for Menangle Park (HLA (2004: 76ff, McDonald 2004: 13). Importantly, some of the proposed gas gathering lines and access tracks will pass through or nearby areas previously designated as possessing high archaeological sensitivity (refer McDonald 2004: 17).

Information on pre-recorded sites and sites identified in this assessment is used in combination with observations of terrain nature and integrity to assess archaeological sensitivity. Sensitivity can be rated in terms of low, moderate or high, as set out below:

<i>Low Archaeological Sensitivity</i>	Areas where archaeological material is unlikely to occur. This can be due to the landscape being unsuitable for human occupation, or to the landscape being heavily modified in recent history by European activity.
<i>Moderate Archaeological Sensitivity</i>	Areas where archaeological materials may occur. Some indication of the natural soil profile or natural terrain remains, but where high site or artefact density is unlikely to occur.
<i>High Archaeological Sensitivity</i>	Areas known or likely to contain archaeological materials. The terrain remains largely undisturbed, and sites are known to occur in this context in high concentrations or as a wide range of types.

While the survey was restricted to pre-defined transect lines and well surface locations, the collected data supports the predictions made by previous investigators of the correlation between specific landscape features and site distribution, particularly in regard to the Menangle Park area. Here much of the northwest and south of the area has been identified as possessing high archaeological sensitivity land that includes medium to low elevation terrain along tributaries of the Nepean River (HLA 2004: Figure 9). The newly recorded sites at Menangle Park cluster in the low lying and medium elevation terrain within some 500 m of tributaries. Here two site clusters can be identified in the vicinity of well locations MP19, MP21, MP22 and MP31, and near well locations MP02 and MP03 (**Figures 8.8, 8.9 and 8.10**). At Spring Farm the presence of medium elevation terrain in proximity to water also seems to be a major factor in site distribution. Two obvious concentrations of sites are apparent. One is in the area of well SF10 on low land at the end of a ridge near a formerly watered area. The other is near the ridge crest overlooking former wetlands, between well locations SF17 and SF20.

Based on these findings and the wider archaeological literature of the Stage 2 Concept Area, a relative assessment of archaeological sensitivity can be made for the Spring Farm and Menangle Park areas to be potentially impacted by the gas gathering lines, well surface locations, and access roads, and more generally for the wider Stage 2 Concept area. Areas of archaeological sensitivity are identified in **Table 8-25**.

Table 8-25: Areas of Archaeological Sensitivity

Archaeological Sensitivity	Stage 2 Concept Area	Menangle Park Project Area	Spring Farm Project Area
High Archaeological Sensitivity	All areas near major creek lines (second order or higher) and elevated areas, particularly those near creeks. Specific examples include areas near the Nepean River and its associated banks and nearby elevated areas, Central Springs Creek banks and the crest north of Jack's Gully Waste Management Facility.	Areas encompassed by low lying and medium elevation land in the vicinity of well surface locations MP19, MP21, and MP22 with identified sites M1/MPRP8, M2, M3, M4, MPRP11 and sites identified on AHIMS database.	Low lying land around SF10, including identified sites S1–7; sites previously identified on AHIMS database; and the high ridge between SF17 and SF20, including sites S8, 9 and 10. Artefact densities appear high in these areas. Likelihood of undisturbed contexts nearby.
Moderate Archaeological Sensitivity	All areas found on first order creeks or erosion channels, and areas a reasonable distance from higher course creeks, such as the Nepean River.	Medium elevation terrain between well locations MP02 and MP03, with identified sites M5, M6, M7, and M8 and sites previously identified on AHIMS database. Here there are scattered artefacts in disturbed contexts, possibly deriving from <i>in situ</i> deposits to the immediate north (upslope) of the access track, where the terrain is relatively level. Additionally, the area surrounding MP04 which Heritage Concepts (2006) recorded IF 1 and 2	The area of proposed access route and gathering line from SF17 to the existing Glenlee well field that encompasses sites S11. The potential for archaeological sites is relatively high although erosion is visible on ridge slopes. Sites are possibly not as intensively distributed as the area to the northwest, and identified above as highly sensitive.
Low Archaeological Sensitivity	Areas of substantial erosion, steep terrain, slopes, and previous natural or man-made impacts, including access roads, infrastructure services, and residential development.	Remaining areas investigated as part of this study, not outlined in the high and moderate sensitive areas above, MP05, MP06, MP11, MP23, MP24, and MP33.	Remaining areas investigated as part of this study, not outlined in the high and moderate sensitive areas above.

8.11.4 Potential Impacts

Stage 2 Concept Approval

This report considers both the impacts of the Concept approval for Stage 2 and the Project approval for Spring Farm and Menangle Park. **Table 8-26** provides a summary of the wider generic impacts in relation to the installation of gas wells and associated infrastructure if the works proceed without any further mitigation measures.

The potential impacts to archaeological sites are outlined in some detail in **Table 8-26** and fall into four main activities - construction, production, post development activities, and closure and final rehabilitation. While all the activities have the potential to impact archaeological sites (if present), the first stage (construction), which typically involves the preparation and installation of drill pads, access roads and gas gathering lines, has the most potential to remove and/or destroy archaeological sites currently within the nominated well surface locations. Once an archaeological site has been disturbed or destroyed, subsequent activities in relation to heritage are largely irrelevant.

It must be noted, however, that existing farm tracks will typically be utilised where possible as access roads for the construction and maintenance of gathering lines and well surface locations. Artefacts have been recorded on these tracks in a state of disturbance from natural erosion and vehicle traffic. Use of existing tracks will not greatly further compromise the already disturbed archaeological integrity of these sites. On the other hand, if there is a requirement to widen or otherwise improve the traversability of these tracks, as might be required for heavy machinery egress, then there is a threat to potentially undisturbed deposits that might exist immediately beyond the present track boundaries. This is particularly a risk for those areas identified in this report as possessing high or moderate archaeological sensitivity.

Table 8-26: Generic Potential Impacts to Archaeological Sites based on Activities

Proposed Activity	Potential Impacts
- Construction (including preparation and construction of drill pads, access roads, and gas gathering lines); - Production (including operation, maintenance and access to the wells); - Post Development Activities (including upgrades and further installations); and - Closure and Final Rehabilitation (including removal of wells and associated equipment and earthworks)	Direct impact to archaeological sites through the movement of topsoil and subsoil during construction and rehabilitation of drill pads, access roads and gas gathering lines. Indirect or accidental impacts may also occur with the potential for equipment being located or placed outside the areas previously investigated.

Project Approvals

Based on the activities outlined in **Table 8-26**, it seems likely that any Aboriginal sites within the proposed impact areas have the potential to be destroyed unless mitigation measures are applied. Sites located on the periphery of the activities may be retained and/or un-impacted depending on the management systems put in place.

Without mitigation measures, the following sites may be impacted by construction, production, post development, and closure and final rehabilitation activities (Figures 5 and 6 of

Appendix H):

- Spring Farm
 - S1, #52-2-3256, S2, S4, S5, S6, S7, #52-2-3258, #52-2-3238, #52-2-3260, S9, S10, S11, S12 and S13.
- Menangle Park
 - M2, M3, M4, M5, M6, M7, M8, MPRP1, MPRP11, #52-2-2281, #52-2-2274.

This Indigenous Heritage Assessment has been undertaken using an 'envelope approach' whereby environmental impacts are assessed within a 25 m radius of the indicative well surface location within Spring Farm and within 200 m of the indicative well surface location for Menangle Park to establish the potential impacts of the proposed works within this broader area. Therefore, the final selected wellhead location could be anywhere within that 25 m or 200 m radius dependant upon environmental constraints. The flexibility of this approach would enable identified archaeological sites to be avoided during the project, which would minimise potential impacts.

Summary of Potential Sites Affected

Spring Farm Project Area

Table 8.27: Summary of Potential Impacts - Spring Farm Project Area

Development	Sites Potentially Impacted by Proposed Well Site Activities
SF10 and proposed gas gathering line and access road within well surface location study area	S1, #52-2-3256, S2, S4, S5, S6, S7, #52-2-3258
SF20 and proposed gas gathering line and access road within well surface location study area	S2, S4, S5, S6, S7, #52-32-3238, #52-2-3260, S8??
SF17 and proposed gas gathering line and access road within well surface location study area	S9, S10
Gathering and Water Pipeline SF17 to existing system (GL02)	S11
Jacks Gully Waste Management Facility Road north to SF17	S12, S13,
SF04 and proposed gas gathering line and access road	No sites predicted to be impacted
SF04A and proposed gas gathering line and access road	No sites predicted to be impacted

Menangle Park Project Area**Table 8.28: Summary of Potential Impacts - Menangle Park Project Area**

Development	Sites Potentially Impacted by Proposed Well Site Activities
MP02	M6, M7, M8, #52-2-2277
MP03	M5
MP04 and gas gathering lines to MP05	IF 1 and 2 (recorded by Heritage Concepts)
Access Road: MP04 to Glenlee Road	#52-2-2281, #52-2-2274
MP06	MPRP1
Access Road and Gas Gathering Pipeline: MP06 to MP05	MPRP1
Gas Gathering lines and access roads: MP11 to MP19	M2, M3, M4, MPRP11
Access Road: MP33	#52-2-4597
Gas gathering lines along Glenlee Road East and Menangle Road, and MP 24 to the valve pit	No sites predicted to be impacted
MP05, MP11, MP22, MP23, and associated access roads and gas gathering lines (excluding those outlined above).	No sites predicted to be impacted
MP19	No sites predicted to be impacted

8.11.5 Environmental Safeguards

The following safeguards would minimise or remove potential impacts to items and sites of Indigenous heritage within the Stage 2 Concept Area (including Spring Farm and Menangle Park Project areas):

- For all proposed well surface locations, gas gathering lines and access roads, AGL should prepare and implement an Aboriginal Heritage Management Plan, in consultation with DECC and the relevant Aboriginal communities. The plan should be submitted to the Director-General prior to commencing construction works and include:
 - a detailed description of the measures that would be implemented for salvage, relocation or mapping of archaeological objects within the proposed development footprints: and
 - sections on the project background, environmental context and site setting, archaeological background, and management measures and protocols.

In addition, the following general recommendations are made in respect of the Spring Farm and Menangle Park Project Areas:

- For all proposed well surface locations, gas gathering lines and access roads, AGL should prepare and implement an Aboriginal Heritage Management Plan, in consultation with DECC and the relevant Aboriginal communities. The plan should include:
 - a detailed description of the measures that would be implemented for salvage, relocation or mapping of archaeological objects within the proposed development footprints; and
 - sections on the project background, environmental context and site setting, archaeological background, and management measures and protocols.
- A statement for the protection of any Aboriginal skeletal remains uncovered during development should be placed in the Aboriginal Heritage Management Plan. Aboriginal skeletal remains are protected under the NPW Act and if remains are identified during development then all works must stop and contact with the NSW Police, DECC and the NSW Coroners Office immediately initiated. Management actions for any Aboriginal skeletal material should be developed in conjunction with DECC, the Aboriginal communities and trained archaeologists. Management options could include preservation *in situ*, or detailed excavation and recording followed by retrieval. In relation to the latter, consideration must be given to the ultimate location of the remains before they are retrieved.

Spring Farm Project Area

Table 8-29 provides specific mitigation measures for each of the proposed activities within Spring Farm.

Table 8-29: Spring Farm Mitigation Measures

Development	Archaeological Sites within the Study Area	Mitigation Measures
SF10 and proposed gas gathering line and access road	S1/#52-2-3256, S3/#52-2-3261, S2, S4, S5, S6, S7	All archaeological sites are located in the southwestern quadrant of the study area. While the proposed well surface location is not likely to impact the archaeological sites present, the construction footprint may. Therefore, the proposed construction footprint should be constrained to the northern and eastern sections of the study area. The proposed access road will currently impact S7. To avoid this impact, the access road should be moved north and eastwards of its current location. The proposed gas gathering line will also impact S7 and falls very close to S5 and S6. The gas gathering pipeline should be moved north and eastwards within the study area, if possible, from its present location. Given the density and proximity of archaeological sites within this study area, consideration should be given to fencing or identifying (through flagging, etc) prior to the proposed development.

Development	Archaeological Sites within the Study Area	Mitigation Measures
		The Project would develop a Cultural Heritage Management Plan, which would outline the appropriate procedures for manoeuvring of gas gathering lines with respect to Cultural Heritage management. For example, where sites are identified either through the risk assessment and/or site visit, consideration should first be given to relocation of the well surface location and/or ancillary infrastructure to an area not identified as possessing Aboriginal heritage sites. Should this not be possible, mitigation of site damage or destruction should be undertaken. Mitigation measures should include the detailed recording, collection, excavation (if required), documenting and/or relocation of the site prior to any proposed impacts by a professional archaeologist in conjunction with Aboriginal community representatives.
SF20 and proposed gas gathering line and access roads	S2, S4, S5, S6, S7, #52-32-3238, #52-2-3260, S8	Archaeological sites are present within the study area in the western, southern and southeastern quadrants. While the proposed well surface location is not likely to impact the archaeological sites present, the construction footprint may. Therefore, the proposed construction footprint should be constrained to the northern and eastern sections of the study area. The access road will currently impact S7, S8, S9, S10 and #52-2-3238. To avoid this impact, the east-west access road should be moved northwards of its current location, and the north-south access road should be moved westwards (between #52-2-3260 and #52-2-3238). The proposed gas gathering line will also impact S7 and potentially S8 and S9. The gas gathering pipeline should be moved north within the study area, if possible, of its present location to avoid these sites. Given the density and proximity of archaeological sites within this study area, consideration should be given to fencing or identifying (through flagging, etc) prior to the proposed development. The Project would develop a Cultural Heritage Management Plan, which would outline the appropriate procedures for manoeuvring of gas gathering lines with respect to Cultural Heritage management.

Development	Archaeological Sites within the Study Area	Mitigation Measures
SF17 and proposed gas gathering line and access road	S9, S10	S9 and S10 are situated on the western edge of the study area upon the access track. Currently, the development of the well surface location should not impact these sites. Due to the potential for subsurface archaeological deposits in this location, the access track and gas gathering line should seek to use the existing access track, and fence off or flag S9 and S10 to ensure their conservation. The Project would develop a Cultural Heritage Management Plan, which would outline the appropriate procedures for manoeuvring of gas gathering lines with respect to Cultural Heritage management. Due to the land availability constraints to the north of the access track to avoid identified sites, the implementation of appropriate mitigation measures contained within the Cultural Heritage Management Plan would be considered appropriate.
Gathering and Water Pipeline to SF17 to existing gathering system	#52-2-0918, S11	S11 is unlikely to be impacted by the proposed development, but is within the assessment areas. Hence, in the location of S11, the activities should either be moved southwards, or the site should be made known to the construction team before activities occur in this area.
Jack Gully Waste Management Facility Road north to SF17	S12, S13	Currently, the proposed access road will impact S12 and S13. Both sites are disturbed isolated finds upon the access track. Given the disturbed nature of these sites, their removal should be considered, rather than the relocation of the track to undisturbed soil profiles nearby. These measures would be discussed with the Tharawal Local Aboriginal Land Council (TLALC) and Cubbitch Barta Native Title Claimants (CBNTC).
SF04 and proposed gas gathering line and access road	No sites predicted to be impacted	No archaeological requirements
SF04A and proposed gas gathering line and access road	No sites predicted to be impacted	No archaeological requirements

Menangle Park Project Area

Table 8-27 provides specific mitigation measures for each of the proposed activities within Menangle Park.

Table 8-27: Menangle Park Mitigation Measures

Development	Archaeological Sites within the Study Area	Mitigation Measures
MP02	M6, M7, M8, #52-2-2277	The proposed well location and gas gathering lines will currently impact M6, M7, M8 and #52-2-2277, all of which are situated in the centre and southwestern quadrant of the study area. The proposed access track currently has no heritage issues. To avoid impacting these sites, the well location (and associated construction compound) needs to be moved north and eastwards within the study area, if possible, of its present location. Alternatively, the appropriate mitigation of the four archaeological sites should be undertaken prior to the development. Based on the physical description of the sites (Table 8 of Appendix H), mitigations are likely to be limited to surface collections. The Project would develop a Cultural Heritage Management Plan, which would outline the appropriate procedures for manoeuvring of gas gathering lines with respect to Cultural Heritage management.
MP03	M5	M5 is currently located in the east quadrant of the study area, and will be impacted by the proposed gas gathering line, and potentially by the construction footprint. To avoid impacts, the gas gathering line should be moved northwards of its current location, and the construction footprint should be limited in its eastern extent. Fencing or flagging the site before development, should also be considered.
MP04 and gas gathering lines to MP05	IF 1 and 2 (recorded by Heritage Concepts)	MP04 and gas gathering lines to MP05 would potentially impact upon IF 1 and 2 (as recorded by Heritage Concepts). Due to the unknown actions or timetable of potential test excavations in this vicinity, consultation with the landowner is required. Upon receipt of available information regarding the status of IF 1 and 2, appropriate mitigation measures would be outlined in the Cultural Heritage Management Plan.

Development	Archaeological Sites within the Study Area	Mitigation Measures
Access Road: MP04 to Glenlee Road	#52-2-2281, #52-2-2274	#52-2-2281 is currently within the 25m area assessed for the proposed access road, while #52-2-2274 will be directly impacted through its construction. The extent of these sites (which were not investigated) is unknown, but based on conversations with the Aboriginal communities it is perceived to be extensive. In relation to #52-2-2281, the proposed route may occur unchanged, but the site would need to be identified (and potentially fenced off) to the construction team involved. #52-2-2274 will require the implementation of appropriate mitigation in consultation with the Aboriginal communities. Regardless of these proposed mitigation measures, supervision of activities in this area should occur with appropriate salvage or route relocation occurring as necessary during reconstruction. The Project would develop a Cultural Heritage Management Plan, which would outline the appropriate procedures for manoeuvring of gas gathering lines with respect to Cultural Heritage management. As referred to previously, potential test excavations may occur in the vicinity of MP04 as a result of an indigenous assessment undertaken for an adjacent development (refer Heritage Concepts, 2006). Appropriate mitigation measures for this vicinity would be outlined in the Cultural Heritage Management Plan.
MP06	MPRP1	MPRP1 is located on the southeast edge of the study area. The site will not be impacted by the proposed gas well location or construction footprint.
Access Road and Gas Gathering Pipeline: MP06 to MP05	MPRP1	MPRP1 is located adjacent the railway within MP06's study area. The site is within the assessment area of both the proposed gas gathering line and access road in this location. At this stage, the site appears to be un-impacted by the proposed development, but is very close to both activities. To avoid impacting this site, consideration should be given to moving the gathering and access northwards (to bisect the well location directly). Alternatively, fencing off the site and advising the construction team of its presence during construction may suffice.

Development	Archaeological Sites within the Study Area	Mitigation Measures
Gas Gathering Pipeline and access road: MP11 to MP19	M2, M3, M4, MPRP11	Four archaeological sites are currently located on the proposed gas gathering line and proposed access track between MP11 and MP19. All sites are disturbed low concentration artefact scatters or isolated finds, and consideration to salvaging them prior to development, rather than an alteration of the services into undisturbed areas should be given. Alternatively, the services should be moved either northwards or southwards of their current locations.
Access Road: MP33	#52-2-4597	#52-2-4597 is located outside the proposed access routes study area, but construction teams should be advised of the site prior to development.
Gas gathering lines between Glenlee Road East and Menangle Road, and MP 24 to the valve pit	No sites predicted to be impacted	No archaeological requirements
MP05, MP11, MP22, MP23, and associated access roads and gas gathering lines (excluding those outlined above).	No sites predicted to be impacted	No archaeological requirements
MP19	No sites predicted to be impacted	No archaeological requirements
Access Road: MP21 to 23	No sites predicted to be impacted	No archaeological requirements

8.11.6 Residual Impacts

The proposed development may result in the removal or destruction of a number of Aboriginal sites identified within this EA. However, the environmental envelope assessment approach allows AGL to move the location of infrastructure should an adverse impact be identified. Should the removal and/or destruction of Aboriginal sites of high or moderate archaeological significance be unavoidable, the environmental safeguards and management options identified in **Section 8.11.5** above should be adhered to and implemented in order to minimise impacts as far as possible.

8.11.7 Conclusion

Although the proposed activities of the CGP are anticipated to result in some disturbance to Aboriginal heritage within the locality, potential impacts would be minimised through the implementation of environmental safeguards and management options for Aboriginal heritage sites and artefacts. Upon implementation of environmental safeguards and management measures identified, the impacts associated with Aboriginal heritage are not expected to represent a significant environmental impact.

8.12 Non-Indigenous Heritage

A desktop review of previous non-indigenous studies relevant to the CGP Stage 2 Concept Plan area, and particularly relevant to Spring Farm and Menangle Park has been undertaken as part of the preparation of this EA to determine the locations of previously recorded and listed items of heritage significance. The review has included the following studies:

- Patterson Britton and Partners (2000) Spring Farm Urban Release Area Local Environmental Study. Camden Council;
- Dibden, J. (2003) Camden Gas Project Stage 2 – Archaeological and Heritage Assessment. Report prepared for Sydney Gas Operations Pty Ltd;
- HLA (2006) Environmental Assessment EMAI. Prepared for Camden Gas Project Joint Venture.
- HLA (2006) Environmental Assessment Razorback. Prepared for Camden Gas Project Joint Venture

In addition, searches of the following relevant heritage instruments, registers and databases have been undertaken:

- The Register of National Estate;
- The Stage Heritage Inventory;
- Campbelltown LEP 2002;
- Camden LEP No. 121 (Spring Farm);
- Camden LEP No. 46
- Camden LEP No. 47; and
- Wollondilly LEP 1991.

8.12.1 Existing Environment

The Stage 2 Concept Plan area has been subject to considerable land disturbance from previous agricultural, recreational and industrial land uses that occurred in the region, together with more recent residential, commercial and industrial development which has occurred in certain locations within the area. Sand and soil extraction within the areas of Spring Farm and Menangle Park has resulted in significant land disturbance.

8.12.2 Concept Plan

An internet search of the State Heritage Inventory (SHI) and the RNE relating to the Stage 2 Concept Plan area was conducted on the 23rd August 2006. Given the relatively large area covered by Stage 2 of the CGP, several items were identified, particularly of local heritage significance. The majority of these items are listed in the relevant LEP as having heritage significance, and include old homesteads and cottages. The area identified as Camden Park also accounts for a large portion of the listed items identified in the search. Since the time the search was conducted, the NSW Heritage Office has indicated that Camden Park Estate and Belgenny Farm (EMAI) property within the Wollondilly LGA were included on the SHR early 2007, this has been incorporated in **Table 8-31** below.

Table 8-31 identifies those matters of non-indigenous heritage significance identified as part of the desktop review, relevant to the Stage 2 Concept Plan area.

