AECOM

Certification

Submission of Environmental Assessment (EA) prepared under the Environmental Planning and Assessment Act 1979 Section 75F

EA prepared by Name Qualifications	Kate Tilden Bachelor of Science (Marine Science) Project Scientist	Erin Saunders Bachelor of Environmental Science, Diploma of Urban and Regional Planning Senior Professional Planner	Ruth Kelly Master of Arts (Archaeology) Associate Director
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in respect of	Gloucester Gas Project		

Project application Applicant address Applicant name	Gloucester Gas Project 22 Tate Street, Gloucester NSW 2422 AGL Gloucester L E Pty Ltd
Proposed project Land to be developed lot no., DP/MPS, vol/fol etc	The proposed project is to be carried out on the land detailed in **Appendix E** 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	Signature	Signature
Name: Kate Tilden	Name: Erin Saunders	For Name: Ruth Kelly
Date 11/11/09	Date 11/11/09	Date 11/11/09

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Glossary of Terms

Term	Definition
Acid Sulfate Soils	Soils containing pyrite which produces sulphuric acid when exposed to oxygen.
Alluvial	Comprising of sediment deposited by a river or other flowing water body.
Aquaculture	The controlled farming and cultivation of plants and animals that live in water.
Aquifer	Geological formation, group of formations, or part of a formulation capable of transmitting and yielding significant quantities of water.
Archaeological site	A place in which material evidence of past activity is preserved.
Australian Height Datum	The standard reference level used to express the relative elevation of standard features. A height given in metres AHD is essentially the height above sea level.
Backfill	To refill an excavation with the material that was dug out of it.
Biodiversity	The encompassment of biological variety at genetic, species and ecosystem scales.
Bore	A cylindrical hole drilled to access groundwater.
Buffer	A zone of user-specified distance around a point, line or area.
Catchment	The area in which water collects to form the supply of a river stream or drainage area.
Coal	A fossil fuel formed through the compaction of organic matter over time.
Conservation	The management of natural resources in a way that ensures their continuing availability to both present and future generations.
Coal seam	A stratum of coal extending for some distance.
Coal Seam Gas	Gas which occurs naturally within coal deposits
Ecological integrity	The quality of an ecosystem in which the natural ecological processes are sustained, with genetic, species, and ecosystem diversity assured for the future.
Ecologically Sustainable Development	Using, conserving and enhancing resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future can be increased.
Emissions	Release of gases into the atmosphere.
Geographic Information Systems (GIS)	Digital systems for the capture, storage, retrieval, analysis, and display of spatial data in reference to the earth.
Greenhouse emissions	The release of greenhouse gases (such as Carbon Dioxide, methane, CFCs) into the atmosphere.
Groundwater	Water that exists in the pore spaces and fractures in rock and sediment beneath the Earth's surface.

Term	Definition
Hazard	A source or situation of potential threat or danger.
Heritage	The culture, property, and characteristics of past times.
Hydrogeology	The study of the interrelationships of geologic materials and processes with water.
Infill well	Construction of new wells in an existing field within the original well patterns to accelerate recovery or to test recovery methods.
Mitigation	Reduce the severity.
Natural gas	Underground deposits of gas used as fuel. It is comprised of predominately methane.
Open cut mining	A form of mining designed to extract minerals that lie near the surface. Waste or overburden is removed to expose the minerals for mining. Rock covering the minerals is blasted and removed by large draglines or electric shovels and trucks.
Putrescible waste	Food or animal matter (including dead animals or animal parts), or unstable or untreated biosolids.
Petroleum	A mixture of liquid, gaseous, and solid hydrocarbons occurring naturally beneath the Earth's surface.
Physiographic	Physical features and changes of land including slope and elevation.
Pipeline corridor	Passageway allowing for the construction and rerouting of pipeline.
Pollutants	Waste material that contaminates air, soil, or water.
RAMSAR	An intergovernmental treaty that provides the framework for national action and international cooperation for conservation of wetlands and their resources.
Rehabilitation	The return and recovery of previously disturbed land to a stable land surface capable of useful purposes.
Resource	A new or reserve supply that can be drawn upon when needed.
Riparian vegetation	Vegetation occurring alongside streams and rivers.
Solid waste	Any non-hazardous, solid, degradable waste. Includes putrescibles waste, garden waste, uncontaminated biosolids and clinical and related waste where sterilised to a standard acceptable to the Department of Health.
Surface water	All water bodies above the land.
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.
Tributaries	Streams or rivers which contribute flow into a larger river or water body.
Turbidity	The amount of suspended particles in a volume of water.
Wetlands	Areas that are saturated by surface or ground water with vegetation adapted for life under those soil conditions, e.g. swamps, marshes, and estuaries.