Table 8-31: Non-Indigenous Heritage Items of Local, State, Regional or National Significance Within the Stage 2 Concept Area

Suburb within Stage 2 Concept Area	Item	Address	Listing			
			LEP	SRE P 20	SHR	RNE
	Upper Canal System (Prospect Reservoir)	Crosses several LGAs including Camden, Campbelltown and Wollondilly.	✓ (Wollondilly)		✓	
Razorback	Wooden Mile Post Mount Hercules Group	Razorback Road Mount Hercules Group	✓ (Wollondilly) ✓ (Wollondilly)			
Elderslie	Galvin Cottage Bruchhauser House Studley Park House Hilsyde	Corner of Galvin and Macarthur Road. 23 Bruchhauser Crescent 52 Lodges Road 56 Hilder Street	 ✓ (Camden) ✓ (Camden) ✓ (Camden)	✓	✓	
Glen Alpine	Glen Alpine (second house) Glen Alpine (site of original house).	12 Belltrees Close Arlington Crescent	✓ (Campbelltown) ✓ (Campbelltown)			✓ ✓
Ambarvale	Englorie Park	2 Parkholme Circuit	✓ (Campbelltown)			✓
Bradbury	St Helens Park Denfield	Appin Road Appin Road, St Helens Park.	✓ (Campbelltown) ✓ (Campbelltown)		✓ ✓	 ✓
Gilead	Sugarloaf Farm 'Mount Gilead', group, house, outbuildings, dam and mill	Menangle Road Part Lot 1 DP 807555, Appin Road	 ✓ (Campbelltown)	✓	✓	
Menangle	Camden Park (house and & garden) Menangle Rail Bridge Menangle Railway Station Group	Elizabeth Macarthur Avenue Over Nepean river Main Southern Railway	✓ (Wollondilly) ✓ (Wollondilly) ✓ (Wollondilly)	✓ ✓	✓ ✓	✓
	Barrigal Monument and Vista	Camden Park Drive near Barrigal Lagoon	✓ (Wollondilly)			
	Camden Park Estate Central Creamery	Station Street	✓ (Wollondilly)			✓

Suburb within Stage 2 Concept Area	Item	Address	Listing			
			LEP	SREP 20	SHR	RNE
	Camden Park Rotolactor	Station Street	✓ (Wollondilly)			✓
	Dairy No. 4	Woodbridge Road (EMAI)	✓ (Wollondilly)			
	Gilbulla (Anglican Conference Centre).	Moreton Park Road	✓ (Wollondilly)			
	Menangle Gate Lodge	46 Woodbridge Road	✓ (Wollondilly)			
	Menangle Store	57 Menangle Street	✓ (Wollondilly)			
	Railway Station	Off Station Street	✓ (Wollondilly)			
	St James Anglican Church	Menangle Road	✓ (Wollondilly)			✓
	St Patrick' Roman Catholic Church	Menangle Street	✓ (Wollondilly)			
Narellan	Studley Park	Camden Valley Way			✓	✓
	Anglican Cemetery	6 Richardson Road	✓ (Camden)			
	Burton Arms Inn	322 Camden Valley Way	✓ (Camden)			
	St Thomas Church Hall	1A Wilson Crescent	✓ (Camden)			
Camden South	Begenny Farm (Group)	100 Elizabeth Macarthur Ave	✓ (Camden)			
	Camden Park Lodge, Former	224 Old Hume Highway	✓ (Camden)			
Cawdor	House, Slab House and Hayshed	Cawdor Road	✓ (Wollondilly)			
	Methodist Church Group	Cawdor Road	✓ (Wollondilly)			
	Slab Hut and Trees	470 Cawdor Road	✓ (Wollondilly)			
Camden	20, 21, 25, 27, 28 Hill Street		✓ (Camden)			
	1, 5, 7, 9 Menangle Road	Menangle Road	✓ (Camden)			
	70, 72, 74, 76, 78, 80 John Street		✓ (Camden)			
	Camden Park Estate Group	Camden Park Estate	✓ (Wollondilly)	✓	✓	✓

Suburb within Stage 2 Concept Area	Item	Address	Listing			
			LEP	SREP 20	SHR	RNE
	Camden Park Estate and Belgenny Farm (EMAI)	Elizabeth Macarthur Avenue			✓	
	Camden Park Estate and Belgenny Farm (EMAI)	Remembrance Driveway			✓	
	Camden District Hospital	61 Menangle Road	✓ (Camden)			
	Camden Valley Inn	Remembrance Drive	✓ (Wollondilly)			
	Dairy No 8	Remembrance Drive	✓ (Wollondilly)			
	Dairy No 9	Remembrance Drive	✓ (Wollondilly)			
	Dr Crookstons House	75 John Street	✓ (Camden)			
	Masonic Lodge	36 Hill Street	✓ (Camden)			
	Old Methodist Parsonage	33 Hill Street	✓ (Camden)			
	St John's Church, Cemetery and Slopes	6 & 10 Menangle Road	✓ (Camden)			✓
	St Johns Hill and John Street Conservation Area	St Johns Hill, John Street				✓
	St Johns Church Group	Comprising: St John the Evangelist Church; St John's rectory and stables; and St John's Church grounds, as bounded by Menangle Road, Broughton Street and rear of subdivisions fronting Alpha Road and Forrest Crescent, including: cemetery, lych gate and trees.	✓ (Camden)			✓
	Thurns Weir	Between Camden and Menangle		✓		

Suburb within Stage 2 Concept Area	Item	Address	Listing			
			LEP	SREP 20	SHR	RNE
	Macarthur Family Cemetery	South of the Camden Park Estate Road, being an extension of Elizabeth Macarthur Avenue.				✓

It should be noted that a number of heritage items are also under consideration for possible SHR listing, having been the subject of nominations. These include:

- Yamba, 165 Camden Valley Way, Elderslie;
- St. John's Church Group, Menangle Road/ Broughton Street, Camden;
- Mount Gilead, Appin Road, Gilead (suburb);
- Glen Lorne, Appin Road, Gilead (suburb);
- Humewood / Beulah, Appin Road, Gilead (suburb); and
- Meadowvale, Appin Road, Gilead (suburb).

8.12.3 Spring Farm

An internet search of the SHI and the RNE conducted on 31 May 2007 identified one known item of heritage significance within the Spring Farm area listed by local government and State agencies. This is a private residential building built in the latter half of the nineteenth-century located at 196 Macarthur Road, Spring Farm, known as NESBITT.

No items within Spring Farm were identified on the RNE.

8.12.4 Menangle Park

An internet search of the SHI and the RNE conducted on 31 May 2007 relating to Menangle Park indicated a total of five items of heritage significance, including one item listed under the *Heritage Act 1977*, four items listed by local or State planning instruments and three items identified on the RNE. These heritage items are listed in **Table 8-32** below.

Table 8-32: Non-Indigenous Heritage Items Within Menangle Park

Item	Address / Suburb	Listing		
		RNE	SHR	Local / Regional
'Glenlee' House, outbuildings, garden and gatelodge	Glenlee Rd East, Menangle Park	✓	✓	✓ (Campbelltown LEP)
Menangle Park Racecourse/Paceway	Menangle Park			✓ State Regional Environmental Plan 20 (SREP20)

Item	Address / Suburb	Listing		
		RNE	SHR	Local / Regional
Menangle Railway Viaduct	Over Nepean River, between Gillead and Menangle suburbs.	✓	✓	✓ (Wollondilly) LEP
Menangle Weir	Below rail bridge, Menangle Park			✓ (SREP20)
Menangle House	Corner of Menangle Rd and Racecourse Ave, Menangle Park.	✓		✓ (SREP20)

8.12.5 Assessment of Impacts

As previously noted, the environmental envelope assessment approach allows the well surface locations to move within a 50 metre radius in Spring Farm and a 100 metre radius in Menangle Park (to recognise the differences in the level of information about future urban land releases) and 25 metres either side of gas gathering lines and access roads mean that there is flexibility and an ability to deal with future issues as they arise.

This consultation with landholders during the early project design phase ensured that wells and other infrastructure were sited to accommodate the primary land use. This has resulted in the relocation, removal or redesign of wells before the proposal is submitted for approval.

Construction activities associated with the proposal have the potential to impact on identified heritage items. The level of potential impact varies for the different stages of the development which include construction, production, post development and closure and final rehabilitation.

The proposed well surface locations within the Spring Farm area were determined having regard to the location of NESBITT. The nearest proposed well surface location is more than 1km from this listed heritage item. Given the distance of the proposed well surface location to this heritage item, no significant impacts are expected.

The Upper Canal System passes the proposed MP04 well surface location before transferring into pipelines to cross the Main Southern Rail Line. The options for the proposed gas gathering line running from MP03 to MP04 may need to underbore the Upper Canal System. There are, however, options for linking the MP03 and MP04 well surface locations that do not require an underbore of the Upper Canal System and the impacts will be considered as part of the assessment of the design and feasibility of all options for gas gathering lines to connect MP02, MP03 and MP04.

As with the Spring Farm area, well surface locations for the Menangle Park Project Area were chosen with consideration of heritage items within the area. There are potential visual impacts for heritage items during the construction period related to construction activities which include earthworks such as topsoil stripping and excavation; drilling and associated processes and trenching associated with the establishment of gas gathering lines. Glenlee House in particular, located approximately 500 m from proposed well surface location MP11 may have potential views from the south western side of the building of works at MP11.

For later stages of the development following construction, visual impacts will be minimised from mitigation measures such as the use of appropriate fencing for the enclosure and vegetation planting around the enclosure in order to provide screening of the well development. With

regard to construction activities related to the gas gathering system, the activities will be temporary and will move at a rate of approximately 300 to 400 metres per day, depending on terrain. In addition, following the completion of construction, the land would be returned to its original state or better and therefore impacts will be temporary and relatively short term.

Prior to the selection of final well surface locations and infrastructure within the Stage 2 Concept Area consideration would be given to the identified items of heritage significance to ensure that the potential for adverse impacts resulting from the proposed activities is minimised. It is considered that potential impacts can be minimised through the siting of well surface locations to avoid heritage items. In this respect, the following general locational guidelines will be used when considering the siting of well surface locations within the Stage 2 Concept Area:

- Well surface locations to be sited in areas which have been subject to previous disturbance due to past activities, where possible;
- Well surface locations sited to avoid heritage items and significant curtilage;
- Well surface locations to take into account of significant views to and from heritage items; and
- Well surface locations to be informed through further heritage studies to be undertaken as part of future assessment associated with future Project Applications within the Stage 2 Concept Areas.

8.12.6 Mitigation Measures

As identified previously, much of the land has been subject to significant disturbances due to previous land uses that occurred in the region. To prevent disturbance to the heritage items, the location of wells and infrastructure would be selected in order to avoid the identified heritage items and significant curtilage wherever possible.

With specific reference to the Upper Canal, the Proponent shall carry out the proposed Project in a manner that will not adversely affect the structural integrity of the Upper Canal and associated structures nor impact upon water quality.

It is considered unlikely that further non-indigenous heritage sites will be disturbed or uncovered during the construction stage of the development. Therefore the need to obtain an excavation and permit from the NSW Heritage Council prior to construction is not considered necessary. However, in the event that any historic relics, as defined in the *Heritage Act 1977* are identified in the course of construction activities in the Spring Farm or Menangle Park Project areas, then works in the vicinity of the finds would cease immediately and an archaeologist from the NSW Heritage Office would be contacted, and an appropriate course of action implemented.

In addition, the following mitigation measures have been identified in order to minimise the potential visual impacts on non-indigenous heritage items within the Spring Farm and Menangle Park Project Areas:

- Removal of existing vegetation is to be minimised;
- Existing vegetation which provides screening of the proposed works should be maintained where possible;
- In areas where potential views to and from a heritage item exist, such as Glenlee House, green mesh fencing or other appropriate screening should be erected around the construction area in order to provide screening of construction activities;
- Vegetation planting around the development site is to commence as soon as possible once construction is complete.

8.12.7 Conclusion

The siting of the well surface locations and infrastructure would be designed in consideration of the identified heritage items within the Stage 2 area, including the proposed project areas of Menangle Park and Spring Farm. These items would be avoided in order to ensure the potential impacts on these items from the development is minimised. For the Spring Farm and Menangle Park Project Areas, provided the recommended mitigation measures above are implemented, significant adverse environmental impacts on non-indigenous heritage items resulting from the proposed development are not anticipated.

With regards to the Stage 2 Concept Area, it is considered that potential impacts on non-indigenous heritage items within the area could be minimised through the careful planning of the well surface locations with consideration of heritage items. Locational Guidelines for the siting of well within the Stage 2 Concept Area have been developed in **Section 4.3.1** to assist in minimising impacts on identified non-heritage items.

8.13 Traffic and Transportation

8.13.1 Existing Environment

The Stage 2 Concept Plan area spans across three LGAs, Camden, Campbelltown and Wollondilly (see **Figure 8.11**), which are located in the Macarthur Region south-west of Sydney's CBD. These LGAs are the southern boundary of the Greater Sydney Metropolitan area bordering the north of the Wollongong Region. The Macarthur Region provides an important hub of Sydney's industrial and residential zones, with several important transport corridors linking Sydney to the south coast of NSW and Victoria.

Major roadways that service the Macarthur Region are:

- M7 - Western Sydney Orbital (Westlink);
- M5 Motorway;
- F5 – South-western Freeway;
- The Northern Road; and
- Camden Valley Way.

The Westlink M7 was opened in 2005 and connects the Western Sydney road network by providing a 40 km uninterrupted journey between the M2, M4 and M5 motorways. The M7 connects with the M2 at Baulkham Hills in the north and with the M5 at Prestons in the south thereby creating a ring road highway (Roads and Traffic Authority (RTA), 2006).

The M5 Motorway opened in August 1992 and provides a high-speed transit corridor spanning 22 km of Sydney's south west from Prestons to Beverly Hills.

The F5 Freeway extends south of the M5 Motorway at the Cross Roads and is the principle route serving Macarthur and the Southern Highlands. The F5 is the primary link between Canberra and Sydney and forms part of the national highway network (RTA, 2006).

The Northern Road and Camden Valley Way form part of the arterial road network of the South West Sydney Region providing entry and exit to the aforementioned freeways and motorways.

The existing road network of the Stage 2 Concept Plan Area and the Spring Farm and Menangle Park Project Areas is shown in **Figure 8.11**. The roads within the Stage 2 Concept Plan Area relevant to the project include:

- F5 – South-western Freeway;
- Camden Valley Way;
- Camden Bypass;
- Narellan Road;
- Appin Road;
- Remembrance Drive;
- Richardson Road;
- Macarthur Road;
- Springs Road;
- M5 Motorway; and
- Menangle Road;

The South Western Freeway provides the major north-south highway link and runs through the Stage 2 Concept Area. There is a grade-separated interchange with Narellan Road which connects with Camden Valley Way providing the northern boundary of the Stage 2 Concept Area.

Narellan Road connects with Appin Road in the east, which runs the length of the eastern boundary for the Stage 2 Concept Area. The Camden Valley Way-Camden Bypass-Old Hume Highway (Remembrance Drive) route provides a lower capacity north-south route. Remembrance Drive runs the length of the western boundary of the Stage 2 Concept Area.

East - west arterial routes include Narellan Road, with an interchange with the South Western Freeway (F5) and a direct connection to Campbelltown CBD. Narellan Road joins Camden Valley Way at its western end, with a dog leg connection to the Northern Road. Narellan Road provides major access into the developing areas of Mount Annan, Narellan Vale and Currans Hill while the Northern Road provides an arterial link with Penrith and Windsor.

Several minor and private roadways provide access to adjacent residential and rural-residential areas within the Stage 2 Concept Area. Menangle Road is a sub-arterial road connecting the township of Menangle with the City of Campbelltown and is currently a sealed single-lane (each direction) road with travel speeds of up to 100 km/h. Access to the Menangle Park Project Area would be via minor and private roadways from Menangle Road.

The Spring Farm Project Area would be accessed from Macarthur Road, Richardson Road, Springs Road and Glenlee Road West or private access ways extending from these. Macarthur Road has a grade-separated interchange with Camden Bypass while Richardson Road passes under the Camden Bypass linking to the Spring Farm area. The northern section of Richardson Road links with Camden Valley Way at a traffic-signal controlled junction. Springs Road runs in an east-west direction and connects Macarthur Road and Richardson Roads only. Glenlee Road West is a short stretch of east-west road extending from the intersection of Richardson Road and Springs Road while Glenlee Road (East) is an east-west road off Menangle Road passing over the freeway and forming an access point to Glenlee House.

8.13.2 Road Use

Road Hierarchy Classification

The classification of roads on the existing road network can be used as an indication of the function each road plays with respect to the volume of traffic they should appropriately carry. The RTA has developed a set of road hierarchy classifications, detailed in **Table 8-33** below, indicating typical nominal volumes expressed in terms of average annual daily traffic (AADT) served by various classes of roads.

Table 8-33: Road hierarchy classification

Type of Road	Traffic Volume (AADT)	Peak Hour Volume (vph)
Arterial Road	> 15, 000	1, 500 – 5, 600
Sub-Arterial Road	5, 000 – 20, 000	500- 2, 000
Collector Road	2, 000 – 10, 000	250 – 1, 000
Local Road	< 2, 000	0 - 250

Source: RTA Guide to Traffic Generating Developments (www.rta.nsw.gov.au)

Average Annual Daily Traffic (AADT)

The most current RTA Traffic data for the Sydney Region (2002) has been used to provide estimates of AADT for the abovementioned roadways within the Stage 2 Concept Area. A summary of the data is provided in **Table 8-34** below.

Table 8-34: Average Annual Daily Traffic (AADT)

Project area	Recording Location	2002 AADT
Stage 2 Concept Area	Narellan Road, MR178	32 172
	Narellan – E of MR620, Camden Valley Way	
	Narellan Road, MR178	20 418 (1991)
	Narellan – W of MR620, Camden Bypass	
	Hume Highway SH2-NB on/ramp Campbelltown from WB on Narellan Road	4 067 (1996)
	Hume Highway SH2- SB off/ ramp Campbelltown from EB on Narellan Road	
Spring Farm Project Area	Camden Bypass MR620-SL3 Camden at Macarthur Bridge	19 078
	Camden Valley Way, MR178 Elderslie – N of Macarthur Rd	
	Macarthur Road Camden – S of MR178, CVW	3 824 (1987)
Menangle Park Project Area	Menangle Road MR179-SL3	5 041
	Menangle – at Nepean River bridge	

Source: RTA Traffic Data for the Sydney Region 2002

It should be noted that the figures provided do not include the traffic impacts of the new land release areas within the region, since 2002, including the proposed Spring Farm and Menangle

Park release areas. The region has experienced an increase in urban development since the date of AADT recordings.

Classification

Using the road hierarchy classification and AADT data for identified roadways, along with information gained through consultation with the local government authorities, the classification of roadways to be utilised to access the Spring Farm and Menangle Park project areas during the construction and operation of the CGP Stage 2 expansion are provided in **Table 8-35** below.

Table 8-35: Roadway Classification

Project Area	Roadway	Classification	Designated B-Double Route	Council Authority
Spring Farm and Menangle Park	Richardson Road	Collector Road	Yes	Camden
	Macarthur Road	Collector Road	Yes	Camden
	Springs Road	Collector Road	Yes	Camden
Menangle Park	Menangle Road	Sub-Arterial / Collector Road	Yes	Campbelltown

Heavy Vehicles

Information from Camden Council indicates that some 75% of heavy vehicles generated by industrial practices in the Spring Farm area, such as Jacks Gully Waste Management Centre and the Glenlee Coal Washery, use Springs Road and Macarthur Road as the quickest route to the Camden Bypass. Approximately 25% of Council heavy vehicles also use Richardson Road as the predominant route. A 24 hour vehicle classification survey undertaken on 21 April 1999 identified 400 trucks entering the Camden Bypass via Macarthur Road. (Spring Farm LES, Camden Council 2000).

Springs Road has an approximate daily traffic flow of 2,486 vehicles per day (vpd), with some 21.6% of the traffic comprising heavy vehicles. This traffic flow suggests that the road is lightly trafficked and attracts a high usage by commercial type vehicles. Comparison of the traffic volumes for collector roads with the average daily traffic volume, demonstrates that Springs Road operates well below the design volume capacity for a collector road.

Richardson Road has a traffic flow of 8,310 vpd, including some 7% heavy vehicles. This shows Richardson Road is moderately trafficked and is currently operating below the design volume capacity of a collector road.

The existing traffic flow of Menangle Road is relatively low for a sub-arterial roadway, however road capacity envisages future growth in the area.

Future Development

The level of service of the existing roadways in the Stage 2 Concept area is likely to be affected by the proposed new release developments within the region. The areas of Spring Farm, Menangle Park and Elderslie are within the Stage 2 Concept area and are three of six areas in the Sydney's southwest committed for release. The expected timeframe for development, (between 2004 to 2006), has been delayed with Elderslie having been partially developed and Spring Farm only recently rezoned. Menangle Pak has yet to be rezoned for urban (residential commercial and industrial) development. **Table 8-36** identifies the expected lot yields associated with these.

Table 8-36: Release areas in the Stage 2 Concept Plan Area

Release area	Lot yield
Elderslie (Camden)	2000 lots
Spring Farm (Camden)	Between 3717 - 4083 lots
Menangle Park (Campbelltown)	4200 lots

The development of the new release areas has potential total of 10,283 lots. It would be assumed that the increase in traffic flow would be proportionate to the increase in housing lots released. Therefore the increase in private vehicles would be in the order of 10 000 vehicles. It is anticipated that this increase will contribute a greater traffic impact over the long term resulting in improved road services and an expansion of the road network in the locality. Such an increase in the area would reduce the potential impacts of increased traffic flow associated with the development of new wells. However, this will not happen until after the wells are constructed and operational when traffic impacts resulting from the expansion will be minimal.

However, further roads will be developed in this area as part of the future urban (residential, commercial and industrial) development. AGL has sought to locate the proposed wells close to the proposed arterial roads in order to minimise future potential impacts to future urban development in the area.

8.13.3 Potential Impacts

The proposal will result in additional vehicles, including heavy vehicles, transport machinery and personnel to and from the well surface locations with the most significant impact being through the construction phase of the project. The production and post development phases of the project will result in intermittent vehicle activity associated with maintenance and testing, and installation of in-field compression and re-fracture stimulation of wells. Similarly, the closure and rehabilitation phase of the project will result in some additional vehicle movements over a relatively short period of time.

Construction

The RTA's *Guide to Traffic Generating Developments* identifies that development related to chemical, petroleum and coal products generate low employee density and low commercial vehicle generation rates (RTA, 2002). Additional traffic generated by the proposed construction of the well surface locations is dependant on the particular phase of construction being undertaken.

The worst case scenario used in this assessment, up to six well heads at one surface location, for the construction and drilling works proposed would be undertaken at each individual surface location with only relevant equipment for that activity required to be transported and therefore impacting on traffic. During the construction activities machinery would be generally maintained on-site for the duration of the works resulting in two major heavy vehicle movement cycles (one for the machinery to come in and one to take the machinery out). Equipment and machinery to be transported would include a drill rig, mud pumps, generators, equipment, casing and tubing for up to six wells, demountable buildings and personnel vehicles. This worst case assessment indicates that other drilling scenarios would reduce the quantity of vehicle movements and some of the equipment required for the construction works.

Given the indicative number of heavy vehicles operating on roads within the locality (**Section 8.13.2**) the increase in heavy vehicles resultant from the proposed works is not considered to be a significant increase. The heavy vehicle movements would be restricted to

two main movement cycles as noted above. The increase in vehicles can be accommodated within the existing capacity of the roads and it is not anticipated to cause significant adverse impacts to the traffic flow of the locality.

The construction works have the potential to impact on roadways and access ways through the increase in vehicles, the need for additional access ways, and requirements for manoeuvring within the proposed work areas. This may result in increased vehicles in some paddock areas and property access roads for some period during the construction phase. This is not expected to significantly impact on the locality given the temporary nature of the activities and current land use and development around the proposed well surface locations.

A secondary impact as a result of the construction of the well surface locations would be the installation of gas gathering lines to connect with the existing gathering system within parts of the road reserve. The gas gathering lines would extend from the individual well surface locations to interconnect with existing low pressure gas gathering lines to transport the gas to the gas plant. This would involve trenching adjacent to roadways which may result in temporary disruptions to traffic flows. These works would be undertaken out of peak traffic times and would be conducted under controlled traffic conditions minimising impacts to road users.

Production

Traffic movements during the production phase of the project would be associated with the general maintenance and monitoring of the well surface locations, however, the well heads will have the capacity to be controlled remotely, reducing the need for vehicle access. Should vehicles be required during the production phase for monitoring and basic maintenance, it would primarily involve a single vehicle making multiple site visits in a single trip as required. The impact of this single vehicle would be negligible to the overall distribution of traffic and therefore has not been further addressed.

During major maintenance or work over, vehicles including a work over rig and equipment vehicles would be required during these works, however, they would be limited to single movements to and from the site, remaining onsite during the proposed activity.

Continuous staffing would not be required at the individual well surface locations with the production monitored remotely from the gas plant, therefore minimising the daily traffic required for the operation of the proposed well surface locations.

Post Development

Traffic increases during the post development phase would be based on site specific needs and conditions and would include re-fracture stimulation operations and infield compression.

Re-fracture stimulation and compression works would result in the greatest impacts during the post development phase. Vehicles including a rig and equipment vehicles and light vehicles would be required during these works, however, they would be limited to single movements to and from the site, remaining onsite during the proposed activity. Additionally, the twinning of gas gathering lines would occur within the road reserve. These activities would occur as required, subject to further future Project Approval. It is anticipated that at the time of these works the locality would have experienced an altered traffic regime due to urban (residential, commercial and industrial) expansion and associated road upgrades (refer to **Section 8.1**). The road upgrades and network modification is expected to result in improved traffic regulation and provide additional carriage ways for vehicle transport. Concept Approval within the Stage 2 Concept Area is sought for re-fracture stimulation and infield compression works and these would be subject to more detailed assessment in subsequent Project Applications.

Given the above modifications to the existing traffic regime the likely increase in traffic flow of the locality and the minor infrequent and temporary nature of vehicle movements associated with this phase of development, it is considered unlikely that the post development works would adversely affect traffic flows in the local area.

Closure and Final Rehabilitation

Closure of the well surface location would be undertaken at the end of the production life of the well, which is estimated to be 10-15 years. Based on the program for future urban (residential, commercial and industrial) development, it is likely that residential development would be located in proximity to individual well surface locations and as such an improved urban road network would exist in the area to accommodate the increase in vehicle movements in the locality.

Traffic generation anticipated from the proposed closure and final rehabilitation of well surface locations is likely to include light vehicles and trucks. The movements of these vehicles are likely to be site specific based on the required levels of works at each individual location. It is generally anticipated that two main daily movements would occur, once to the site and once from the site, for the duration of works.

These vehicles are expected to utilise the upgraded road network of the proposed urban development in the locality. It is not anticipated that the vehicles required for the closure of wells and rehabilitation of the site would have adverse impacts on traffic in the locality. On this basis, the increase in vehicle movements during this phase of development would be finite and temporary, ceasing upon completion of the works.

8.13.4 Mitigation Measures

The following mitigation measures would be implemented to minimise potential impacts on the traffic and transport of the Stage 2 Concept Area and the Spring Farm and Menangle Park Project Areas. A greater level of detail regarding site establishment, site constraints and site specific mitigations measures for the Stage 2 Concept Area will be detailed in future project applications.

Construction

- A Traffic Management Plan will be developed for the project area incorporating any previous traffic management proposed for well surface locations and/ or gathering line construction as appropriate;
- Unnecessary vehicle movements would be minimised where possible;
- Appropriate notification of potential roadway disruptions would be displayed/ issued in advance to road users and local residents;
- Vehicle operators would be advised of designated access routes and roadways. These specific routes would be used to access sites to minimise potential impacts on larger areas of the locality;
- Transportation of equipment and machinery likely to cause delays to traffic flows would be undertaken outside standard work hours, and would be timed to avoid peak traffic flows, wherever possible; and
- All works undertaken in proximity to roadways would be conducted under controlled traffic conditions.

Production

- Unnecessary vehicle movements would be minimised wherever possible.

Post development

- Transport routes for equipment and machinery would be reviewed, considering updated road alignments, to strategise a route of minimal impact.

Closure and Final Rehabilitation

- Vehicle movements would be minimised to reduce the potential to impact on traffic within the locality; and
- Transport routes for equipment and machinery would be reviewed, considering updated road alignments, to strategise a route of minimal impact.

8.13.5 Residual Impacts

Residual impacts which may be experienced as a result of the proposed works, include a minor increase in traffic volumes for short periods of time. Given the generally minor and temporary nature of these impacts, the proposed development is considered to be acceptable in terms of traffic and transport.

8.13.6 Conclusion

As the urban development proceeds within the locality and new roads are provided, requirements for, and location of access roads may vary. The Proponent will work with this to adapt to the evolving nature of road development and access provision in the locality. The traffic and transport impacts associated with the proposed development are negligible when considered in light of the existing and future traffic situation, having regard to the relatively minor increase in additional vehicles, and the temporary and relatively short term duration of vehicle related activities.

8.14 Waste Management

8.14.1 Overview

The *NSW Waste Avoidance and Resource Recovery Strategy 2003* (the Waste Strategy) sets out principles incorporating the adoption of measures which avoid unnecessary resource consumption, and promote resource recovery, including reuse, reprocessing, recycling and energy recovery. Four key areas are identified where outcomes must be achieved in order to avoid and manage waste. These include:

- Preventing and avoiding waste;
- Increasing use of renewable and recovered materials;
- Reducing toxicity in products and materials; and
- Reducing litter and illegal dumping.

Waste management measures proposed for this project will encourage efficient resource use alternatives, re-use and recycling. Waste that cannot be re-used or recycled will be disposed of in an appropriate manner.

8.14.2 Potential Impacts

The proposed development involves a number of activities that will result in the generation of waste materials. Wastes generated within the Stage 2 Concept Area and the Spring Farm and Menangle Park Project Areas would largely be the same. Waste would predominantly be generated during the construction phase of works from activities including:

- Civil works associated with the construction and preparation well surface locations and drill pads;
- Drilling activities;
- Fracture stimulation (fracture stimulation and re-fracture stimulation);
- Initial rehabilitation of surplus construction areas; and
- Sanitary waste from contractors and personnel on site.

Surplus materials expected to be generated during these activities includes:

- Excavated topsoil resources removed from access roads, drill pits and construction footprint areas;
- Excess construction materials such as materials used in the construction of silt fencing and wire fencing around well surface locations;
- Excavated rock and rubble;
- Cleared exotic vegetation;
- Drill cuttings generated during drilling of wells; and
- Formation waters generated during the fracture stimulation procedure (expected to be brackish to saline in nature).

Wastes generated during the production and post development phases of proposed development are expected to be minimal. Re-fracture stimulation may be carried out during the post development phase of works on existing wells where a production issue is identified, however, this would generally not be required for all wells. The re-fracture stimulation procedure would generate waste similar to wastes generated during fracture stimulation.

During the closure and final rehabilitation phase of development, well surface locations would be returned to the pre-operational land use and condition or better. Waste materials likely to be generated during these activities may include:

- Crushed rock removed if required from temporary hardstand areas and access roads; and
- Excess construction materials such as materials used in the construction of silt and wire fencing around well surface locations.

8.14.3 Environmental Safeguards

During all phases of the project, management measures will be implemented in order to ensure that waste generation is minimised and that all waste suitable for reuse or recycling is handled appropriately. Wastes requiring disposal would be removed from the site and disposed of at a licensed waste facility.

The following environmental safeguards would be implemented to ensure that waste generated during the life of the project is minimised:

- Waste generated would be reused or recycled where possible;

- Excavated topsoil removed during the construction phase would be stockpiled and appropriately maintained onsite for reuse during initial rehabilitation of surplus construction area;
- Soils excavated from trenches and drill pits will be temporarily stockpiled for reuse during backfill or well surface location initial rehabilitation;
- Excess construction wastes which are not suitable for reuse or recycling would be disposed of at a licensed waste facility;
- Exotic vegetation cleared from construction areas would be mulched and stockpiled onsite and maintained appropriately for reuse during initial rehabilitation. Excess mulched organic material would be removed from the site and disposed of at a licensed waste facility as appropriate;
- Formation waters removed from coal seams following fracture stimulation and re-fracture stimulation would be transferred from the drill pit either reused for future fracture stimulation or stored in tanks for disposal at a licensed waste facility or into the water distribution network, and into the centralised storage pits for reuse at other well surface locations;
- Appropriate spill, incident management and response procedures would be developed and implemented through EHSMP and ERP would include measures to avoid spillages of chemicals, liquids and other wastes;
- Domestic waste such as glass jars, aluminium cans, paper and compostable matter would be placed in a dedicated container for removal off site;
- All waste to be disposed offsite would be classified, transported and disposed of in accordance with the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (DEC, 2004); and
- Portable toilet facilities would be installed in construction areas during the construction period and maintained by a waste contractor.

Prior to the commencement of works, all personnel would be informed of waste management and disposal procedures to be undertaken on site.

8.14.4 Residual Impact

The proposed development will result in the generation of waste from all phases of the project, however, it is expected that the majority of waste generated would be during the initial construction phase, and be temporary in nature. While the generation of waste requiring offsite disposal will be unavoidable, where possible, wastes would be reused and recycled in accordance with the principles of the Waste Strategy in order to minimise residual impacts associated with the generation of waste.

The implementation of environmental safeguards identified in **Section 8.14.3** would minimise impacts associated with the generation and management of waste resulting from the proposed development, therefore residual impacts are considered to be temporary and manageable.

8.14.5 Conclusion

This EA has identified the potential for the generation of waste during all phases of the proposed development, however, it is likely that a majority of the waste generated will be during the construction period, and would be temporary in nature. Furthermore, the waste generated requiring offsite disposal is not expected to be substantial, as much of the waste including

excess topsoil, mulched vegetation and formation waters generated during fracture stimulation will be reused for various activities associated with operation.

The implementation of waste management measures and environmental safeguards identified in **Section 8.14.3** would further minimise and effectively manage waste generated, thus minimising residual impacts. The generation of waste from the proposed development is therefore considered to be manageable and does not represent a significant constraint to the project.

8.15 Rehabilitation and Final Landform

8.15.1 Overview

The overall objective of undertaking rehabilitation at each of the well surface locations is to return the land to pre-operational land use and condition or better. Rehabilitation of well surface locations would also minimise residual impacts of the proposed development on land use within the Stage 2 Concept Area and Spring Farm and Menangle Park Project Areas. Rehabilitation of well surface locations would be undertaken in two stages. These include:

- Initial rehabilitation of surplus construction footprint following completion of the construction phase; and
- Final rehabilitation of well surface locations following closure of the wells.

This section describes the existing land uses and discusses the processes and environmental safeguards to be implemented during both of the stages of rehabilitation, to ensure that the final landform is representative of pre-operational land use and condition or better and it fits with future land use.

8.15.2 Existing Environment

Stage 2 Concept Area

The landform of the Stage 2 Concept Area is characterised by low lying, gently undulating plains and rolling low hills and rises, with the Nepean River a dominant feature of the landscape. The region currently comprises a mix of semi-rural and urban, industrial and commercial development scattered between green belts and isolated areas of remnant vegetation.

Spring Farm Project Area

The Spring Farm Project Area is located on the northern terraces of the Nepean River and on the western slopes of the low hills which form part of the Mount Annan Botanical Gardens and the William Howe Reserve (CC, 2000). The Spring Farm Project Area well surface locations have a predominantly south western aspect with views across the extensive Nepean River floodplains. Landform is gently undulating with steeper sections to the east of the site reaching elevations of up to 170 m Australian Height Datum (AHD). Generally the land falls away toward the Nepean River in the south with an extensive floodplain adjacent to the River.

Several modifications to the landscape have occurred since European settlement including the formation of large dams, roadways, substations, mining sites, waste disposal/ recycling facilities and residential areas. Much of the Project Area has been cleared of vegetation for grazing and farming purposes with a noted remnant vegetation corridor in the vicinity of the Nepean River and extending along Jacks Gully (Hazelton and Tille, 1990). Mining and intensive agriculture activities have altered the landscape creating some depressions, exposed areas and gully systems.

Spring Farm has been identified as an urban land release area. Up to around 4,080 new dwellings are expected to be provided within the Spring Farm release area (Camden Council DCP 2006), in a range of housing forms including single dwellings on individual lots, attached housing and multi-unit housing, together with land uses required to support the future residential population. As part of the future development of Spring Farm, bushland corridors will be established, along creeklines to facilitate the conservation of endangered ecological communities.

Menangle Park Project Area

The Menangle Park Project Area is located on the eastern floodplain and terraces of the Nepean River. The area has a predominantly westerly aspect with relatively low lying landform and generally falls within the Nepean River floodplain. Drainage patterns within the site slope to the west toward the Nepean River. The Menangle Park Project Area has been modified since European settlement including the formation of dams, roadways, rail lines, mining sites and residential areas. Much of the area has been cleared of vegetation for grazing and farming purposes with remnant vegetation primarily located in the riparian corridor of the Nepean River and along drainage lines. It should also be noted that there is an extracted sand resource in this area.

Similar to Spring Farm, Menangle Park has been set aside for future urban development having been included by the State Government on the Metropolitan Urban Development Program in 2001, with an estimated yield of some 4,200 lots.

8.15.3 Potential Impacts

As previously outlined, rehabilitation of well surface locations will be undertaken in two stages; initial rehabilitation of surplus construction areas, and closure and final rehabilitation. These are discussed below.

Initial Rehabilitation

The initial rehabilitation of surplus construction areas would be undertaken following the construction and well commissioning phases of the development. The initial construction footprint would generally be up to approximately 10,000m², comprising a level well pad area and drill pit measuring up to 25 m x 25 m. The drill pit would have an excavated depth of approximately 2 to 3 m.

Once the well completion and initial work over has been undertaken, surplus construction areas would be rehabilitated, and the construction footprint surrounding the well would be reduced to approximately 45 m x 45 m. Typically, only the immediate wellhead infrastructure and equipment required for well commissioning would remain at the well surface location.

The initial stage of rehabilitation works would include:

- Backfilling excavated areas such as drill pits when no longer required as part of operation; and
- Rehabilitation, contouring, and revegetating disturbed areas surrounding well surface locations using stockpiled soil.

Potential impacts during these initial stages of rehabilitation works include:

- Erosion and sedimentation from exposed areas within the construction footprint, such as access roads, drill pad and drill pit;
- Erosion and sedimentation from stockpiles of soil being stored for use in rehabilitation works.

Closure and Final Rehabilitation

Given that both project areas have been identified as future urban release areas and as the closure and final rehabilitation phase can be expected anywhere between 10 – 15 years after completion of construction, it is likely changes in the surrounding land use from semi-rural to urban (residential, commercial and industrial) would have occurred for many of the well surface locations.

Upon completion of operations, closure of the wells and rehabilitation of the well surface locations and gas gathering systems would be undertaken. Wells are expected to operate for some 10 to 15 years, therefore the closure and final rehabilitation of well surface locations would typically not occur until this time.

This stage of rehabilitation works would include:

- Removing plant and equipment from well surface locations and gas gathering systems if required;
- Filling in excavated areas and trenches;
- Sealing and cementing wells;
- Lightly ripping disturbed areas; and
- Rehabilitation, contouring, and revegetating disturbed areas. Revegetating would include broadcast of seed and ongoing maintenance and monitoring activities.

Final rehabilitation would also involve removal of the steel pipe/ casing from the coal seam.

The preferred method of rehabilitation for the gas gathering system would be to purge with air or water in order to remove remaining gas, seal and then leave in position to prevent any further disturbance. This method would be subject to consultation with the land owner. Should removal of the gas gathering system be required, the excavated trench would be backfilled and rehabilitated, including contouring and revegetating.

Potential impacts during closure and final rehabilitation include:

- Erosion and sedimentation from exposed surfaces during rehabilitation works, such as access roads, well surface locations and gas gathering lines, resulting in potential impacts to water quality of receiving waters; and
- Erosion and sedimentation from stockpiles of soil being stored for use in rehabilitation works.

8.15.4 Environmental Safeguards

During each stage of rehabilitation, mitigation measures and environmental safeguards would be implemented to minimise potential impacts.

All rehabilitation works would be undertaken with maximum regard to environmental protection including training operators in the principles of least possible disturbance and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation. Requirements for managing erosion and sediment control and rehabilitation are to be determined for each site with reference to methods in Landcom (2004) Soils and Construction.

The planned limit of disturbance is to be flagged to avoid disturbing adjacent areas, in particular vegetation and riparian areas (40 metres from a major drainage line). Topsoil is to be separated

from subsoil and protected during storage and replaced in the appropriate order. Revegetation is to be undertaken as soon as works are complete. Reseeding is to be undertaken if the site has not shown good germination within two months of sowing.

Other general mitigation measures and environmental safeguards that would be implemented include:

- Installation of erosion and sedimentation control measures such as silt fencing surrounding exposed areas or soil stockpiles;
- Erosion and sedimentation controls would be checked and cleaned weekly to ensure effective operation;
- Where available, soil stockpiled for use in the initial rehabilitation stage of works would be utilised to fill excavated areas such as drill pits. Topsoil is to be separated from subsoil and replaced in an appropriate order;
- The ground surface would be contoured to match surrounding land to avoid directing runoff away from natural drainage lines;
- Where the surrounding land use is agricultural, consultation would be held with the landowner to determine crop cover required;
- Where seeding and replanting is to be carried out, native endemic species equivalent to those already found on the site are to be used where possible;
- Stock proof fencing would be installed surrounding rehabilitated areas until sufficient surface/ ground cover is established;
- Regular maintenance and monitoring is to be carried out at each site on completion of the rehabilitation process in order to identify the presence of weeds, subsequent erosion and changes in the drainage patterns.

These mitigation measures and safeguards would be incorporated into the Proponent's existing EHSMP which would be implemented at each well surface location. This would guide both the rehabilitation of the surplus construction area, and the closure and final rehabilitation stages of work.

8.15.5 Residual Impacts

Both the initial rehabilitation of surplus construction areas and the closure and final rehabilitation of well surface locations would result in the land being returned to a land use consistent with the pre-operational land use of the site or better. While minor and temporary impacts may occur during rehabilitation activities, and the transient and temporary nature of the proposed activities, there is considered to be no significant net residual impacts associated with the rehabilitation of the proposed development.

8.15.6 Conclusion

The rehabilitation of the subject areas would ultimately return the land to pre-operational land uses. Rehabilitation activities would occur in two discrete phases; namely initial rehabilitation and the closure and final rehabilitation. Whilst the proposed development would be a temporary and transient use of land, the assessment identified minor potential impacts associated with each of the rehabilitation stages. However, the development and implementation of appropriate environmental management measures and the EHSMP would ensure the minimisation of impacts associated with rehabilitation activities.

8.16 Cumulative Impacts

Cumulative impacts can result from a number of different elements within a project, as well as from other projects with interacting impacts in the same locality. The cumulative impact of a project is a combination of each elemental impact of the project. Cumulative impacts on the environment can be considered on a project basis, taking into account each element on a locality or regional basis as well as taking into account the interacting impacts of other projects in the immediate locality and the region.

8.16.1 Cumulative Impact of the Project

The cumulative impacts of the proposal have been considered in relation to each identified environmental issue in **Sections 8.1 to 8.15** of this EA. Cumulative impacts of the proposal, particularly with respect to hazards and risks, noise and vibration, flora and fauna and heritage have been considered in each of the technical studies undertaken in respect of this proposal.

The potential impacts for each of the environmental factors were considered to be minimal provided the prescribed mitigation measures and safeguards are implemented. It should also be noted that the well surface locations are a temporary and transient land use which will be completely removed after 10 to 15 years in the closure and final rehabilitation stage. As a result, no significant cumulative impact is expected.

8.16.2 Cumulative Impact with Other Projects

The cumulative impacts of the proposal must take into account other major projects planned in the local area. These include:

- Spring Farm and Menangle Park urban (residential, commercial and industrial) development;
- Transgrid Macarthur Substation (located adjacent to MP04);
- Potential future sand extraction within the Concept Area; and
- Harness racing upgrade proposal.

The Proponent has undertaken extensive consultation with landholders in the area during the early project design phase to ensure that wells and other infrastructure would be sited to accommodate the respective primary land uses. The result of this consultation has been the relocation, removal or redesign of the proposal was submitted for approval.

The use of alternative designs and technologies such as SIS technology, co-location of wells resulted in the Proponent significantly reducing the number of wells from around 45 to 16 and also reducing the overall footprint of the project. In Spring Farm Project Area, the proposal was originally for around 20 wells which has been reduced to four (4) well surface locations and in Menangle Park Project Area there were around 25 wells originally proposed, while now there are 12 well surface locations. This amended project design has been the result of extensive consultation with surrounding landowners.

Additionally, the environmental envelope assessment approach allows the well surface locations to move within a 50 metre radius in Spring Farm and a 100 metre radius in Menangle Park (to recognise the differences in the level of information about future urban land releases) and 25 metres either side of gas gathering lines and access roads mean that there is flexibility and an ability to deal with future issues as they arise.

As previously noted, the Spring Farm and Menangle Park Project Areas have been earmarked for future urban (residential, commercial and industrial) development, which would result in urban development being located in close proximity to the well surface locations in some instances. A Master Plan has been developed for the Spring Farm release area, with up to 4,083 new dwellings expected to be provided in a range of housing forms including single dwellings on individual lots, attached housing and multi-unit housing, together with land uses required to support the residential population.

Further environmental and planning studies are yet to be undertaken for the Menangle Park release area which has a more protracted development timeframe than Spring Farm, however it is estimated that some 4,200 lots would be released as part of this urban development land release.

The construction of wells and associated infrastructure within areas of future urban development land release is expected to be completed prior to the commencement of development and subsequent occupation of these areas. This would therefore minimise potential cumulative impacts resulting from disruptions to amenity associated with traffic, air quality and noise impacts generated during construction. For future development with the Concept Area, the application of location principles as discussed in **Section 4.3.1** would minimise potential cumulative land use conflicts.

With regard to operational activities, based upon observation of existing well fields and AGL's previous experience, operational activities are confined to the reduced wellhead location, and are therefore expected to have minimal impacts. The operational activities associated with well surface locations are therefore not likely to result in cumulative impacts with the urban development land release areas and other known projects in the area.

8.16.3 Conclusion

The cumulative impacts of the proposal have been considered with respect to impacts associated with the proposed development, as well as with impacts associated with other projects in the region. The cumulative impact assessment concluded that the project is temporary nature of the proposed activities and that would be no significant net residual impacts associated with the proposed development's interaction with other known projects in the area.

The design and assessment approach to the project allows the extraction of a strategically valuable and important energy resource in an already constrained market, while still allowing future urban (residential, commercial and industrial) development of the land.