Term	Definition
Wells	A hole made by drilling in connection with exploration for petroleum or operations for the recovery of petroleum, but does not include a seismic shot hole.

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Abbreviations

AADT	Average Annual Daily Traffic
ABARE	Australian Bureau of Agricultural and Resource Economics
AC	Alternating Current
AGA	Australian Gas Association
AGL	AGL Energy Pty Ltd
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AQIA	Air Quality Impact Assessment
ASS	Acid Sulfate Soils
ASSMP	Acid Sulfate Soil Management Plan
ASX	Australian Securities Exchange
BCC	Brine Crystal Concentrator
Bcf	Billion cubic feet
CBD	Central Business District
CDI	Capacitive Desalination
CEMP	Construction Environmental Management Plan
CKPoM	Comprehensive Koala Plan of Management
CPF	Central Processing Facility
CSG	Coal Seam Gas
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CO	Carbon Monoxide
DC	Direct Current
DCP	Development Control Plan
DECC	Department of Environment Climate Change (now Department of Environment Climate Change and Water)
DECCW	Department of Environment Climate Change and Water
DEWHA	Department of the Environment, Water, Heritage and the Arts
DII	Department of Industry and Investment
DoP	Department of Planning
DPI	Department of Primary Industries (now part of Industry and Investment NSW)
Draft GLEP 2009	Draft Gloucester Local Environment Plan 2009
DWE	Department of Water and Energy (now part of Industry and Investment NSW)
EA	Environmental Assessment
EARs	Environmental Assessment Requirements

EASR	Environmental Assessment Scoping Report
EC	Electrical Conductivity
EDR	Electrodialysis Reversal
EEC	Endangered Ecological Communities
EP&A Act	Environmental Planning and Assessment Act 1979
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPI	Environmental Planning Instruments
EPL	Environment Protection Licence
ENSR	ENSR Australia Pty Ltd.
ESD	Ecologically Sustainable Development
ESP	Electric Submersible Pump
GFDA	Gas Field Development Area
GHD	GHD Pty Ltd.
GIS	Geographic Information Systems
GLC	Ground Level Concentration
GLEP 2000	Gloucester Local Environmental Plan 2000
HDD	Horizontal Directional Drilling
HDS	Hexham Delivery Station
HDPE	High Density Polyethylene
Heritage Act	Heritage Act 1977
HIPAP	Hazardous Industry Planning Advisory Paper
Hunter REP	Hunter Regional Environmental Plan
HVRF	Hunter Valley Research Foundation
I&I NSW	Industry and Investment NSW
LEP	Local Environmental Plan
LEP 1993	Maitland Local Environmental Plan 1993
LEP 1996	Great Lakes Local Environmental Plan 1996
LEP 2000	Port Stephens Local Environmental Plan 2000
LEP 2003	Newcastle Local Environmental Plan 2003
LEP 2006	Dungog Local Environmental Plan 2006
LES	Local Environmental Study
LGA	Local Government Area
LHRS	Lower Hunter Regional Strategy
LNG	Liquefied Natural Gas
MCA	Multi Criteria Analyses

mg/L	Milligrams per Litre
ML	Megalitre
ML/d	Megalitres per day
MPO	Molopo Australia NL
NEPM	National Environment Protection Measure
NES	National Environmental Significance
NO_x	Nitrogen Oxide
NPI	Australian National Pollutant Inventory
NPWS	National Parks and Wildlife Service
OEMP	Operational Environmental Management Plan
PASS	Potential Acid Sulfate Soils
PCP	Progressive Cavity Pump
PE	Polyethylene
PEA	Preliminary Environmental Assessment
PEL	Petroleum Exploration License
PFM	Planning Focus Meeting
PHA	Preliminary Hazard Analysis
PJ	Peta-Joule
PM_{10}	Particulate matter less than 10μm
PO Act	NSW Petroleum (Onshore) Act 1991
POEO Act	Protection of the Environment Operations Act 1997
PPL	Petroleum Production Lease
PPM	Part per million
QHGP	Queensland Hunter Gas Pipeline
RA	Risk Assessment
REP	Regional Environmental Plan
RNE	Register of the National Estate
RO	Reverse Osmosis
ROW	Right of way
RTA	Roads and Traffic Authority
SAR	Sodium Adsorption Ratio
SCADA	Supervisory Control and Data Acquisition
SEPP	State Environmental Planning Policy
SEPP 14	State Environmental Planning Policy 14 - Coastal Wetlands
SEPP 2005	State Environmental Planning Policy (Major Development) 2005
SEPP 2007	State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007
SEPPI	State Environmental Planning Policy (Infrastructure) 2007

SEPP 33	State Environmental Planning Policy 33 - Hazardous and Offensive Development Application Guidelines
SEPP 44	State Environmental Planning Policy 44 - Koala Habitat Protection
SEPP 55	State Environmental Planning Policy 55 - Remediation of Land
SEPP 71	State Environmental Planning Policy 71 - Coastal Protection
SMYS	Specified Minimum Yield Stress
SWMP	Soil and Water Management Plan
TDS	Total Dissolved Solids
TEG	Triethylene Glycol
TJ	Tera-Joule
The Agreement	Agreement between the Commonwealth of Australia and the New South Wales Government under section 45 of the Environment Protection and Biodiversity Conservation Act 1999 relating to environmental assessment
TSC Act	Threatened Species Conservation Act 1995
UF	Ultrafiltration
VCE	Vapour Cloud Explosion
VOC	Volatile Organic Compound
VSD	Variable Speed Drive
WMP	Weed Management Plan
ZLD	Zero Liquid Discharge

Executive Summary

Introduction

Petroleum Exploration Licence (PEL) 285 was previously held by the Joint Venture (comprising both Lucas Energy Pty Limited and Molopo Australia Limited) and was sold to AGL Energy Pty Ltd in December 2008. Its related company AGL Gloucester LE Pty Ltd (AGL) is the operator of PEL 285.

The Gloucester Gas Project (the Project) includes works for the extraction of coal seam gas (CSG) from the Gloucester Basin within the PEL 285 area. The Project involves the development of gas wells and associated infrastructure, the development of a Central Processing Facility (CPF), and the construction and operation of a high pressure gas transmission pipeline from Stratford to a delivery station at Hexham, NSW. AGL is the Proponent for the

The Project has been declared by the Minister for Planning (the Minister) as a Major Project under the *Environmental Planning and Assessment Act 1979* (EP&A Act) which requires assessment under Part 3A of the EP&A Act. Furthermore, the Minister has authorised the submission of a Concept Plan for the Project under Part 3A.

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

- Concept Plan Approval for:
  - Staged well field development within the Concept Area, including development of wells, gas and water gathering lines, and associated infrastructure; and
- Concurrent Project Approval for:
  - Construction and operation of gas wells at proposed well site locations within the Stage 1 Gas Field Development Area (Stage 1 GFDA), access roads, gas and water gathering system and associated infrastructure;
  - Construction and operation of a CPF with an annual capacity of approximately 30 petajoules (PJ), which equates to an average of 80 terajoules (TJ) per day, on one of two potential sites within the Stage 1 GFDA, as well as associated water treatment plant, ancillary 15MW power generation plant, storage ponds and associated infrastructure; and
  - Construction and operation of the gas transmission pipeline within an assessed 100 m corridor from Stratford to Hexham; and
  - Construction and operation of a delivery station at Hexham.

AECOM has been engaged by AGL to prepare this Environmental Assessment (EA) to assess potential impacts associated with the Project. This EA has been prepared in accordance with the provisions of Part 3A of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), together with the Environmental Assessment Requirements (EARs) issued by the Director-General of the Department of Planning in August 2008.

Overview of Proposed Activities

Works proposed under the Concept Plan and concurrent Project Approval would involve the construction and operation of a well field, CPF and associated infrastructure, gas transmission pipeline and delivery station. The range of activities for which approval is sought can be broadly described within the following elements:

- **Construction:** Activities necessary to develop the Project infrastructure, including CSG wells, underground water and gas gathering lines, electricity supply, access roads, the CPF and ancillary activities, gas transmission pipeline, and HDS. Two construction workforce camps would be required to provide temporary accommodation for the construction workforce. One construction workforce camp would be located within the Stage 1 GFDA, with a second located approximately midway along the pipeline corridor.
- **Production, Operation and Maintenance:** Production of CSG from wells, to be transferred through gas gathering lines to the CPF for compression and dehydration, before delivery via gas transmission pipeline to the existing gas network at Hexham. Other activities that may be required to maintain production efficiency include: development of infill wells; upgrade of gas and water gathering lines; well work-over (including fracture stimulation, where required); installation of infield compression; maintenance of gas and water processing facilities; and walkover and aerial surveys of the transmission pipeline.
- **Decommissioning and rehabilitation:** Rehabilitation would be undertaken in two stages:
    - Initial rehabilitation of well site construction pads, and construction areas for the CPF and pipeline, following completion of construction.
    - Final rehabilitation following decommissioning involving removal of above ground infrastructure and abandonment of underground infrastructure.