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Figure 8.1

Indicative Spring Farm Masterplan with
Proposed Wells

Environmental Assessment -

Expansion of Stage 2 of the Camden Gas Project

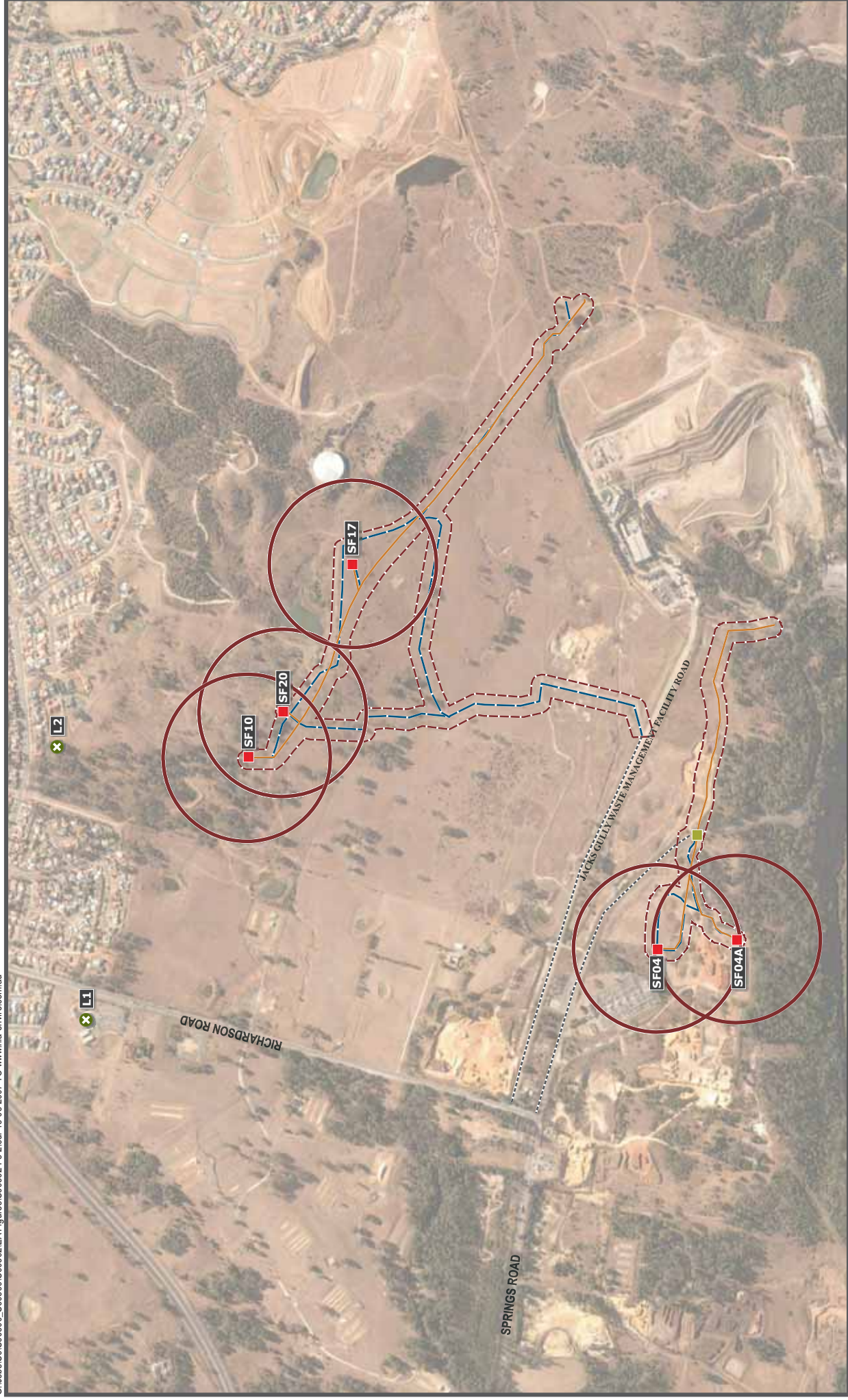


Figure 8.2

Noise Loggers- Spring Farm
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

- Well surface location assessment area
- Infrastructure assessment corridor
- Access road
- Existing access road
- Proposed gathering pipeline
- Proposed well surface location
- Gathering underbore location
- Noise Logger - St Thomas Church, Elderslie
- Noise Logger - Gundungurra Reserve, Spring Farm

Merged
with ENSR
in 2007

HILA

AGL

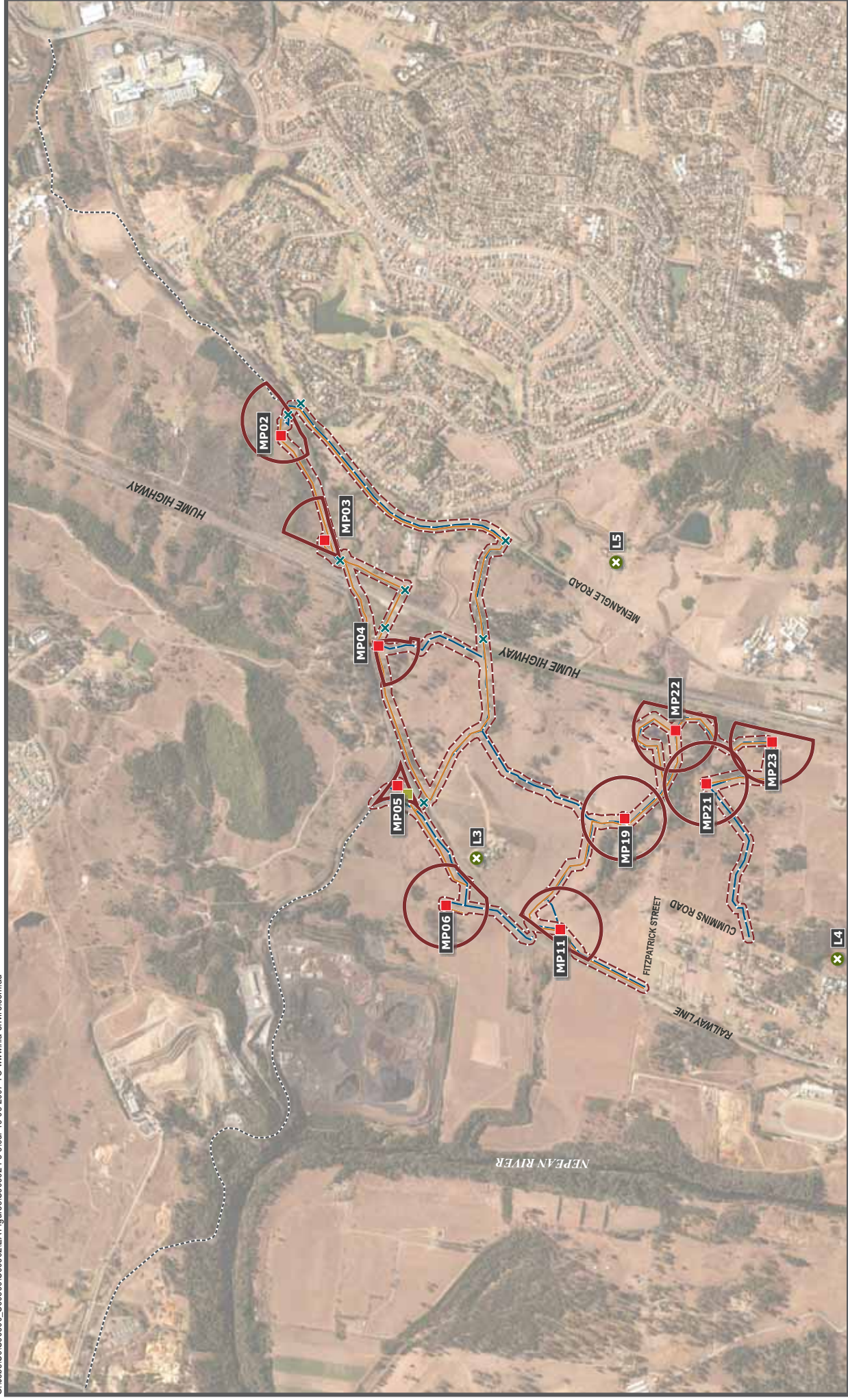


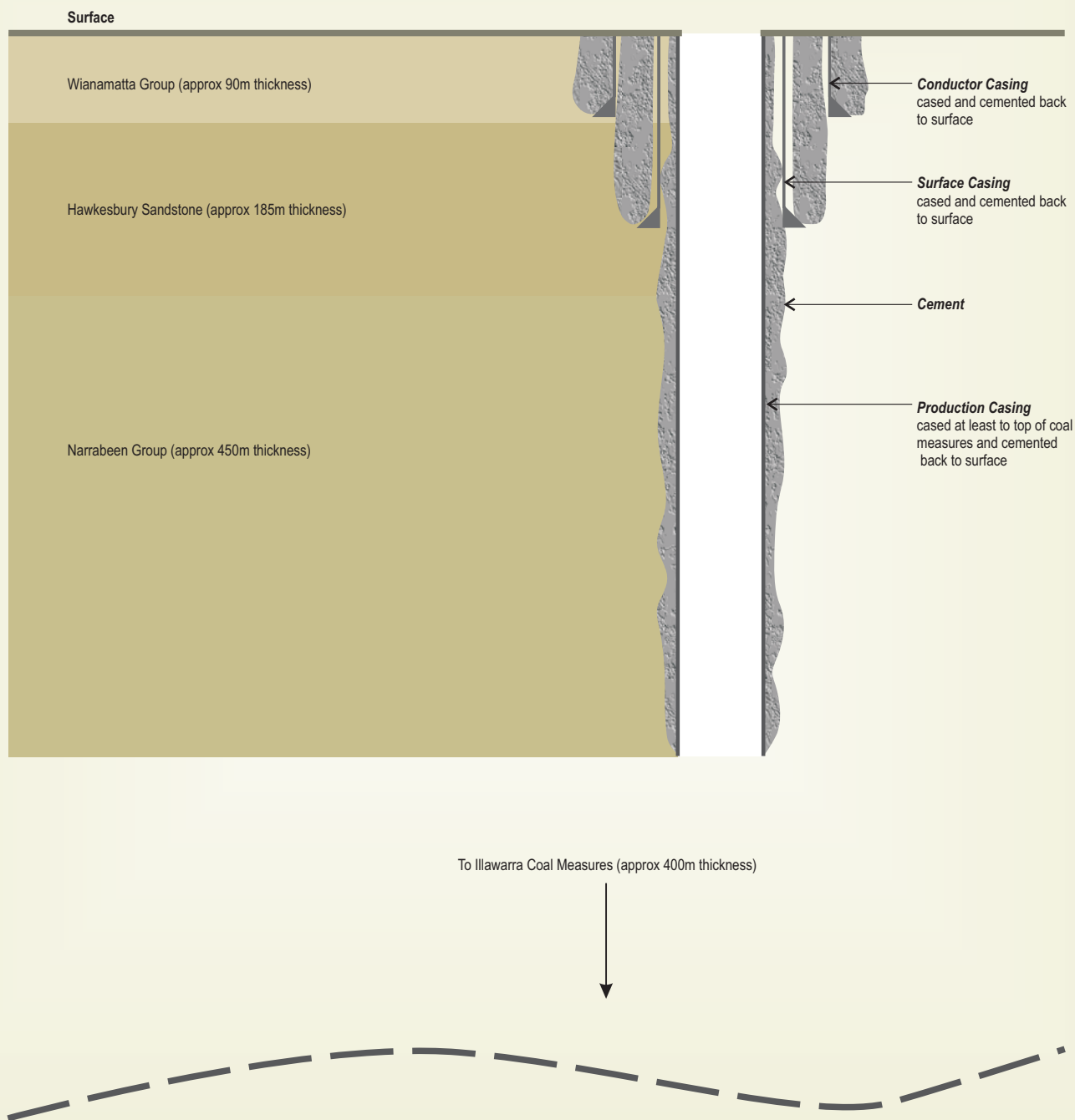
Figure 8.3

Noise Loggers - Menangle Park (North)

Environmental Assessment -

Expansion of Stage 2 of the Camden Gas Project

- Well surface location assessment area
- Infrastructure assessment corridor
- Access road
- Existing access road
- Proposed gathering pipeline
- Proposed well surface location
- Gathering underbore location
- Gathering line crossing location
- Noise Logger - Glenlee House, Glenlee
- Noise Logger - 44 Cummins Road, Menangle Park
- Noise Logger - Sugar Loaf Residence, Sugarloaf



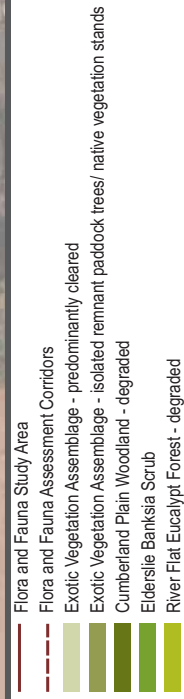
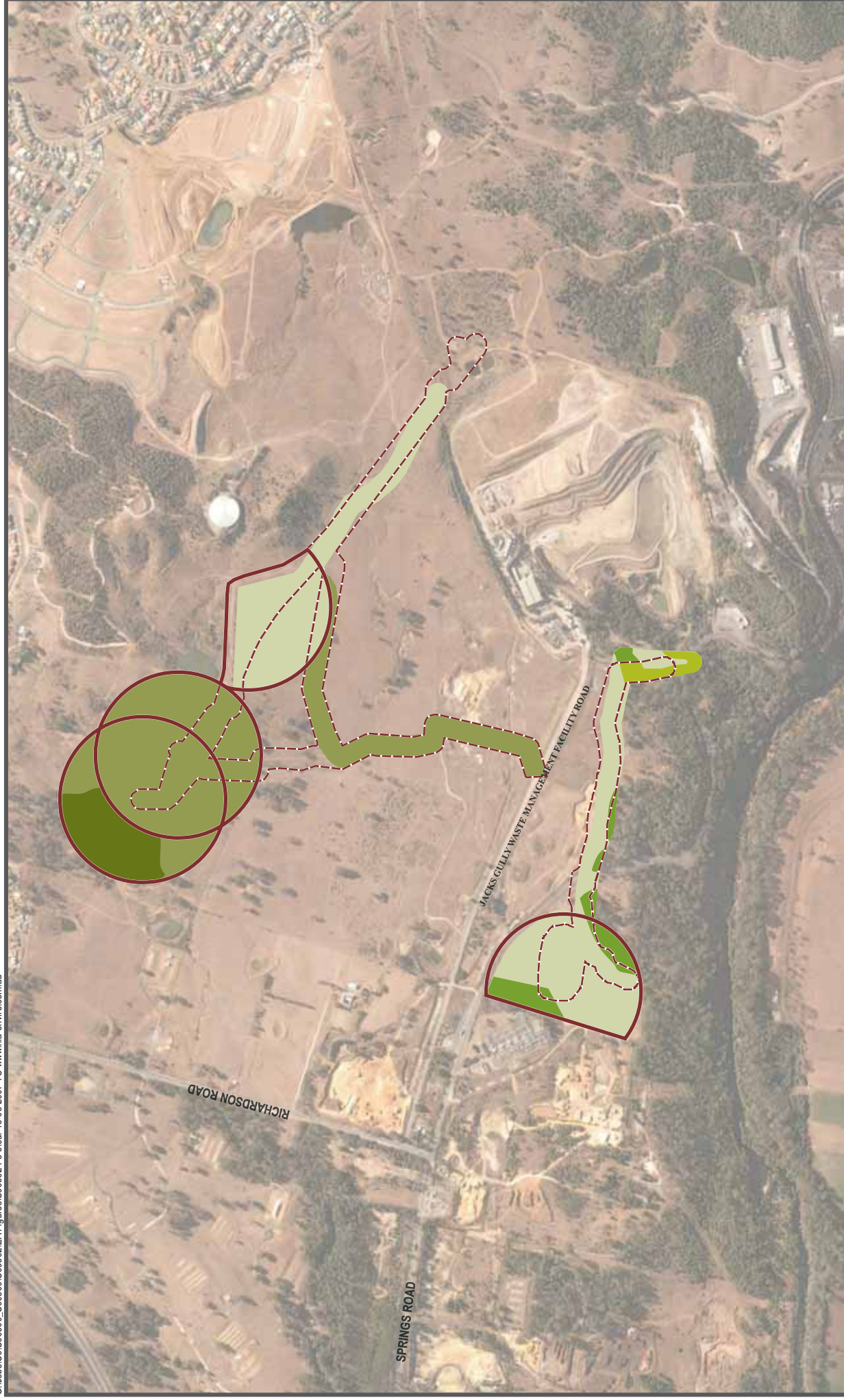
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Merged
with ENSR
in 2007

Figure 8.4

Schematic Well and Casing Construction
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project



Merged
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in 2007



Figure 8.5

Vegetation Communities - Spring Farm

Environmental Assessment -

Expansion of Stage 2 of the Camden Gas Project

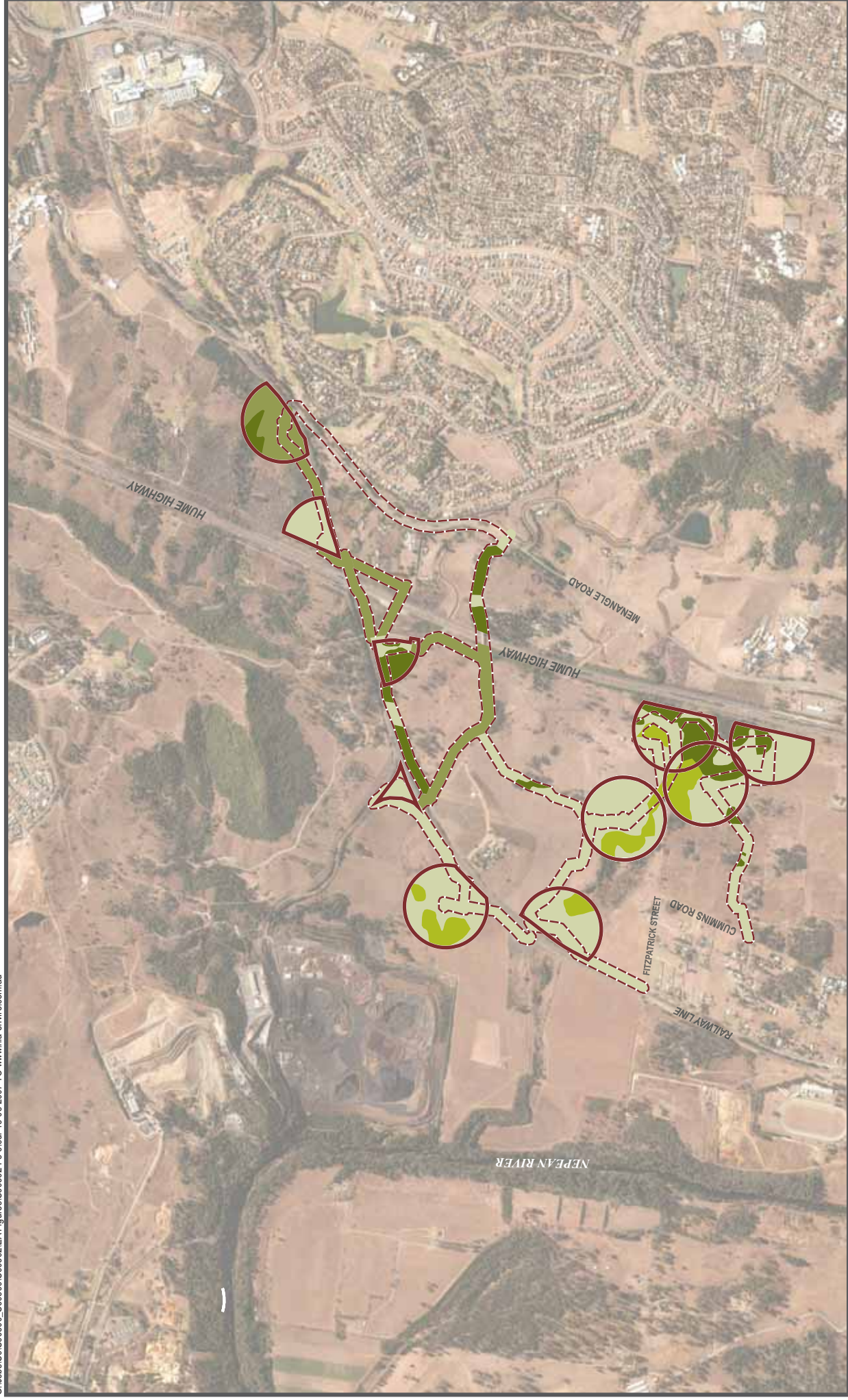
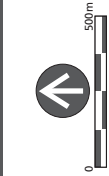
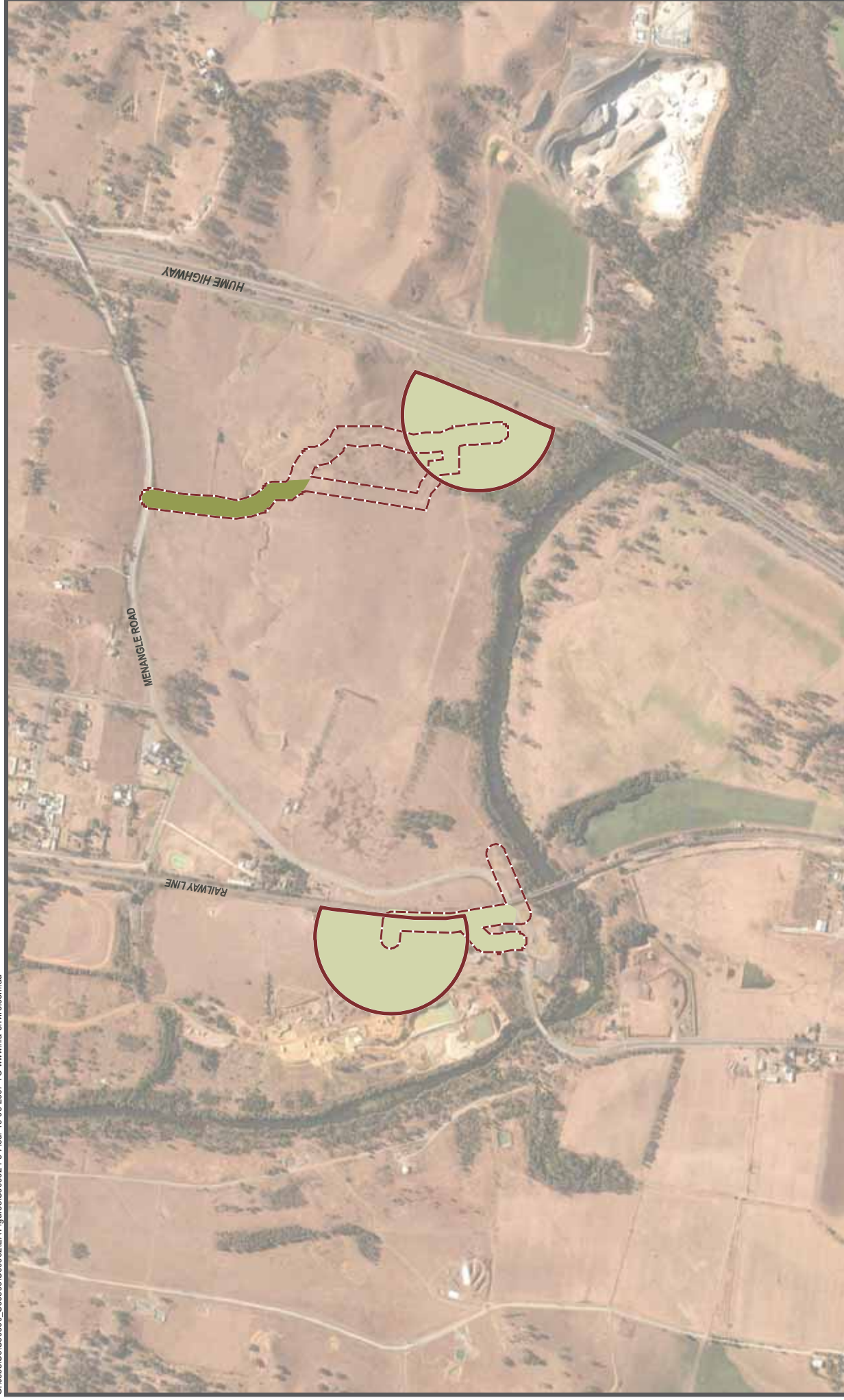


Figure 8.6
Vegetation Communities - Menangle Park (North)
 Environmental Assessment -
 Expansion of Stage 2 of the Camden Gas Project

— Flora and Fauna Assessment Study Area
--- Flora and Fauna Assessment Corridors
--- Exotic Vegetation Assemblage - predominantly cleared
--- Exotic Vegetation Assemblage - isolated remnant paddock trees/ native vegetation stands
--- Cumberland Plain Woodland - degraded
--- River Flat Eucalypt Forest - degraded





- Flora and Fauna Assessment Study Area
- - - Flora and Fauna Assessment Corridors
- Exotic Vegetation Assemblage - predominantly cleared
- Exotic Vegetation Assemblage - isolated remnant paddock trees / native vegetation stands



Figure 8.7

Vegetation Communities - Menangle Park (South)

Environmental Assessment -

Expansion of Stage 2 of the Camden Gas Project

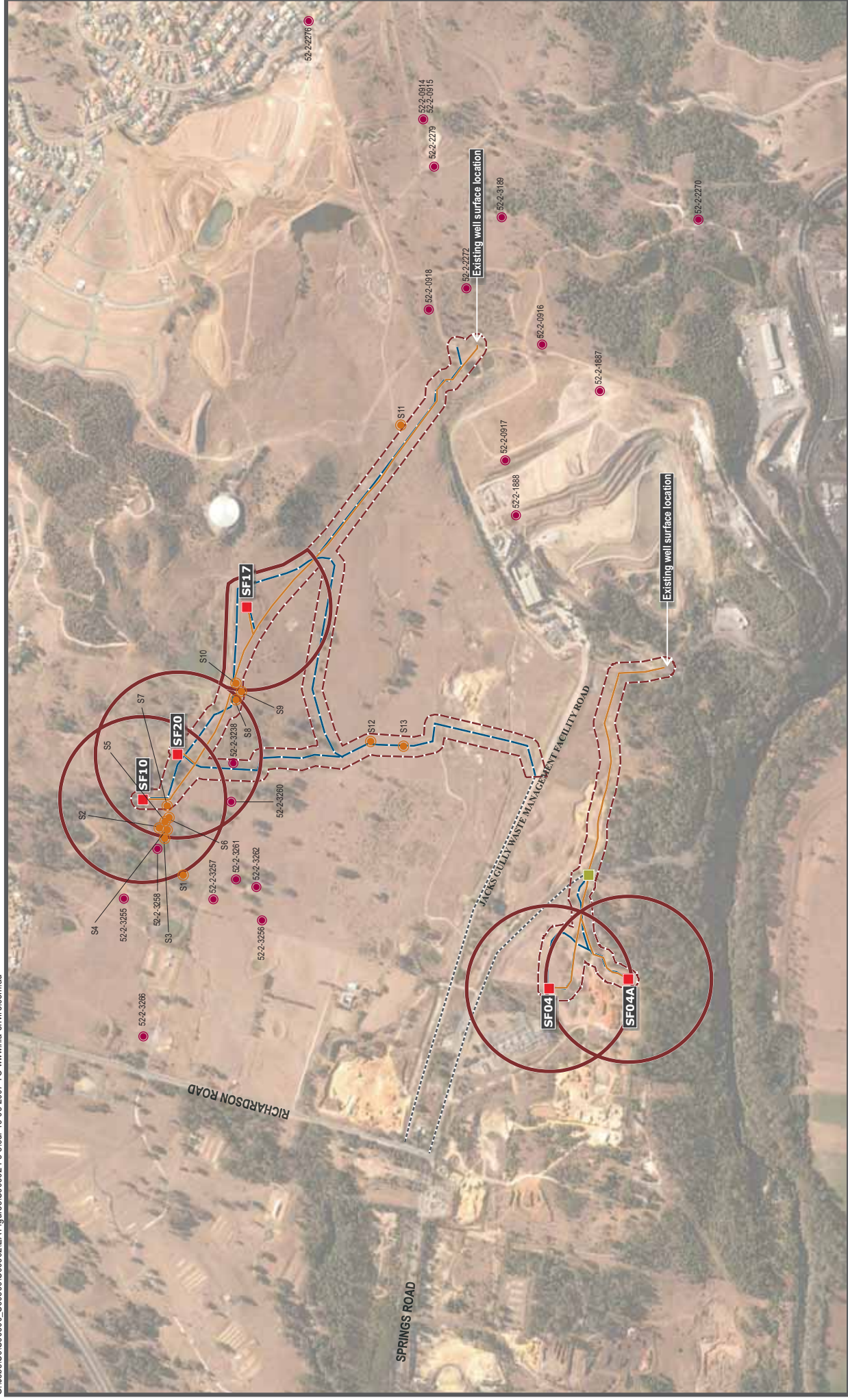


Figure 8.8

Location of Recorded AHIMS Sites

and Identified Survey Sites - Spring Farm

Environmental Assessment -

Expansion of Stage 2 of the Camden Gas Project

- Well surface location assessment area
- Infrastructure assessment corridor
- Access road
- Existing access road
- Proposed gathering pipeline
- Proposed well surface location
- Gathering underbore location
- Pre-recorded archaeological sites (November 2006)
- Archaeological sites (November 2006)

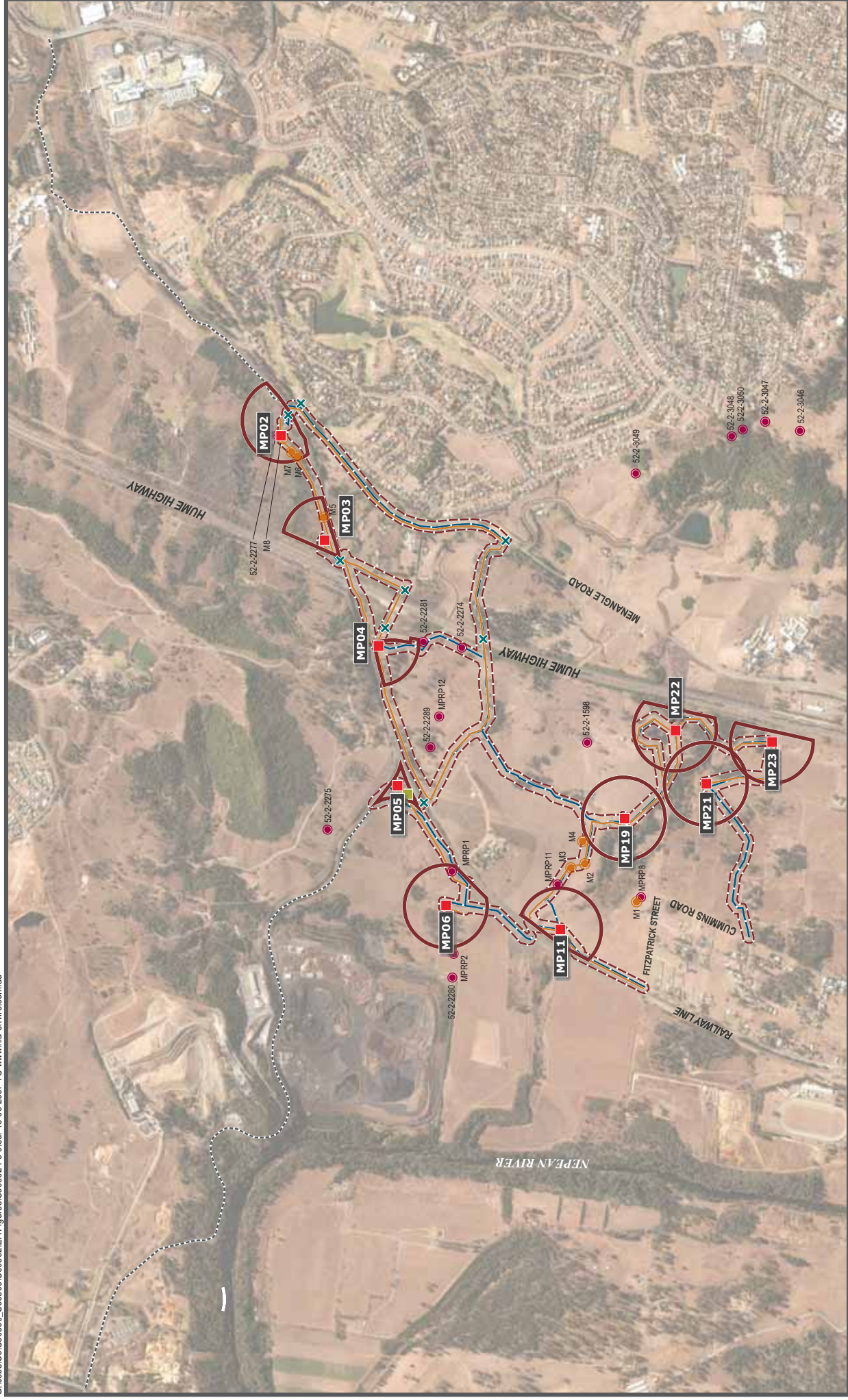


Figure 8.9

Location of Recorded AHIMS Sites

and Identified Survey Sites - Menangle Park (North)

Environmental Assessment -

Expansion of Stage 2 of the Camden Gas Project

- Proposed well surface location
- Gathering underbore location
- Gathering line crossing location
- Pre-recorded archaeological sites (November 2006)
- Archaeological sites (November 2006)
- Well surface location assessment area
- Infrastructure assessment corridor
- Access road
- Existing access road
- Proposed gathering pipeline



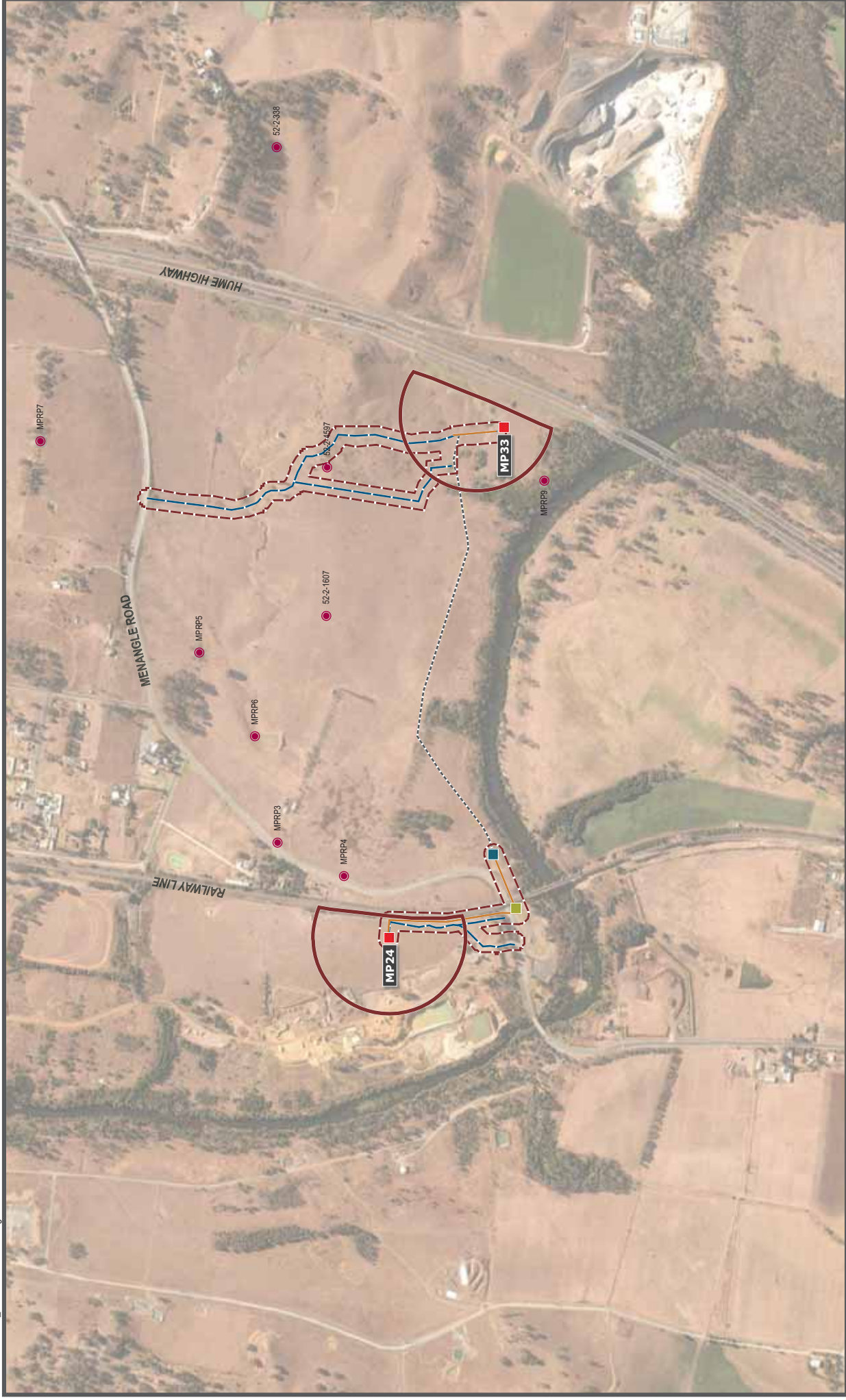


Figure 8.10
Location of Recorded AHIMS Site - Menangle Park (South)
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

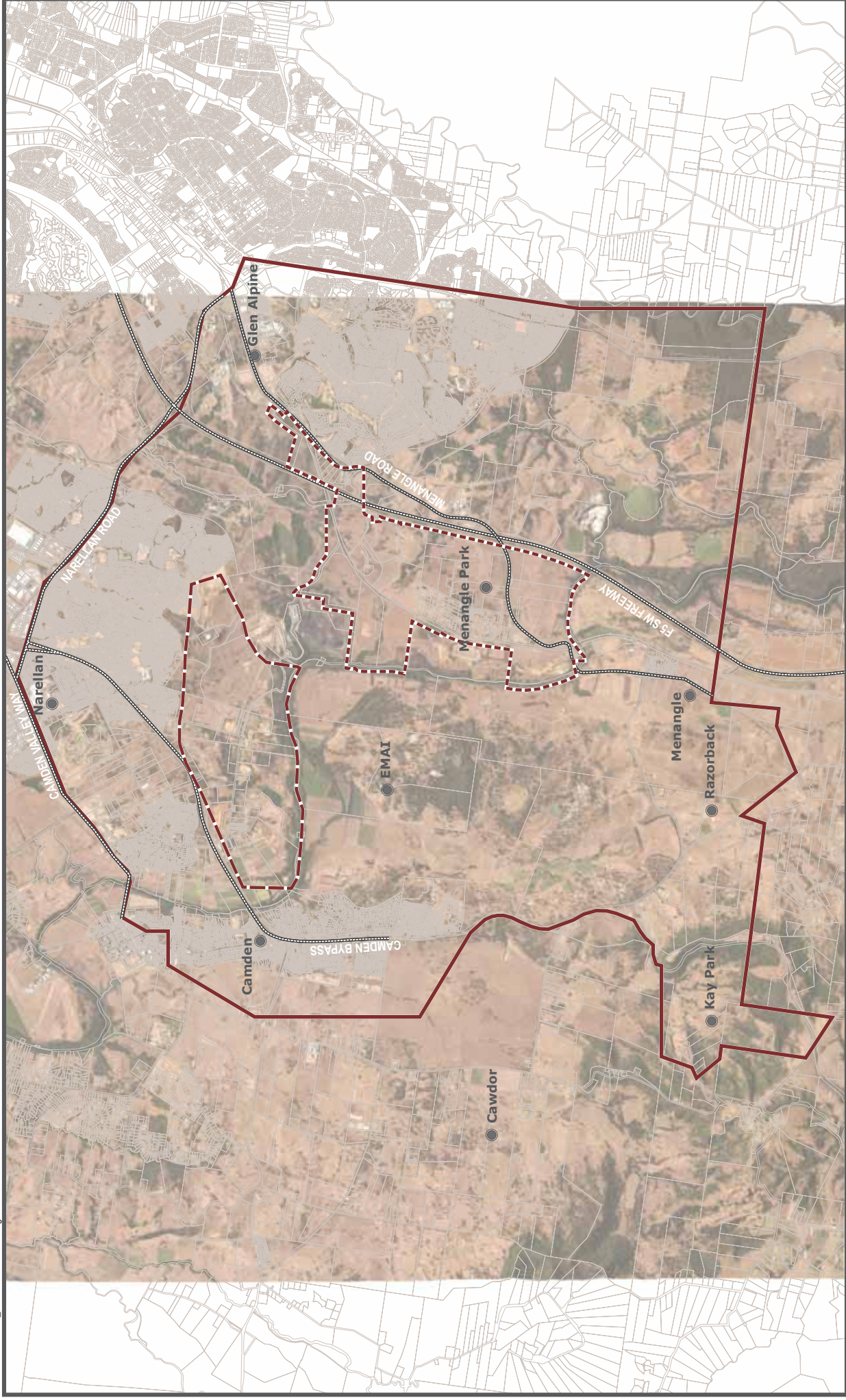
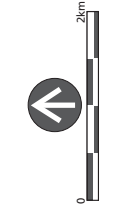


Figure 8.11
Surrounding Road Network
Environmental Assessment -
Expansion of Stage 2 of the Camden Gas Project

Stage 2 Concept Area Boundary
Spring Farm Project Area Boundary
Menangle Park Project Area Boundary
Access road



9 ENVIRONMENTAL MANAGEMENT AND COMMITMENTS

9.1 Introduction

Environmental management measures to mitigate and manage the potential environmental impacts of the proposal will be incorporated into the Proponent's EHSMPs. The Proponent currently has EHSMPs relating to the following components of the CGP:

- Well Surface Location Construction, Drilling, Completion and Production Operations;
- Gas Gathering System Construction; and
- Field Operations.

The EHSMPs detail the management measures to be implemented to minimise environmental impacts associated with the physical works undertaken to construct, establish and operate the various elements of the CGP, and are therefore more applicable to the Project application. The Proponent will update the existing EHSMPs to reflect the activities and environmental management measures outlined as part of this EA, together with existing operating conditions, which may be appropriate. Each EHSMP will be provided for the benefit of the operating staff, contractors and regulators.

Prior to commencing operations on site, the selected contractor together with the Proponent will review each EHSMP and supporting documentation to familiarise themselves with the manner in which construction will be managed and controlled.

Each EHSMP will contain details of environmental monitoring to be carried out and procedures for reporting the environmental performance of the site.

Each EHSMP will:

- Identify the potential environmental effects of site operations;
- Confirm the environmental controls to be implemented;
- Specify any conditions of approval;
- Indicate how the conditions are to be met; and
- Specify a monitoring program.

Environmental incidents will be controlled by the standards and procedures presented in the Camden Gas Project Emergency Response Plan (ERP) (see **Section 8.2**).

The Proponent is committed to responsible management and believes that:

- potential adverse environmental effects can be effectively managed; and
- potential OH&S incidents are preventable to all practical extent.

All planning, construction and operation activities will be conducted in accordance with the Health and Safety and Environmental Policy that outlines the Proponent's commitment to sound management of environmental aspects and OH&S performance for the Project.

The Proponent's objectives with regard to OH&S are:

- to provide a safe and healthy work environment for employees and contractors;
- to conduct operations with due regard to the safety of the public;
- to foster a positive attitude to health and safety at all levels of operations consistent with the philosophy that these are issues of paramount importance in all business decisions;
- to maintain appropriate standards of quality in all aspects of the Project operations; and
- to empower all employees and contractors to actively assume responsibility and accountability for safety and health.

9.2 Environmental Objectives

The Proponent's environmental objectives for the proposed project are aimed at ensuring appropriate management of the environment. The commitments outlined in **Section 9.3** of the EA have been designed to meet these environmental objectives.

Table 9-1: Construction and Post-Construction Objectives and Goals

Issue	Objective		Goal	
Construction Objectives				
Land use	1	- To minimise adverse impacts associated with the construction on existing and future land uses. - To avoid significant disturbances to land use or damage to existing infrastructure.	1.1	To ensure that rural productivity is adequately protected in the area.
			1.2	To prevent significant adverse impacts on stock.
			1.3	To avoid unacceptable disturbances to landowner assets and infrastructure.
			1.4	To ensure that complaints from landowners relating to construction activities are resolved promptly and not left outstanding or unresolved.
			1.5	To notify the landowner at least one week prior to construction commencing.
			1.6	To ensure that all construction activity is constrained to the subject site and access roads.

Issue	Objective		Goal	
Soils and Terrain	2	To minimise and where possible prevent soil disturbance and contamination caused by operations.	2.1	To limit soil erosion to an acceptable standard.
			2.2	To prevent soil contamination.
			2.3	To appropriately control soil compaction.
			2.4	To appropriately manage construction activities in waterlogged and inundated soils.
			2.5	To prevent mixing of topsoil and subsoil.
			2.6	To ensure that soil exposure times between clearing and restoration are kept to a minimum.
Noise	3	- To comply with the construction standards for noise control. - To minimise the noise impacts associated with construction.	3.1	To minimise noise pollution during the construction phase.
			3.2	To limit construction work activities to daylight hours between 7:00am and 6:00pm weekdays and between 8:00am and 1:00pm on Saturday. No work on Sundays or public holidays, except in the case of drilling of wells, which would require 24 hour activities, seven days a week, and where authorised by regulatory agencies for safety/emergency reasons.
			3.3	Where 24 hour drilling is permitted, sound mitigation measures are to be implemented where required and sound monitoring is to be conducted where required to ensure the noise is within DEC guidelines.
			3.4	To ensure that any complaints from the landholder or neighbours are appropriately addressed and that no complaints are left unresolved.

Issue	Objective		Goal	
Emissions	4	- To adequately protect air quality. - To minimise potential emissions that may cause public concern.	4.1	To control the quality and quantity of vehicle exhaust emissions.
			4.2	To control the emissions of greenhouse gases.
			4.3	To control the quantity of dust generated by earthworks and traffic movements.
			4.4	To ensure that dust is minimised through the use of regular suppression methods.
Water Resources	5	To minimise the negative impacts associated with construction and installation phases on surface water resources.	5.1	To maintain current surface drainage patterns.
			5.2	To maintain surface water quality.
			5.3	To ensure that windrows and soil stockpiles have been broken at appropriate places to allow natural surface water flow.
			5.4	To minimise the amount of water used during construction activities through effective management and recycling.
Noxious Weeds, Pathogens and Pest Species	6	To prevent the introduction and dispersal of noxious weeds, pathogens and pest species.	6.1	To appropriately control the introduction and spread of weeds, pathogens and pest species.
			6.2	To have all vehicles adequately and appropriately checked and cleaned (by the relevant authority) prior to site access.