Environmental Assessment Approach

Concept Plan

Concept Plan Approval is sought for a staged gas field development within the Concept Area. The Concept Plan represents a strategic overview of future works likely to occur within the Concept Area. The purpose of the Concept Plan is to provide an overview of likely future activities to be established in the Concept Area, while allowing further time for detailed design and project planning. This approach is intended to provide agencies and the community with an understanding of where the future works may occur.

The environmental assessment associated with the Concept Plan is based on a more strategic approach and deals with key issues. Concept Plan Approval provides for more complex projects to be considered based on an assessment of strategic issues rather than a detailed assessment of physical impacts in order to determine broad scale potential impacts and requirements up front.

Given the strategic nature of the Concept Plan, locational principles have been developed to guide the future placement of well sites and associated infrastructure, as well as activities associated with construction and operation. Locational principles are discussed in **Section 5.2** of the EA.

Activities proposed within the Concept Area would require Project Approval prior to development once future project elements have undergone detailed design. Subsequent project applications would provide assessment of key environmental issues and would be required to be undertaken in accordance with the terms of the Concept Plan Approval. **Section 6.2** of the EA further discusses the Concept Plan and Project Approvals process.

Project Approval

Concurrent Project Approval is being sought for specific components of the Project for which more planning and design has been undertaken. Indicative well site locations and associated infrastructure within the Stage 1 GFDA, the location of the CPF (including Sites 1 and 7), and the alignment of an assessed 100 m corridor for the gas transmission pipeline (within which a 30 m Right of Way (ROW) would be developed) have been identified, through detailed environmental constraints analysis and environmental assessment.

Given the spatial nature of the development of the Stage 1 GFDA, an ‘environmental envelope’ approach has been adopted to assess and avoid or minimise potential impacts. The steps involved in developing the environmental envelope are described below.

- Establishment of Envelope

  The location of the Stage 1 GFDA footprint is based on geological considerations. A 600 x 600 m well grid is established within the Stage 1 GFDA, with each 600 x 600 m grid square comprising an individual environmental envelope.

- Constraints Analysis

  Environmental constraints are identified and assessed within each environmental envelope. Constraints include ecological, archaeological, landforms, water courses, infrastructure, noise, visual amenity and land use. Environmental constraints mapping is undertaken utilising geographical information systems (GIS) to spatially identify constraints and develop an overall site suitability model.

- Indicative Well Site Locations

  Constraints mapping is utilised to determine indicative placement of well site locations within each grid square and to avoid and minimise potential environmental impacts. Indicative placement of wells also takes into consideration land owner consultation and commercial considerations. Final well site locations would avoid environmentally sensitive areas identified through the constraints mapping and in consultation with respective land owners.

As noted above, each grid square of 600 x 600 m was assessed as an environmental envelope as a basis for systematic assessment. Each grid square is located back to back so in effect, the entire grid becomes one larger environmental envelope. As such, the Proponent has a degree of flexibility to locate, and re-locate infrastructure within the assessed envelope to accommodate both landowner and commercial considerations, without affecting the surrounding environment or requiring further approvals. As such, while the current indicative well locations represent the current project plan, as long as constraints are avoided and sensitivity criteria observed, the Proponent would be able to establish final locations anywhere within the overall environmental envelope.

A similar approach has been adopted for the pipeline corridor. A pipeline corridor selection study was undertaken, which utilised a combination of GIS and Multi Criteria Analysis (MCA) methods to determine the preferred pipeline corridor utilising numerous sensitivity criteria. Major constraints identified during this process were avoided where possible during the selection of the final pipeline route.