Issue	Objective		Goal	
Flora (vegetation)	7	To minimise the loss of remnant native vegetation.	7.1	To avoid development in areas of remnant vegetation, where practicable.
			7.2	To minimise disturbances to native vegetation (including grasses and herbs).
			7.3	To carry out rehabilitation activities to promote vegetation regrowth in all disturbed work areas to a standard consistent with the surrounding area.
			7.4	Establish a photographic record of environmental monitoring stations prior to any clearing activities.
Fauna (wildlife)	8	To minimise adverse impacts on fauna.	8.1	To minimise habitat disturbance to an acceptable level.
			8.2	To ensure fauna is adequately protected from physical harm.
			8.3	To ensure that the drill pit is checked daily for trapped fauna and that fauna escape methods are provided.
Waste	9	To minimise waste creation and associated impacts.	9.1	To minimise waste creation and maximise reuse and recycling.
			9.2	To avoid land or water contamination.
			9.3	To minimise health risks.
			9.4	To avoid disturbances to visual amenity.
			9.5	To clean up and remove domestic waste from the site.
Cultural heritage	10	To protect and preserve cultural heritage.	10.1	To adequately protect cultural heritage sites and values.

Issue	Objective		Goal	
Public Risk	11	To minimise the risk to public health and safety.	11.1	To adequately protect public safety.
			11.2	To adequately reduce the likelihood of fire and ensure no fires occur as a result of Project related activities.
			11.3	To encourage load consolidation to reduce the number of heavy vehicle movements.
Visual Amenity	12	To minimise impacts to the visual characteristics of the area.	12.1	To ensure that visual impacts are maintained at an acceptable level.
Emergency response	13	To quickly and effectively minimise adverse impacts associated with an emergency situation.	13.1	To limit the impacts of an emergency through regular training and review of emergency response plans and procedures.
Post-Construction, Testing and Operation objectives				
Land use	14	To avoid significant disturbance to land use or damage to infrastructure.	14.1	To minimise disturbance to land use and damage to infrastructure.
			14.2	To ensure that no landowner issues are outstanding or remain unresolved as a result of operations.
Soils and Terrain	15	To promote and maintain soil stability.	15.1	To ensure there are no long-term erosion impacts on the site as a result of proposed works.
			15.2	To continue to monitor and manage soil erosion on the site consistent with surrounding land until the area has stabilised.

Issue		Objective		Goal
Flora (vegetation)	16	To promote and maintain regrowth of vegetation.	16.1 16.2 16.3	To monitor and maintain vegetation cover to ensure that it is consistent with surroundings. To ensure that a photographic record is maintained at all environmental monitoring station locations. To ensure that the area subject of works remains free of weeds and pathogens. No new weed establishment at the well surface locations.
Visual Amenity	17	To minimise impacts to the visual characteristics of the area.	17.1	To maintain visual impacts at an acceptable level.
Operational Noise	18	To minimise the noise impacts generated from operations.	18.1 18.2	To ensure that operations comply with relevant noise standards. To ensure that there are no unresolved complaints from the public.
Operation Emissions	19	To minimise the potential for emissions that may cause public concern.	19.1	To ensure that uncontrolled emissions are reported and acted upon immediately.
Public Risk	20	To minimise the risks to public health and safety.	20.1 20.2 20.3 20.4	To ensure that public safety is adequately protected during normal operation. To adequately reduce the likelihood of fire associated with maintenance activities. To adequately protect public safety during maintenance. To advise landowners of the nature and schedule of maintenance activities.
Emergency Response	21	To ensure that adverse impacts associated with an emergency situation are minimised quickly and effectively.	21.1	To limit the impacts of an emergency through regular training and review of emergency response plans and procedures.

9.3 Summary of Safeguards

The development and implementation of environmental mitigation measures for the project holds great significance in ensuring that potential environmental effects associated with the project are minimised. A summary of the mitigation measures developed in this EA is provided in **Table 9-2** below.

Table 9-2: Summary of Mitigation Measures

Issue	Mitigation Measures
Land Use	• Consultation with landholders during the early project design phase ensures that wells and other infrastructure can be sited to accommodate the primary land use. This has resulted in the relocation, removal or redesign of wells before the proposal is submitted for approval; • The use of SIS technology, co-location of wells and consultation with landowners has resulted in the Proponent significantly reducing the number of wells from around 45 to 16 and the overall footprint of the project. In Spring Farm, the proposal was originally for around 20 wells which has been reduced to four (4) well surface locations and in Menangle Park there were around 25 wells originally proposed, while now there are 12 well surface locations; • The environmental envelope assessment approach allows the well surface locations to move within a 50 metre radius in Spring Farm and a 100 metre radius in Menangle Park (to recognise the differences in the level of information about future urban land releases) and 25 metres either side of gas gathering lines and access roads mean that there is flexibility and an ability to deal with future issues as they arise; • Development of locational principles for works the subject of the Concept application in order to provide agencies and the community with an understanding of where the future works may occur, whilst providing the flexibility for the Proponent to determine precise locations, based on geology and consultation with landowners; • Well design and construction methods which allow for reduction in the level of wells to accommodate future development which may require re-levelling such as road construction associated with future urban (residential, commercial and industrial) development and sand mining; • Completion of the construction period (where the most significant potential impacts are likely to occur) prior to development and occupation of the surrounding land for urban purposes will minimise impacts upon future residents in the area; • Co-location of up to six well heads at a single well surface location which has reduced the footprint of the project; • Screening and revegetation; and • Redesign of the wellhead surface facilities so that either an enclosed wellhead design or an open fenced compound can be used as is needed to fit with the future land use or security as appropriate. The redesign will also relate to matters like electricity at compounds, redesigned telemetry and other equipment.

Issue	Mitigation Measures
Hazard and Risk	The Camden Emergency Response Plan will be applied to the Project and includes safeguards for the following scenarios: Well Blowout, Fire or Explosion Emergency at a Well Surface Location • The key to containing a well surface location fire is to isolate the problem area and then depressure that section of the wellhead equipment at risk, if possible. • The Person-In-Charge should ensure that Rural Fire Services details are posted and that personnel know and understand their duties. Drills should be conducted as appropriate. Bush Fire at a Well Surface Location • Isolate the problem areas and then shut in the affected well(s) at risk, so as to minimise damage from the fire. Gathering Line Emergencies • If a rapid drop in gathering line flow or pressure is observed, the fields are to be shut in at the field isolation valves. This isolates the field from the main low pressure gathering line. The well or wells supplying gas into the line where there is a concern, must be shut-in at the Master Valve. The gathering line will then be de-pressured and made safe at the Gas Plant. Oil and Chemical Spill • All spills will be handled in accordance with the APPEA Code of Practice. Security Breach • The presence on site of any individuals who have not made themselves known to the operations personnel is to be treated as a security breach. Technical safety features are built into the design of the gas wells including overpressure controls and leak and fire protection to ensure that the potential impacts associated with the proposal in terms of hazard and risk are minimised. Further details of these inbuilt design measures are provided in the QRA included as Appendix D to this report. General inspection and maintenance of wells to form part of the ongoing operation of the well in order to maintain the integrity of the equipment and systems. Measures include: • Visual inspections of each well (at least three-weekly); • Regular leak testing (soap testing, 6-monthly or more often depending on the location of the well in relation to urban development); and • Regular (yearly) testing of pressure safety valves, as per regulatory requirement.

Issue	Mitigation Measures
	In addition to the general measures which will be applied to all wells, the following mitigation measures will be applied specifically to SIS wells in order to minimise and manage the potential risk associated with the possible co-location of up to six SIS wellheads: • Well compounds are to include a fenced-off area which exceeds the identified hazardous zone; • Bollards to be installed in high risk areas to protect the well installation against damage from vehicles or other moving machinery; • The Proponent to assess the practicality of extending the fusible link past the shut down valve, to incorporate the entire gas well installation in this protective system up to and including the metre run; • The Proponent to investigate the possibility of shutting down all wells within the compound in case of initiation of the shut down valve from an identified emergency scenario (for example in case of a closure of the shut down valve due to a failure of the fusible link); • Pipe-length between the well head and the first shut down valve to be minimised; • The number of connections used on the wells is to be minimised; • The Proponent to investigate the use of flanges instead of screwed connections; and • Final well design must minimise the risk of confinement and subsequent ignition of a release of natural gas, also in the case of an enclosed well.
Air Quality and Odour	The following mitigation measures would be applied during the construction phase of the Project: • Earthworks, vegetation clearing and soil disturbance would be minimised at sites wherever possible; • Disturbed surfaces would be remediated as soon as practical after disturbance with minimal lag time between clearing and remediation; • Construction activities shall be monitored to identify excessive dust generation. Dust control measures (such as the use of water carts) shall be implemented in the event of excessive dust generation; • Stockpiles and unsealed surfaces would be sprayed with water to minimise excessive dust generation, where necessary; • During high wind conditions, activities likely to generate dust would be minimised or ceased wherever possible; • Machinery, plant and equipment would be serviced, in good working order and would be fitted as required with appropriate exhaust emission control devices; • Unnecessary traffic movements would be eliminated or minimised; • All welding procedures would be undertaken in accordance with relevant Australian Standards and guidelines; • Annual leak detection services would be undertaken by a third party operator; and • Surrounding residents would be notified prior to the start of construction activities and contact details would be provided for reporting and further information.

Issue	Mitigation Measures
	The following mitigation measures would be applied during the production phase of the Project: - Gas well surface locations would be monitored remotely from the control room at the gas plant and inspected regularly for gas leaks and emissions; and - The release of gas into the atmosphere produced during the testing phase would be controlled. This is to be achieved through the undertaking of appropriate venting options (controlled venting of gas, venting of gas to a mobile flame or an immediate link-in to the gas gathering system) in order to significantly reduce or eliminate the need for venting. The following mitigation measure applies to the post development phase of the Project: - Activities would be continually monitored for emissions to ensure that they are in accordance with relevant guidelines and requirements. Mitigation measures to be applied during the closure and final rehabilitation phase of the Project include: - During high wind conditions, activities likely to generate dust would be minimised or ceased wherever possible; and - Machinery, plant and equipment would be serviced, in good working order and would be fitted with appropriate emission control devices. Measures to mitigate the cumulative impact of increased exhaust emissions on the regional air quality include: - Regular maintenance of all equipment and trucks associated with the proposed operation in an efficient manner and monitoring of service records. - If visible smoke can be seen from a vehicle or equipment for longer than 10 seconds, the equipment would be taken out of service and appropriately repaired.

Issue	Mitigation Measures
Landform, Geology and Soils	The following mitigations measures would be applied during the construction phase of the Project: • A Soil and Water Management Plan (SWMP) would be prepared for the earthworks and construction activities associated with the CGP. The SWMP would identify: - Property description; - Origin of levels; - Location of site boundaries and adjoining roads (where applicable); - Approximate grades and indications of direction of fall; - Approximate location of mature trees; - Location of access roads and gates; - Nature and extent of earthworks including cut and fill and drill pit location; - Location of all soil stockpiles; and - Location and type of proposed erosion and sediment control measures. • The SWMP would be developed at the site planning stage in consultation with the construction leaders. Prior to commencing earthworks, all necessary erosion and sediment control measures would be installed. These would then be inspected on a daily basis during construction to ensure that they remain functional; • Contaminated lands with the potential to be impacted by the Project would be identified and a Contaminated Lands Management Plan (CLMP) created (if required); • Erosion and sediment control measures shall be implemented where necessary to prevent erosion and water contamination and shall be in place prior to the commencement of works with the potential to cause erosion. Measures would include, but are not limited to, surface drains and berms and sediment traps such as silt fences and straw bales; • Erosion control berms and drains shall be designed and constructed so as to ensure that runoff water does not result in off-site effects of erosion or sedimentation;

Issue	Mitigation Measures
	• Areas designated for ground disturbance, including well surface locations, and vegetation clearing would be clearly marked on site plans and on the ground surface and would be minimised wherever possible; • Works (including stockpiling of gas gathering line sections) shall be confined to identified areas within the gas gathering system route, designated parking and lay down area and access routes; • The period between clearing, trenching and rehabilitation would be minimised; • Soil stockpiles would be located at least 40m away from drainage lines and shall be designed to minimise runoff. Soil stockpile sites would be enclosed within a bunded area to reduce the likelihood of sediment entering drainage lines; • Graded soil and cleared vegetation shall not be stockpiled where it has the potential to disrupt surface water flow; • Erosion and sedimentation controls would be checked and cleaned weekly to ensure effective operation; • Refuelling of vehicles, plant and machinery would be undertaken by suitably trained personnel within a levelled area with a spill kit present, preferably on a hardstand area, to minimise contamination from spills; • Fuels, chemicals and liquids would be stored in a bunded area to minimise the potential for spills to escape off site; and • A spill kit would be located on site at all times. The following mitigation measures would apply • Where erosion does occur, the area shall be stabilised as soon as practicable and measures taken to rehabilitate the site; • Refuelling of machinery would be undertaken by suitably qualified personnel within a levelled area, preferably on a hardstand area with a spill kit present, to minimise contamination from spills; and • A spill kit would be located in all production vehicles. Mitigation measures to be applied during the closure and rehabilitation phase of the Project include: • Rehabilitation of disturbed areas would be undertaken as soon as practical with the restoration of site to natural contours wherever possible; • Stockpiled top soil and seed stock shall be respread across the work areas from which it was removed; • Compacted areas shall be deep ripped or scarified for relief as required; and • Routine inspections of the site would be undertaken to ensure rehabilitation and regeneration activities are successful and to identify areas of subsequent erosion.
Noise and Vibration	During the construction phase of the Project, a combination of the following mitigation measures will be implemented on a site by site basis as identified in the Noise Assessment included as Appendix F to this EA: • Use of only one (of two) mud pumps; • Placement of mud pumps on the ground; • Orientation of mud pumps away from sensitive receivers; • Placement of temporary or permanent noise barriers; • Acoustic treatment of mud pumps; and • Best practice, construction equipment and noise mitigation.

Issue	Mitigation Measures
	If required, the Proponent will implement the following additional measures during the construction period to further manage potential noise impacts: • Preparation of a Construction Noise Management Plan (CNMP) to consider the following issues: - Identification of noise goals; - Identification of residential receivers; - Length of construction; - Hours of construction; - Best practice, construction equipment and noise mitigation; - Noise monitoring; - Community notification; and - Complaints handling. • Notification of the local community in accordance with the CNMP; • Complaints handling in accordance with the CNMP; and • For well surface locations where SIS drilling is required source and site specific noise mitigation measures such as silencers and noise barriers are to be investigated and implemented as necessary on a site by site basis. • The Proponent shall undertake noise monitoring once wells are operational in order to determine required mitigation for operating well surface locations.. They include (but are not restricted to): - Well head design, including enclosure; - Noise barriers for individual well heads; - Noise barriers for well surface locations (a fence around it) – thus mitigating noise from all wells at a surface location; - Enclosure of pumps/ generators and/ or separators; - Replacement of diesel pumps/ generators with electric pumps/ generators. The noise reduction provided by the different options should be designed for specific locations. For example a noise barrier around the final compound could reduce noise levels by up to 10dBA at some houses. If enclosures are preferred to noise barriers, they could easily be designed to have reductions up to 30dBA. Barriers and enclosures could be combined, thereby requiring only 10-20dBA reduction from the enclosure. A case by case approach to noise mitigation at each well surface location will ensure that noise criteria can be met whatever the future land use throughout the life of the project. Noise mitigation measures during the decommissioning and rehabilitation phases of the development will be determined on a site by site basis closer to the commencement of these phases of the Project.
Social	Safeguards imposed in respect of land use, hazard and risk, air quality, noise, traffic and visual impact are sufficient to mitigate potential social impacts effectively.
Economic	No specific safeguards required.
Surface Water	• Soil and Water Management Plans (SWMPs), Emergency Response Plan, Flood Management Plan and EHSMPs would be implemented or updated to minimise impacts on water quality throughout all phases of the development.

Issue	Mitigation Measures
	• A water management system including a water distribution network where necessary employed to enable collection, management and appropriate reuse of water produced as a result of the drilling and fracture stimulation. The water management system would incorporate the following safeguards: - Drill pits would be constructed with an upslope diversion drain around the site to divert rain water surface runoff around the excavation; - Drill pits would be constructed with a polyethylene lining to prevent seepage of brackish formation waters to underlying soil; - All pits would be designed with adequate capacity to accommodate water associated with construction as well as rainfall events; and - Pipelines for the water distribution network where required would be laid alongside the gas gathering pipelines. This would allow for water transfers to centralised storages from drill pits with this water to be reused at other well surface locations for the fracture stimulation process. Excess waters would be disposed of to a licensed disposal facility. • Produced formation water will be collected into a lined drill pit or storage tank for future reuse in drilling/ fracture stimulation of other wells. Ultimate disposal will be to licensed disposal facilities. • The exposure of the ground surface to erosion is to be limited to disturbance caused by vehicles using access routes and exposed drill pads. The removal of vegetation shall be avoided wherever possible. • At identified creek crossings, such as Howes Creek, the Proponent will construct a bed level crossing to an acceptable standard.
Groundwater	• The potential for cross-contamination of groundwater aquifers would be minimised through the use of a pressure-rated steel casing that would provide assurance that communication between aquifers is unlikely as a result of operations. This would also prevent migration of methane into shallow aquifers. All wells are cased-off and cemented for their entire length in accordance with the requirements of the Department of Primary Industries. All aquifers within the geological section would thus remain isolated and groundwater cross-contamination would not be likely to occur, which is in accordance with requirements the NSW Government. • Decommissioned and abandoned wells would be filled with cement to further avoid cross-contamination of groundwater after the cessation of production.
Flooding	• Design measures have been incorporated to ensure that in the event of flooding, operational processes would be set in place effectively isolating the meter run from the gathering system. The wellhead, separator and meter run would be safely submerged for an extended period of time with no risk to the environment or the infrastructure. • Warning of significant flooding (namely, 1 in 100 year) events would be issued to enable operations on flood-prone land to be made secure.

Issue	Mitigation Measures
Flora and Fauna	The following general mitigation measures are to be applied with respect to flora and fauna: • Construction footprint to be kept to a minimum; • Avoid spread of weeds by ensuring vehicles remain on designated roads; • If an animal is inadvertently injured, call WIRES or a local wildlife care group; • Rehabilitate the construction footprint using endemic species; • Enhance local environmental values by rehabilitating in accordance with best practice guidelines such as <i>Recovering Bushland on the Cumberland Plain</i> (DEC, 2005) and applicable local management plans such as the <i>Gundungurra Reserve Plan of Management</i> (Environmental Partnership Pty Ltd, 2004) In addition to the general mitigation measures identified above, the following measures will be applied to specific sites as identified in Section 8.9 and Appendix G to this EA: • Install erosion and sediment control measures around all construction work and adjacent to roads to prevent contaminated runoff entering water bodies and affecting their health. • Avoid clearing of native vegetation, particularly remnant trees, EBS and CPW. • Clearly identify or fence off significant habitat trees and EECs.
Landscape and Visual Amenity	The following mitigation measures would be applied in respect of landscape and visual amenity: • A Landscape Management Plan would be prepared (or the existing Plan updated) in respect of the proposed Project to identify appropriate landscaping to be implemented at well surface locations along with a program of long-term maintenance for landscape works; • Earthworks, vegetation clearing and soil disturbance would be limited to the construction and operational footprint as appropriate; • Existing vegetation will be maintained wherever possible; • Dust control measures would be implemented during construction and operation; • Screening in the form of appropriate fencing and landscaping will be implemented at well surface locations as necessary and in accordance with the Landscape Management Plan for the Project; • Initial rehabilitation of the well surface location is to be consistent with the established character of surrounding land; • Construction activities for the gas gathering lines will be rehabilitated to be consistent with the established character of the land; and • With regard to the future urban (residential, commercial and industrial) land release areas, where well surface locations are expected to be near residential development, material used for fencing or the enclosure will be chosen to integrate with the surrounding urban form. For sites where residents may be exposed to extended periods of uninterrupted views during construction, green mesh fencing is to be erected around the construction compound.

Issue	Mitigation Measures
Indigenous Heritage	The following general safeguards would be applied in respect of the proposed Project: - For all proposed well surface locations, gas gathering lines and access roads, the Proponent would prepare and implement an Aboriginal Heritage Management Plan, in consultation with DEC and the relevant Aboriginal communities, and to the satisfaction of the Director-General for affected well surface locations, gathering lines and access roads. The plan should include a detailed description of measures to be implemented for salvage, relocation or mapping of archaeological objects within the proposed development footprints. - A risk assessment should be undertaken for all well surface locations planned for the remainder of the Stage 2 Concept Area, followed by a site visit and investigation by a professional archaeologist in conjunction with relevant Aboriginal community representatives; - Where sites are identified either through the risk assessment and/or site visit, consideration should first be given to relocation of the well surface location and/or ancillary infrastructure to an area not identified as possessing Aboriginal heritage sites. Should this not be possible, mitigation of site damage or destruction should be undertaken, including detailed recording, collection, excavation (if required), documenting and/or relocation of the site prior to any proposed impacts by a professional archaeologist in conjunction with Aboriginal community representatives; - If sites are identified and can be avoided, but are within 150m of the proposed well locations and/or associated ancillary infrastructure, they should be fenced off. A professional archaeologist in conjunction with Aboriginal community representatives should assist in the fencing off of the site/s to ensure they are appropriately delineated; - Where Aboriginal sites cannot be feasibly relocated or collected (such as with rockshelters, grinding grooves, engravings, and perhaps scarred trees), consideration should be given first to <i>in situ</i> preservation, then to detailed recording and investigation by a professional archaeologist in conjunction with Aboriginal community representatives. The scope of investigation and eventual location of all artefacts and objects recovered should be decided in discussion with Aboriginal communities prior to the commencement of any investigation; - Discussions with the proponent and Aboriginal communities should be undertaken to identify an appropriate “keeping place” for Aboriginal objects/artefacts prior to their collection; - Aboriginal skeletal remains are highly significant and are protected under State legislation. Should remains be found, work should cease immediately and consultation with the DECC, NSW Police, NSW Coroners Office and Aboriginal communities be undertaken to seek agreement on the most appropriate course of action. Actions could include either 1) the preservation of the remains <i>in situ</i>, or 2) the detailed recording and recovery of the remains by qualified personnel in conjunction with Aboriginal community representatives. Agreement should be reached on the subsequent relocation and/or re-burial of remains prior to their removal;

Issue	Mitigation Measures
	In addition to the general safeguards identified above, the following safeguards would be implemented for the Spring Farm and Menangle Park Project Areas: • Consideration should be given to avoiding sites within areas designated as possessing high archaeological sensitivity (refer Section 8.11), if necessary by re-routing gathering lines and access tracks, and re-locating well locations; • Consideration should be given to avoiding sites within areas designated as possessing moderate archaeological sensitivity (Section 8.11), if necessary by re-routing gathering lines and access tracks, and re-locating well locations; • If disturbance to sites within areas of high and moderate archaeological sensitivity is unavoidable then mitigation action should include surface collection of artefacts, followed by sample excavation of undisturbed contexts at these locales. All artefact collection and excavation should be undertaken by professional archaeologists and Aboriginal community representatives; • Aboriginal sites likely to be impacted should be recorded and collected in consultation with the Aboriginal communities prior to the proposed development occurring. Should any of these sites fall outside the proposed areas of impact, consideration to their preservation as outlined below should be undertaken; and • Areas identified as of low archaeological sensitivity have no further Aboriginal heritage requirements.
Non-Aboriginal Heritage	To prevent disturbance to the heritage items, the location of wells and infrastructure for Stage 2 Concept works would be subject to further detailed assessment and selected in order to avoid the identified heritage items and significant curtilage wherever possible. If any historic relics, as defined in the <i>Heritage Act (1977)</i> are identified in the course of the construction activities in the Project area, then works in the vicinity of the finds should cease immediately and an archaeologist from the NSW Heritage Office should be contacted, and an appropriate course of action implemented. The Proponent shall carry out the proposed Project in a manner that will not adversely affect the structural integrity of the Upper Canal and associated structures not impact the quality of water in the Upper Canal. The following mitigation measures have been identified in order to minimise the potential visual impacts on non-indigenous heritage items within the Spring Farm and Menangle Park Project Areas; • Removal of existing vegetation is to be minimised; • Existing vegetation which provides screening of the proposed works should be maintained; • In areas where potential views to and from a heritage item exist, such as Glenlee House, green mesh fencing should be erected around the construction area in order to provide screening of construction activities; • Vegetation planting around the development site is to commence as soon as possible once construction is complete.

Issue	Mitigation Measures
Traffic and Transport	The following mitigation measures will be applied during the construction phase of the Project: • A Traffic Management Plan will be developed for the project area incorporating any previous traffic management proposed for well surface locations and/or gas gathering line construction, as appropriate; • Unnecessary vehicle movements would be minimised; • Appropriate notification of reduced speed zones and potential roadway disruptions would be displayed / issued in advance to road users and local residents; • Vehicle operators would be advised of designated access routes and roadways. These specific routes would be used to access sites to minimise potential impacts on larger areas of the locality; • Transportation of equipment and machinery likely to cause delays to traffic flows would be undertaken outside standard work hours, and would be timed to avoid peak traffic flows, wherever possible; and • All works undertaken in proximity to roadways would be conducted under controlled traffic conditions. Mitigation measures to be applied during the production and post-development phase of the Project include: • Unnecessary vehicle movements would be minimised wherever possible; and • Transport routes for equipment and machinery would be reviewed, considering updated road alignments, to strategise a route of minimal impact. Mitigation measures to be implemented during the closure and final rehabilitation phase of the Project include: • Vehicle movements would be minimised to reduce the potential to impact on traffic within the locality; and • Transport routes for equipment and machinery would be reviewed, considering updated road alignments, to strategise a route of minimal impact.

Issue	Mitigation Measures
Waste Management	The following general mitigation measures would be implemented in respect of waste management: • Waste generated would be reused or recycled where possible; • Excavated topsoil removed during the construction phase would be stockpiled and appropriately maintained onsite for reuse during initial rehabilitation of surplus construction area; • Soils excavated from trenches and drill pits will be temporarily stockpiled for reuse during backfill or well surface location initial rehabilitation; • Excess construction wastes which are not suitable for reuse or recycling would be disposed of at a licensed waste facility; • Exotic vegetation cleared from construction areas would be mulched and stockpiled onsite and maintained appropriately for reuse during initial rehabilitation. Excess mulched organic material would be removed from the site and disposed of at a licensed waste facility as appropriate; • Formation waters removed from coal seams following fracture stimulation and re-fracture stimulation would be transferred from the drill pit either reused for future fracture stimulation or stored in tanks for disposal at a licensed waste facility or well surface location into the water distribution network, and into the centralised storage pits for reuse at other well surface locations; • Appropriate spill, incident management and response procedures would be developed and implemented through EHSMP and ERP would include measures to avoid spillages of chemicals, liquids and other wastes; • Domestic waste such as glass jars, aluminium cans, paper and compostable matter would be placed in a dedicated container for removal off site; • All waste to be disposed offsite would be classified, transported and disposed of in accordance with the <i>Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes</i> (DEC, 2004); and • Portable toilet facilities would be installed in construction areas during the construction period and maintained by a waste contractor.
Rehabilitation and Final Landform	All rehabilitation works would be undertaken with maximum regard to environmental protection including training operators in the principles of least possible disturbance and rehabilitation, vegetation, subsoil and topsoil management, weed control, erosion and sedimentation management and revegetation. Requirements for managing erosion and sediment control and rehabilitation are to be determined for each site with reference to methods in Landcom (2004) Soils and Construction. The planned limit of disturbance is to be flagged to avoid disturbing adjacent areas, in particular vegetation and riparian areas (40 metres from a major drainage line). Topsoil is to be separated from subsoil and protected during storage and replaced in the appropriate order. Revegetation is to be undertaken as soon as works are complete. Reseeding is to be undertaken if the site has not shown good germination within two months of sowing. Requirements for managing erosion and sediment control and rehabilitation are to be determined for each site with reference to methods in Landcom (2004) Soils and Construction.

Issue	Mitigation Measures
	Other general mitigation measures and environmental safeguards that would be implemented include: • Installation of erosion and sedimentation control measures such as silt fencing surrounding exposed areas or soil stockpiles; • Erosion and sedimentation controls would be checked and cleaned weekly to ensure effective operation; • Where available, soil stockpiled for use in the initial rehabilitation stage of works would be utilised to fill excavated areas such as drill pits. Topsoil is to be separated from subsoil and replaced in an appropriate order; • The ground surface would be contoured to match surrounding land to avoid directing runoff away from natural drainage lines; • In the event of an accidental discharge of formation waters from a drill pit, the Project Construction Manager would assess whether receiving water courses have been affected and whether work such as de-silting is required; • Where the surrounding land use is agricultural, consultation would be held with the landowner to determine crop cover required; • Where seeding and replanting is to be carried out, native endemic species equivalent to those already found on the site are to be used where possible; • Stock proof fencing would be installed surrounding rehabilitated areas until sufficient surface/ground cover is established; • Regular maintenance and monitoring is to be carried out at each site on completion of the rehabilitation process in order to identify the presence of weeds, subsequent erosion and changes in the drainage patterns.

9.4 Statement of Commitments

9.4.1 Introduction

In accordance with the EARs issued under Part 3A of the EP&A Act, the following Statement of Commitments (SoC) is provided. As the Project comprises two separate components – a Concept Application and a Project Application, two separate Statements of Commitments have been developed in recognition of the different approvals paths.

The SoCs state the Proponent's environmental commitments and detail the environmental management and monitoring of the proposed Project along with further investigations or studies which the Proponent will carry out (particularly in relation to the Stage 2 Concept area).

The Proponent is committed to ensuring the preparation and implementation of the environmental management and monitoring plans, further investigations and studies and environmental mitigation measures detailed in the SoCs for the proposed Project.

9.4.2 Commitments

The SoCs, prepared in respect of the proposed Project, have been compiled on an issues basis and are informed by the environmental risk analysis and impact assessment undertaken as part of this EA. The SoCs have been written in a format which can be incorporated into any project or concept approval issued, to act as the conditions of that approval.

Table 9-3: Statement of Commitments – Stage 2 Concept Area

Issue	Commitment
General	1. Works the subject of the Concept application would be subject to further detailed environmental assessment on a range of issues as identified in this Statement of Commitments. 2. The location of wells and associated infrastructure forming part of the Concept application would be developed in consideration of relevant environmental constraints and would be subject to consultation with landowners with a view to minimising the potential impacts of the Project. 3. The location of new wells within the Stage 2 Concept area would be selected generally in line with the following: • Where possible, wells would be co-located at existing well platforms so as to minimise new land disturbance; • Supporting gas gathering lines would be located in existing disturbed areas wherever possible; and • Access roads would be located in existing disturbed areas wherever possible. 4. The location of infill wells within the Stage 2 Concept area would be selected generally in line with the following • Infill wells are either new wells co-located within the pad of existing wells in existing well fields within Stage 2 to access additional resource from currently disturbed areas through the installation of a new wellhead and bore; or new wells at undisturbed sites with associated infrastructure (including gas gathering and water pipelines and access roads) to be located within existing well fields within Stage 2 where the gas reserve is not able to be accessed from existing wellhead locations; 5. The location of supporting infrastructure within the Stage 2 Concept area would be selected generally in line with the following: • If required, increasing the capacity of the existing gas gathering system would be carried out along established gas gathering routes. • If required, in-field compression would be located in proximity to either existing wellhead locations or along gas gathering routes. • If required, re-fracture stimulation of wells would occur at existing wellhead locations within the Stage 2 area. The feasibility of re-fracture stimulation would be subject to environmental considerations at the time.
Air Quality	6. In the selection of potential well surface locations and associated infrastructure within the Stage 2 Concept area, the Proponent shall take account of opportunities to minimise air quality impacts generated by the construction and operation of the project.
Ecology	7. The Proponent shall undertake further detailed ecological assessment of proposed works within the Stage 2 Concept Area once details of well surface locations and associated infrastructure are known. Details of this assessment shall form part of subsequent project applications in respect of the proposed works. 8. In the selection of potential well surface locations in the Stage 2 Concept area the Proponent shall take into consideration all practicable measures to minimise potential flora and fauna impacts of the proposed Project.

Issue	Commitment
Noise	9. The Proponent shall undertake further detailed noise assessment in respect of proposed works within the Stage 2 Concept area once further details of well surface locations and the location of associated infrastructure is known. Details of this assessment shall form part of any subsequent project application required to be submitted in respect of the proposed works. 10. As a guide, the following general principles would be considered when identifying potential well surface locations for the Stage 2 Concept works: - Well surface locations would be chosen in consideration of the proximity to nearest sensitive receivers and would take account of local topography and meteorological conditions which may affect the extent of noise impacts; - The potential for noise impact would be considered in the preliminary planning phase of the project such noise minimisation will be built into the inherent project design; - The full range of available mitigation measures would be considered and applied where necessary to ensure that noise impacts can be maintained at an acceptable level; - Well surface locations which would result in significant exceedances of project specific noise criteria despite the application of mitigation measures would be flagged and alternative sites considered.
Soil and Water	11. The Proponent shall undertake further investigations into the potential soil and water impacts of the proposed Stage 2 Concept works once details of well surface locations and the location of associated infrastructure is known. Details of these investigations will form part of a broader environmental assessment associated with any subsequent project application required in respect of the proposed Project.
Heritage	12. The Proponent shall undertake further studies in respect of Indigenous and Non-Indigenous heritage as this relates to works subject of the Stage 2 Concept application as part of broader environmental assessment associated with any subsequent project application required to be submitted in respect of the proposed Project.
Safety and Risk Management	13. All works subject of the Stage 2 Concept application will be subject to the Proponent's Emergency Response Plan and Safety Management System. The plan/ system shall be submitted to the Director-General, prior to the commissioning of the Project.

Table 9-4: Statement of Commitments - Spring Farm and Menangle Park Project Areas

Issue	Commitment
General	1. The Proponent shall implement all practicable measures to prevent or minimise harm to the environment that may result from the construction or operation of the Project. 2. The Proponent shall provide Camden Council and Campbelltown City Council with the Geographical Positioning System (GPS) co-ordinates and digital survey data for gas well surface locations and gas gathering systems within its Local Government Area, in a format suitable to Council, within three months of the commissioning of the gas wells. 3. The Proponent shall provide Camden Council and Campbelltown City Council with the wellhead configurations of each gas well within three months of the gas well being commissioned. 4. The Proponent shall comply with the following in the construction of the gas gathering system pipeline: (a) the route of gas gathering and water transport systems and access roads follow previously or currently disturbed areas wherever possible; (b) signs stating the presence of a buried gas pipeline shall be erected periodically along the length of the trench once the pipeline has been laid; (c) trenches are to be restored and reseeded with local grass seeds or a seed blend agreed to by the landowner on completion of the work; (d) the Proponent shall construct the gas gathering system so as not to impede lateral water flows; (e) the Proponent shall ensure that no crown or camber remains along the gas gathering systems, following construction; (f) the pipeline shall be designed, constructed and operated in accordance with the Australian Standard for the installation and maintenance of Plastic Pipe Systems for Gas AS 3723-1989 (or its latest version); and (g) trenches are not left open overnight, unless adequately covered.
Air Quality	5. The Proponent shall implement all practicable measures to minimise dust emissions generated by the construction and operation of the project to the satisfaction of the Director-General.
Ecology	6. The Proponent shall take all practicable measures to minimise potential flora and fauna impacts of the proposed Project. 7. The Proponent shall prepare and implement a Landscape Management Plan detailing landscaping to be undertaken at well surface locations, including a maintenance program for these landscaping works. Landscaping shall be undertaken using appropriate native species. 8. The Proponent shall take all practicable measures to limit the potential spread of noxious weeds at the sites.

Issue	Commitment
Noise	9. The proponent shall conduct construction activities, except for drilling of wells for the Project only between the following hours: 7.00 am to 6.00 pm Monday to Friday; and 8.00 am to 1.00 pm Saturdays 10. The Proponent shall implement all practicable measures to undertake the development in a way that minimises the noise generated. 11. The Proponent will utilise a combination of design measures at well construction sites as required (refer to Section 8.5.5 for identified mitigation measures at each site) to ensure that noise impacts during the construction period are minimised. 12. The Proponent will implement the following measures during the construction period to further manage potential noise impacts: (a) Preparation of a Construction Noise Management Plan (CNMP) to consider the following issues: (b) Identification of noise goals; (c) Identification of residential receivers; (d) Length of construction; (e) Hours of construction; (f) Best practice, construction equipment and noise mitigation; (g) Noise monitoring; (h) Community notification; and (i) Complaints handling. 13. The Proponent shall undertake a program of noise monitoring once wells are operational in order to validate design of operating well surface locations. A combination of the mitigation measures and design options would be applied on a site by site basis, as determined by the results of noise monitoring, to ensure that operational noise is maintained at an acceptable level.
Soil and Water	14. The Proponent shall prepare and implement a Flood Management Plan for wells located within the 1 in 100 year flood level to the satisfaction of the Director-General. The plan shall be submitted to the Director-General prior to commissioning of those wells, and shall include measures to minimise and mitigate flooding impacts associated with the project. 15. The Proponent shall prepare and implement a Soil and Water Management Plan for the project to the satisfaction of the Director-General. The plan shall be submitted to the Director-General prior to construction commencing.

Issue	Commitment
Heritage	16. The Proponent shall prepare and implement an Cultural Heritage Management Plan, in consultation with the DECC and relevant Aboriginal communities, and to the satisfaction of the Director-General for well surface locations, gathering lines and access roads associated with this Project which are likely to impact on the archaeological relics. The plan shall be submitted to the Director General prior to commencing construction of those works, and shall include: • A description of the measures that would be implemented for the salvage, relocation or mapping of the archaeological relics as identified in the Aboriginal Heritage Assessment included as Appendix H to this EA.
Safety and Risk Management	17. The Proponent shall prepare/update and implement an Emergency Response Plan and Safety Management System for the Project. The plan/ system shall be submitted to the Director-General, prior to the commissioning of the Project. 18. Within three months of commissioning of the Project, the Proponent shall prepare to the satisfaction of the Director-General a compliance report detailing compliance with Commitment 17, including: (a) dates of study/ plan/ system completion/ submission and commencement of construction and commissioning; and (b) actions taken or proposed, to implement recommendations made in the studies/ plans/ systems. The report shall verify that: (a) The Emergency Plan required by Commitment 17 is effectively in place and that at least one emergency exercise has been conducted; and (b) The Safety Management System required by Commitment 17 has been fully implemented and that records required by the system are being kept. The report shall include a signed statement by the Proponent's representative responsible for the operation of the Project that for each study/ plan/ system: (a) The required study/ plan/ system has been undertaken or prepared to the relevant Hazardous Industry Planning Advisory Panel; (b) All recommendations of each study/ plan/ system have been implemented; and (c) All safety management systems and their associated risk controls have been implemented and are being maintained.

Issue	Commitment
Environmental Management and Performance	19. The Proponent shall prepare/update and implement an Environment, Health and Safety Management Plan (EHSMP) to provide environmental management practices and procedures to be followed during the operation of the Project. The EHSMP shall include, but not necessarily be limited to: (a) identification of statutory and other obligations that the Proponent is required to fulfil in relation to operation of the Project; (b) a description of the roles and responsibilities for all key personnel involved in environmental management of the Project; (c) the environmental policies and principles to be applied to the operation of the Project; and (d) describe in general terms how the environmental performance of the Project would be monitored and managed. 20. The Proponent shall commission and pay the full costs of an Independent Environmental Audit of the construction of the gas gathering system, construction of the access roads and drilling and fracture stimulation of gas wells within the CGP. (a) be conducted by a suitably qualified, experienced, and independent person(s) whose appointment has been approved by the Director-General; and (b) be consistent with ISO 19011:2002 – Guidelines for Quality and/or Environmental Management Systems Auditing, or updated versions of these guidelines/manuals. The audit shall: (i) assess the environmental performance of the construction of the Project, and its effects on the surrounding environment; (ii) assess whether the development is complying with the relevant standards, performance measures, and statutory requirements; (iii) consider the Proponent's EHSMPs; and (iv) recommend measures or actions to improve the environmental performance of the construction of the Project, and/or its environmental management and monitoring systems (if required). 21. Within one month of completion of the audit, the Proponent must submit a copy of the audit report to the Director-General, the NSW Heritage Office and DPI. The Director-General may require the Proponent to address certain matters identified in the report and any comments received from the NSW Heritage Office and DPI. Any action required to be undertaken shall be completed within such period as the Director-General may agree.

9.5 Environmental Management Procedures

The procedures included in each EHSMP aim to meet the Proponent's commitments and to achieve the enabling objectives and goals. The procedures are intended to provide clear and practical guidance to the planning, construction and operational workforce. As such, general (aspect/ phase) and specific (activity/ task) procedures are structured according to each phase of the Project.

9.6 Responsibilities

The Proponent is responsible for the overall environmental and OH&S management of the Project. However, all contractors are also personally accountable through conditions of employment or contracts. Each individual is responsible for ensuring that their work complies with regulatory requirements, the Proponent's commitments and the appropriate procedures.

The proposed organisation and accountabilities are shown in **Table 9-5**. It is understood that the personnel organisation of the Proponent is not static and that change may occur from time to time.

Table 9-5: Personnel Responsibility

Position	Responsibilities
Field Development Manager	Directly responsible for the management of all Projects and Operations, including all environmental aspects and OH&S issues.
Drilling Supervisor	- Directly responsible for the overseeing and fulfilment of commitments contained in this EHSMP. - Reports to the Field Development Manager regarding the project's environmental and OH&S performance and due diligence.
Drilling Contractors	Responsible for ensuring that works are in compliance with the EHSMP, meeting regulatory requirements, and ensuring that all environmental and OH&S objectives contained in the contracts are attained.
Supervisor – Gas Gathering Lines	- Directly responsible for the overseeing and fulfilment of commitments contained in the EHSMP. - Reports to the Production Engineer regarding the Project's environmental and OH&S performance and due diligence.
Gas Gathering Line Installation Contractors	Responsible for ensuring that works are in compliance with the EHSMP, meeting regulatory requirements, and ensuring that all environmental and OH&S objectives contained in the contracts are attained.
Environment and Safety Officer	- Provides advice to the Field Development Manager and his direct reports, regarding the implementation of the EHSMP. - Coordinates the monitoring and audit program.
Environmental / OH&S Auditors	- External to the Proponent and contracted to conduct periodic audits according to the principles of the EHSMP and environmental and OH&S legislative compliance. - The Auditors are coordinated by the Environment and Safety Officer.
Environmental/ Heritage Advisor	Specialist external contractors used in the field to provide advice on specific environmental and cultural heritage matters on an as need basis.

Position	Responsibilities
Heritage Monitors	- Aboriginal community representatives engaged to assist with cultural heritage site management in nominated areas during construction. - Report to the Environment and Safety Officer.

9.7 Training and Induction

Construction and operations personnel will be required to attend an induction prior to the commencement of activities for each new gas field. The induction will ensure that all personnel are fully aware of their OH&S and environmental responsibilities and gain the necessary knowledge and skills to fulfil their responsibilities. Inductions and/ or training required for specific sites will be conducted for personnel prior to the start of work at that site.

Induction will address general environmental and OH&S management issues including:

- Plant and equipment hazards, controls and residual risk;
- Drilling OH&S hazards, controls and residual risk;
- Management of sensitive areas;
- Erosion control;
- Water quality;
- Air quality;
- Cultural heritage management;
- Weed, pathogen and pest species control;
- Fauna and flora preservation;
- Bushfire Management;
- Traffic and access;
- Noise;
- Chemical storage and handling;
- Emergency and spill response;
- Waste management; and
- Protecting the amenity of landholders.

In addition and where required, job specific training will be conducted, and would also be conducted prior to the commencement of the activities below:

- Clearing and grading;
- Installation of gas gathering lines;
- Drilling/ Fracture stimulation;
- Testing and commissioning; and
- Clean up and rehabilitation.

It will be the responsibility of all Contractors to prepare and implement an induction and job specific training program appropriate to their methods of work. Approval from the Proponent will be required prior to implementation.

9.8 Inspection, Monitoring and Auditing

Inspection, monitoring and auditing will be undertaken to assess and record whether activities are in compliance with regulatory requirements and the objectives outlined in the EHSMP.

In addition to the conditions of the Minister's approval and the Proponent's SoCs, all Project components will be carried out in accordance with:

- conditions specified by the Minister for Mineral Resources pursuant to PPL1, PPL 2, PPL4 and PPL5;
- the Department of Primary Industries (Mineral Resources) (DPI) *Schedule of Onshore Petroleum Exploration and Production Requirements 1992*; and
- conditions specified pursuant to the POEO Act.

9.8.1 Outline of Environmental Reporting

Environmental reporting is a significant tool for environmental management as it can facilitate the collection of information on environmental impacts and issues and assist in identifying possible solutions in order to minimise these impacts. Environmental reporting also brings benefits to the performance and efficiency of an operation. During the construction and operational stages of this Project, environmental reporting is considered a vital component and reporting information will include the following:

- Non-compliance reports;
- Remedial actions undertaken resulting from the reporting of an incident;
- Checklists to address operational compliance;
- Details of any stakeholder consultation and meetings;
- Outcomes of any auditing that is carried out; and
- The findings of any monitoring that is conducted.

The Proponent will ensure that all reporting undertaken in relation to environment and OH&S issues will be in compliance with the relevant licence conditions and regulatory requirements.

9.8.2 Outline of Environmental Auditing

Environmental compliance auditing will be undertaken to assist in identifying the environmental impacts associated with the construction and operational phases of the Project.

Inspection of construction and operational activities will be undertaken on a regular basis by a suitably qualified person. On-going monitoring of these activities is essential to ensure compliance with regulatory requirements and conditions of approval.

Auditing, together with the implementation of inspection and monitoring programs will provide for the assessment of compliance of the Project during construction and operation with regulatory requirements and the environmental objectives identified in **Section 9**.

The Proponent will ensure that records are kept of all auditing that is conducted. Based on results of the audits, the Proponent will ensure modifications and corrective actions are undertaken to rectify any identified environmental impacts or concerns of the project.

9.9 Emergency Response Plan

An Emergency Response Plan (ERP) will be updated as required and implemented prior to the commencement of construction and operational activities associated with the Project. The ERP will describe the procedures and reporting requirements to be carried out in the event of a situation that requires urgent action in order to prevent harm to personnel, property and the work area.

The ERP will be updated in consultation with the relevant emergency authorities where necessary and would include the following information:

- Contact details for all emergency services in the area;
- The contact details (including before and after hours) of all relevant AGL, contractor and government department personnel;
- First aid procedures;
- Fire fighting procedures;
- Gas Gathering System control procedures (including shut-in procedures);
- Details of the procedures to be carried out in an emergency situation by the responsible persons,
- Details of the environmental emergency procedures for general and specific emergency situations that may arise; and
- Reporting requirements for all incidents that are considered dangerous or potentially dangerous or where damage has been caused.

The Proponent will ensure and that all personnel are well informed through training on the required procedures in the event of an emergency and that the ERP is readily accessible for all personnel.



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10 RESIDUAL RISK ANALYSIS

10.1 Approach

The Residual Environmental Risk Analysis for the proposed Project is based on a process adapted from Australian Standard AS 4369:1999 Risk Management, as well as environmental risk tools developed by other organisations. The process is qualitative and is based on the Residual Risk Matrix shown in **Table 10-1**.

Residual Environmental Risk is assessed on the basis of the significance of environmental effects of the proposed project and the ability to confidently manage those effects to minimise harm to the environment.

The significance of environmental effects is given a numerical value between 1 and 5 based on the receiving environment, the level of understanding of the type and extent of impacts and community response to the environmental consequences of the project. This enables both the actual and perceived impacts to be considered. The manageability of environmental effects is similarly given a numerical value between 1 and 5 based on the complexity of mitigation measures, the known level of performance of the safeguards proposed and the opportunity for adaptive management. The numerical value allocated for each issue is based upon the following considerations:

Significance of Effects

5. *Extreme*

Undisturbed receiving environment; type or extent of impacts unknown; substantial community concern.

4. *High*

Sensitive receiving environment; type or extent of impacts not well understood; high level of community concern.

3. *Moderate*

Residual receiving environment; type and extent of impacts understood; community interest.

2. *Minor*

Disturbed receiving environment; type and extent of impacts well understood; some local community interest.

1. *Low*

Degraded receiving environment; type and extent of impacts fully understood; uncontroversial project.

Manageability of Effects

5. *Complex*

Complicated array of mitigation measures required; safeguards or technology are unproven; adaptive management inappropriate.

4. *Substantial*

Significant mix of mitigation measures required; limited evidence of effectiveness of safeguards; adaptive management feasible.

3. *Straightforward*

Straightforward range of mitigation measures required; past performance of safeguards is understood; adaptive management easily applied.

2. *Standard*

Simple suite of mitigation measures required; substantial track record of effectiveness of safeguards; adaptive management unlikely to be required.

1. *Minimal*

Little or no mitigation measures required; safeguards are standard practice; adaptive management not required,

The numbers are added together to provide a result which provides a ranking of potential residual effects of the project when the safeguards identified in this EA are implemented.

Table 10-1: Residual Risk Matrix

Significance of Effects	Manageability of Effects				
	5 Complex	4 Substantial	3 Straightforward	2 Standard	1 Minimal
1 Low	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)	3 (Low)	2 (Low)
2 Minor	7 (High/Medium)	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)	3 (Low)
3 Moderate	8 (High/Medium)	7 (High/Medium)	6 (Medium)	5 (Low/Medium)	4 (Low/Medium)
4 High	9 (High)	8 (High/Medium)	7 (High/Medium)	6 (Medium)	5 (Low/Medium)
5 Extreme	10 (High)	9 (High)	8 (High/Medium)	7 (High/Medium)	6 (Medium)

10.2 Analysis

The analysis of residual environmental risk for issues related to the proposed Project is shown in **Table 10-2**. This analysis indicates the environmental risk profile for the proposed Project based on the assessment of environmental effects, the identification of appropriate safeguards, and the SoC included in this EA.

Table 10-2: Risk Profile

Issue	Significance	Manageability	Residual Risk
Hazard and Risk	3	2	5 (Low/Medium)
Land Use	3	2	5 (Low/Medium)
Noise and Vibration	3	2	5 (Low/Medium)
Air Quality	2	1	3 (Low)
Water Management	2	1	3 (Low)
Visual Impacts	2	2	4 (Low/Medium)



Issue	Significance	Manageability	Residual Risk
Soils and Geology	2	2	4 (Low/Medium)
Ecology	2	2	4 (Low/Medium)
Cultural Heritage	2	2	4 (Low/Medium)
Transport and Traffic	1	1	2 (Low)
Social	3	2	5 (Low/Medium)
Economic	2	1	3 (Low)
Resource Implications	2	1	3 (Low)

The above residual risk analysis indicates that the proposed Project presents an overall low/medium risk in relation to each of the identified environmental issues provided that the recommended mitigation measures are implemented.



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11 PROPOSAL JUSTIFICATION

The proposed expansion of Stage 2 of the CGP would provide numerous benefits associated with the provision of an essential and valuable indigenous energy resource to NSW. Substantial benefits would result from the proposed expansion, including environmental benefits associated with the provision of an alternative and cleaner fuel to that provided by coal, as well as wider economic benefits to the State of NSW and the provision of an important energy resource for commercial and industrial users.

The proposal would therefore have resultant benefits for the local and wider community and the environment, as well as for present and future generations.

Consultation with land owners has enabled the identification of well surface locations and utility corridors that do not physically conflict with current master plans for future urban development. Environmental compatibility with future land uses has been facilitated through the use of an environmental envelope for well surface locations and an environmental corridor for gas gathering lines and access roads. This approach enables some adjustment of facilities to suit final land use designs without compromising the rigour of environmental assessment or the effectiveness of mitigation measures.

The preliminary design of the Project and the assessment of potential impacts presented in this EA show that the Project is able to be constructed and operated in a manner which is compatible with both existing and proposed land uses.

11.1 Justification

The Director-General's EARs issued for this Project require justification for the Project to be provided, having regard to biophysical, economic and social considerations together with the principles of ESD. The environmental impact assessment of the proposal undertaken in this EA, has addressed the relevant biophysical, economic and social considerations, summarised below.

11.1.1 Biophysical

Potential biophysical impacts associated with the proposed Project have been assessed in **Section 8** of this EA. The assessment of the biophysical environment has included individual assessments of terrestrial ecology, soils and geology, water management, air quality, and landform.

The assessment of each of these elements concluded that the implementation of a range of environmental safeguards and measures recommended throughout this EA would mitigate potential impacts, and that the proposal would not have a significant adverse impact on the biophysical environment.

As required by the Director General's EARs for the Project, environmental mitigation, management and monitoring requirements have been compiled and summarised in the Statement of Commitments, which is provided as **Section 9** of this EA.

The proposal is justifiable taking into account potential residual biophysical impacts on the environment.

11.1.2 Economic

The economic impacts of the proposal are assessed in **Section 8.7**, and are largely related to the indirect benefits of the Project for the local, regional and State economy in terms of the provision of a valuable, indigenous energy resource to supply the growing NSW economy.

The Proponent has developed the application of CSM technology locally, and based on the history of existing local operations. The CGP presents a viable application to use this resulting in an increase in gas production in NSW to meet the projected increase in demand for this resource. Furthermore, the development of this local resource locally reduces the need to transport gas from elsewhere (including interstate), improving efficiency and potentially reducing the overall cost of gas for consumers and the environment.

The Project would utilise the existing 35 contractor staff for the majority of the operational requirements of the CGP expansion. The anticipated employment increase for CGP as a direct result of the operational stage of the project is expected to be three new positions and the development of the project would help to secure these positions into the future as well as securing future contract positions.

The importance of securing an indigenous, cost-effective energy supply, with lower greenhouse emissions is considered vital to the social and economic growth of the project area and the State. The Project represents a significant investment in the region and provides the local community with the impetus to plan for future business and service opportunities in the area. Given the economic benefits, the proposal is justifiable taking into account potential economic impacts.

11.1.3 Socio-Cultural

The potential social impacts of the proposal have been assessed in **Section 8** of this EA, and include consideration of hazards and risk; Aboriginal and European heritage, land use, traffic and transport, landscape and visual amenity, social and economic environments, noise, air quality and cumulative impacts of the development.

In determining the proposed well surface locations in the Spring Farm and Menangle Park Project Areas, AGL has taken into consideration available information regarding the future development in these areas, in particular the master plan prepared for the Spring Farm land release area. The assessments undertaken conclude that, provided that the recommended mitigation measures are implemented throughout phases of the proposed development, significant conflict with socio-cultural elements would be avoided. The proposed works are therefore not considered to have significant adverse impacts with respect to social impacts on the community, provided design and management measures are implemented in accordance with the Statement of Commitments.

The proposal is justifiable taking into account potential socio-cultural impacts.

11.2 Ecological Sustainability

Ecologically Sustainable Development (ESD) is a concept firmly entrenched in New South Wales environmental legislation and government policy. The guiding principles of ESD and their relation to the proposed Project are outlined in the following sections.

11.2.1 The Precautionary Principle

The Intergovernmental Agreement on the Environment (IGAE) provides a definition of the precautionary principle, which requires that where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

- (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and
- (ii) an assessment of the risk-weighted consequences of various options.

The IGAE states that the precautionary principle is to be a guiding principle for informed policy making and program implementation by all levels of government in Australia. In this manner, it is to guide both the public and private sector in its decision making and assessment of different options, particularly when decisions are being made in the face of uncertainty. In doing so, it requires avoidance of serious or irreversible damage to the environment, whenever practicable.

The Project has taken on board the precautionary principle by carrying out detailed environmental investigations in order to gain as much knowledge about the environmental characteristics of a locality and the processes and interactions of various components of the environment as reasonably as possible. This knowledge has been used to determine the potential environmental impacts of the proposal and recommend specific environmental management practices and safeguards for the proposed works to ensure significant environmental impacts do not occur and residual impacts are minimised. Environmental monitoring would be undertaken in respect of both the Spring Farm and Menangle Park Project areas to assess the adequacy of the precautions and safeguards used to minimise environmental impacts. This approach is consistent with the precautionary principle.

With regard to the Stage 2 Concept approval, further detailed investigations will be undertaken in this area prior to the commencement of works, to ensure that the environmental impacts of the proposal are minimised.

11.2.2 Inter-Generational Equity

The principle of inter-generational equity defined by the IGAE is a concept that requires the present generation to ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. The most significant aspect of this concept is that future generations should not inherit a degraded environment.

The various components of the Project have been designed to minimise environmental impacts and to ensure that the proposed works do not further degrade the environment. Mitigation strategies have been developed as part of the Project in accordance with current best management practice for CSM well drilling programs and recognising the requirement to achieve, where possible, a neutral or beneficial effect on the environment.

The proposed works will not result in the sterilisation of land or other resources and will return the land to as close as possible to its original state or better upon closure of the wells. Upon implementation of environmental safeguards and mitigation measures, the proposal will result in the provision of a valuable indigenous NSW gas resource without causing significant or irreversible environmental harm.

11.2.3 Biological Diversity and Ecological Integrity

This principle requires the conservation of biological diversity and ecological integrity to be a fundamental consideration of all development projects.

Detailed assessments in relation to the Spring Farm and Menangle Park Project areas, concluded that the proposal can be conducted without significant impact on the biological diversity and ecological integrity of the locality. An ecological assessment was undertaken to consider the impacts of the works proposed as part of the Spring Farm and Menangle Park Project application. The assessment found that the proposal would have no significant impact upon threatened species, populations or ecological communities or their habitats.

Further detailed ecological investigations would be undertaken prior to the commencement of works in the Stage 2 Concept Area to ensure that the impacts of these works on biological diversity and ecological integrity are similarly managed and minimised. Monitoring would be undertaken to ensure that environmental control measures are operating effectively.

Provided best practice planning and impact mitigation measures are implemented as recommended in this EA, the proposed Project is not expected to present a significant risk to the biodiversity of the surrounding environment.

11.2.4 Improved Valuation and Pricing of Environmental Resources

The fourth principle, improved valuation and pricing of environmental resources identifies that environmental factors should be included in the valuation of assets and services, such as polluter pays, full life cycle costing, and utilising incentive structures/ market mechanisms to meet environmental goals.

It is difficult to assign a monetary value to the environment of the locality given the lack of precedent in the valuation of environmental resources not considered for commercial use. As a monetary value could not be placed against the greatest number of environmental attributes, the approach taken was to manage environmental impact by identifying site specific safeguard measures to mitigate against adverse environmental effects, and to include the cost of these measures in the overall Project cost. This enables the value and price of the environmental resource to be more accurately reflected.

The project design and approach to valuation and pricing of environmental resources allows the extraction of a strategically valuable and important energy resource in an already constrained market, while still allowing future urban (residential, commercial and industrial) development of the land.

11.2.5 Decision Making Process

The proposed Project requires approval under Part 3A of the EP&A Act 1979.

An assessment of the short, medium and long term impacts of the proposed activity, taking into account the principles of ESD is described in this EA. The SoC provided in **Section 9**, forms the environmental mitigation, management and monitoring requirements for the proposed works.

The Project/ Concept approval process prescribed under Part 3A of the EP&A Act and subsequent environmental management frameworks ensure that decision making and monitoring of the Project would be undertaken in an integrated manner, having regard to relevant issues associated with the Project within its context. Further assessment would be undertaken and approvals sought for the works subject of the Stage 2 Concept approval in

accordance with the requirements of the legislation and the conditions of any concept approval issued.

11.3 Climate Change and Greenhouse Effect

The Greenhouse Effect involves certain gases, known as greenhouse gases, capturing heat radiated from the earth and re-radiating heat back to the earth. The thermal balance that is known to control earth's climate is maintained by this mechanism, and is influenced by the steadily increasing concentrations of certain greenhouse gases such as carbon dioxide (CO₂), with other greenhouse gases including methane, ozone (O₃), NO_x and Chloro-fluorocarbons (CFCs).

Natural gas is widely considered to be the cleanest and most environmentally acceptable fossil fuel, producing only 55% of the greenhouse gas emissions when burned (including carbon dioxide and sulphur compounds) compared to the burning of coal. For each megajoule of energy produced from burning coal, 50% more carbon dioxide is generated than if that energy had been produced from burning natural gas at the same efficiency (EPA, 1998, as cited by CGPJV, 2005).

The Proponent is a committed member of the Chicago Climate Exchange (CCX), which is the world's first voluntary and legally binding greenhouse gas emissions reduction, registry and trading program.

The CCX is the largest such exchange in the world and traded in excess of 10.5 million tonnes of abatement in 2006, and in the region of 5.9 million tonnes already in 2007. AGL joins global companies such as Sony, Ford, Motorola, IBM, Bayer Corporation and American Electric Power as a member.

CCX commenced greenhouse gas emissions allowance trading in 2003 and a legally binding rules-based greenhouse gas emissions allowance trading system, as well as the world's only global system for emissions trading based on all six greenhouse gases. CCX members are leaders in greenhouse gas management and represent all sectors of the global economy, as well as public sector innovators. CCX Members committed to reduce their greenhouse emissions a minimum of 4% below annual average of 1998-2001 by 2006 and 6% by 2010, depending on membership Phase.

The proposed expansion of the CGP would provide for increased production of natural gas to supply the growing NSW market, meeting future projected demand and reducing the need for consumers to use alternative and perhaps less environmentally acceptable fossil fuel sources such as energy produced through the burning of coal. In addition, with a recent push towards more environmentally acceptable fuels which is expected to further increase in importance into the future, natural gas is seen to represent a natural transition from the use of fossil fuels to cleaner sources of energy.

The proposed Project will, however, result in certain impacts in terms of climate change and the greenhouse effect in terms of the use of diesel and other fuels for the powering of plant, vehicles and equipment used for the drilling and operation of the wells. The total volume of greenhouse gases produced as a result of these activities is, however, expected to be negligible given the scale of the Project and the temporary nature of construction activities required for the Project.

Further, indirect impacts in terms of greenhouse and climate change could be considered in terms of the capturing of a fossil fuel which will in turn be burnt by consumers with resultant production of greenhouse gases. However, as stated above, of the range of fossil fuels

available, natural gas is considered to be the cleanest, producing the least amount of greenhouse gases per megajoule of energy produced.

The overall impact in terms of climate change and greenhouse is therefore expected to be minimal and generally positive when considered in the context of the wider energy market.

11.4 Consequences of Not Proceeding

The importance of securing a cost-effective indigenous energy supply, with lower greenhouse emissions is considered vital to the social and economic growth of the local and metropolitan area and the State. Should the proposal not proceed, a cost-effective indigenous source of energy would be lost.

Projections of natural gas usage in New South Wales estimate that usage will increase to around 230 Petajoules (PJ) per annum by the year 2015, an increase of some 90PJ over existing levels, thus placing additional pressure on suppliers and prices. The development of new gas supplies to the growing Sydney market is important to guarantee supply. This Project will provide the next step both in ensuring that supply to the Sydney market is maintained in the future and in helping to protect the environment.

In AGA's view, the delivery of gas from new sources is required much earlier than ABARE envisages if Australia is to ensure that competitively priced gas is available when major contracts come up for renegotiation later this decade.

Analysis of Australia's future natural gas reserves and production have been reported by ABARE and show that based on current gas demand forecasts, reserves in the Cooper-Eromanga, Bass, Bowen-Surat and Adavale Basins will be all but depleted by 2019, with only the Gippsland Basin maintaining a significant reserve.

It is therefore incumbent upon the Government to ensure that current Australian supplies of gas are supplemented from additional sources sooner rather than later. The main high pressure gas pipelines run through the CGP, consequently, the Proponent is well placed to assist in bringing additional gas to the market from Stage 2 of this Project.

The expansion of the CGP will also assist in the achievement of several State and Regional energy objectives and initiatives which are formulated to provide safe efficient and secure energy supplies into the future.

Should the Project not proceed, the most obvious effects in a State, regional and local context would be:

- The loss of an opportunity to develop a convenient and competitive natural gas supply within the Sydney Basin;
- The loss of resulting economic and social benefits to the New South Wales community; and
- The likely future shortfall in the gas supply to the growing New South Wales market may in turn lead to an increase in the use of less efficient alternative fossil fuel sources that would increase greenhouse gas emissions.

It would also be a lost opportunity to contribute positively to Government initiatives such as the development of coal seam methane resources, the National Greenhouse Strategy, petroleum exploration in New South Wales, and the deregulation of energy markets in Australia.

11.5 Conclusion

Undertaking the proposal in the manner proposed is justifiable taking into consideration its compatibility with existing and future land uses as well as potential biophysical, economic and socio-cultural impacts. Additionally, the proposal accords with the principles of ESD. Consideration of the proposal against a wide range of criteria demonstrates that the project is environmentally sustainable and justifiable.



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12 CONCLUSION

12.1 The Proposal

The proposal comprises an expansion of Stage 2 of the CGP, involving the construction and operation of gas wells and associated infrastructure such as gas gathering lines and access roads. The primary purpose of the proposal is to increase gas production from the CGP to meet projected future demand which is expected to increase significantly. The proposal will also provide for an indigenous gas supply for the Sydney market, reducing the need for transportation of gas from interstate to meet demand and encouraging the use of a cleaner energy source than that provided by coal.

In order to facilitate the Stage 2 expansion, AGL is seeking Concept approval for general works within the Stage 2 area, along with concurrent Project approval for specific works within the Spring Farm and Menangle Park areas consisting of up to 16 new well surface locations. The proposal is identified as a 'Major Project' under SEPP 2005, therefore the Minister for Planning is the approval authority.

12.2 Justification of the Proposal

The proposal has been subject to environmental assessment in accordance with Part 3A of the EP&A Act and the requirements issued by the Director General. The EA undertaken concludes that whilst the Project would have some residual impacts, the mitigation measures identified would effectively reduce these to an acceptable level of environmental risk and enable the Project to operate without detriment to the existing or future land uses. The proposal stands to provide significant public benefit in terms of the provision of a vital source of energy to meet projected future demand as well as allowing for the future urban (residential, commercial and industrial) development of the area. These benefits are considered to outweigh the residual environmental impacts identified in this EA.

Undertaking the proposal in the manner proposed is justifiable taking into consideration potential biophysical, economic and socio-cultural impacts.

12.3 Sustainability of the Proposal

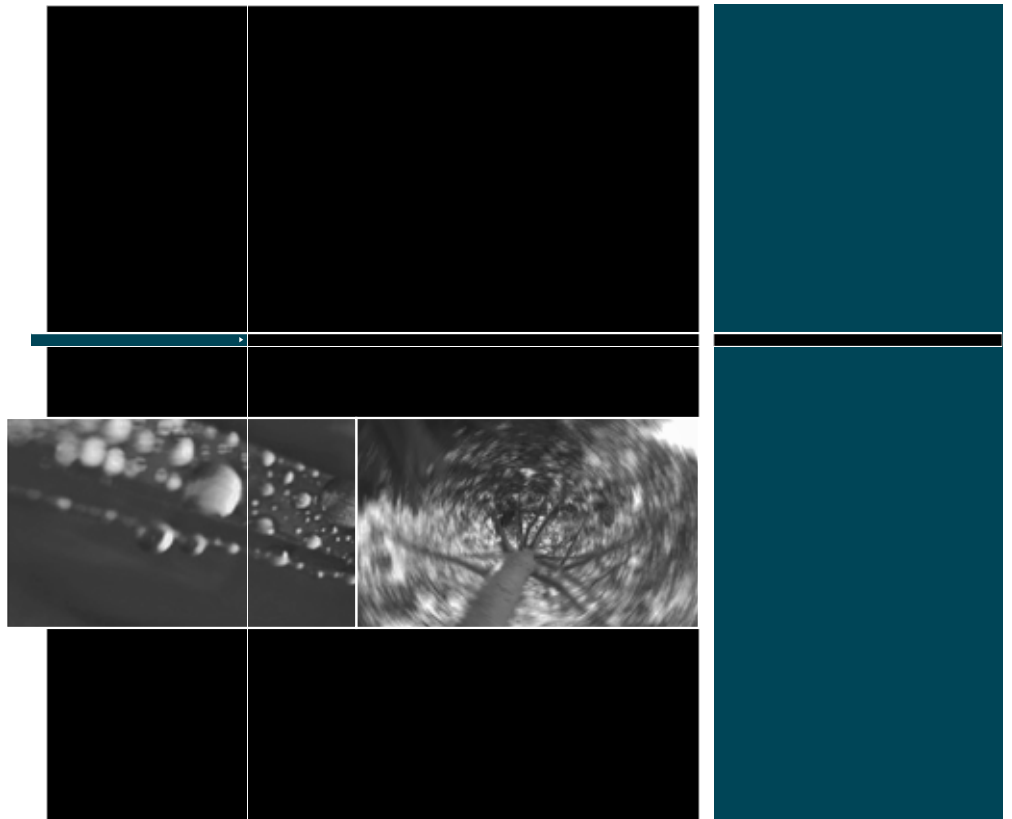
The project is sustainable in terms of:

- Efficiencies in meeting project objectives;
- The acceptability of risks;
- Protection of ecological integrity and biodiversity;
- Social equity considerations; and
- A precautionary approach to analysis, management and monitoring of impacts and risks to the environment.

12.4 Conclusion

Potential environmental impacts resulting from the proposal have been identified and measures and safeguards have been incorporated throughout the EA to manage these. The proposal would be constructed and operated to meet existing environmental standards and the environmental performance of the proposal would be monitored to ensure achievement of these standards.

The proposal is considered to be environmentally acceptable and would have significant local and regional environmental, economic and social benefits, including the provision of safe efficient and secure energy supplies for NSW into the future.



*This report was prepared by HLA-Envirosciences Pty Limited (HLA ENSR),
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