Strategic Context and Need for the Project

The Gloucester Basin currently has certified reserves of 423 petajoules (PJ) of 2P (Proved and Probable) Reserves and 630 PJ of 3P (Proved, Probable and Possible) Reserves. Gas from the Gloucester Basin would produce at 20 – 30 PJ per annum, which is more than 10% of the existing NSW market with potential to increase over time. This represents the additional gas demand growth projected for the underlying NSW gas market over the next three to four years (excluding fuel for power generation). CSG from the Gloucester Basin would be delivered to the NSW Gas Market through the via the gas transmission pipeline into the existing gas network at Hexham. The development of new gas supplies to the growing Sydney and NSW market is important to guarantee supply. Without additional indigenous gas supplies to NSW, there are risks associated with an event that causes an unexpected interruption to a major supply. Unexpected interruptions to major supplies may result in disruption to NSW's gas supply which could consequently result in a material impact on residential, manufacturing and industrial sectors. The Project would provide the next step in ensuring that supply to the Sydney/Newcastle and wider NSW market is maintained in the future.

At the end of FY09, total 2P Gas Reserves for the east coast of Australia (including Queensland and NSW) were 25,578 PJ comprising of 65% CSG and 35% conventional gas (Core Energy Group, 2009). Analyses of Australia's future natural gas reserves and production have been reported by the Australian Bureau of Agricultural and Resource Economics *(*ABARE*)* and show that based on gas demand forecasts in 2002, most reserves of conventional gas in major Australian gas producing basins would be substantially reduced by 2019 (Fainstein *et al.,* 2002).

It is therefore vital that current Australian supplies of gas are supplemented from additional sources. CSG from the Gloucester Basin would be delivered into the Sydney Newcastle trunk pipeline, therefore the Proponent is well placed to assist in bringing additional gas to the market from this Project.

Overall, the Project would be a benefit to the State as it provides:

- Commercial production of CSG for energy supply to the Sydney and Hunter regions and NSW as a whole;
- Local production and regional economic development – employment and service;
- Development of NSW's natural resources in an environmentally sustainable manner;
- Reduced greenhouse gas emission fuel source n in the Hunter region; and
- Commercially competitive indigenous power supply to the State.

Site and Context

The Project is located within the Hunter Region. The Hunter Region is located approximately 200 km to the north-north-east of Sydney and covers an area of approximately 31,000 km^2. The region encompasses a diverse range of geographic landforms, environments, land uses, industries and population centres. The Hunter Region comprises 11 Local Government Areas (LGAs), which are broken up into three subdivisions; the Lower Hunter, Upper Hunter, and Other Hunter. The Project traverses six LGAs, including Maitland, Port Stephens and Newcastle in the Lower Hunter and Gloucester, Dungog and Great Lakes in the Upper Hunter region.

Concept Area

Concept Plan Approval is sought for the development of new wells and associated infrastructure within the Concept Area and the construction and operation of the CPF on one of two possible sites (CPF Site 1 or 7) with an average capacity of 80 TJ per day.

The Concept Area is situated within the Gloucester and Great Lakes LGAs approximately 100 km north of Newcastle. The Concept Area comprises approximately 210 square kilometres (km^2) as shown in **Figure 5.1**, which represents the known coal measures of the Gloucester Basin. The land comprises largely rural/agricultural land, however the township of Gloucester and certain land zoned for environmental protection is also included within this area, which extends as far north as Barrington but lies just to the east of the village. Land use is further detailed in **Chapter 11** of the EA.

Project Area

The Stage 1 GFDA for which Project Approval is sought covers an area of approximately 50 km^2 (including the area comprising the Stratford Pilot Project), broadly located between the township of Stratford and Gloucester as shown in **Figure 5.2**.

The landscape of the Stage 1 GFDA consists of slightly undulating low hills on Permian sediments in the Stroud-Gloucester Basin region characterised as Relief <50 m, Elevation <200 m and Slopes <10%. The soils are moderate to deep, moderately well-drained Brown Sodosols (Yellow Soloths) and moderately well-drained Grey Kurosols (Yellow Soloths) on imperfectly to moderately well drained side slopes and crests shallow to deep, as detailed in **Chapter 17** of the EA.

The majority of the original open-forest vegetation, which once covered most of this landscape, has already been cleared and replaced with improved pasture. Land use includes improved and semi-improved pasture, agricultural activities including dairying, beef cattle production, and some cultivation (Lucas Energy, 2007).

The CPF would be located on one of two potential sites within the Stage 1 GFDA, known as Site 1 and Site 7. The locations of each of these sites are shown on **Figure 5.2**. These sites were selected based on a Site Suitability Assessment undertaken for the CPF as part of the Project.

CPF Site 1 is situated on land currently owned by the Proponent, known as the Tiedeman Property. Site 1 is currently vacant, consisting of mainly grassland on relatively flat terrain. The property also contains the Stratford Pilot Project, as discussed in **Section 1.1.1** of the EA. Access to the Stratford Pilot Project is currently via Tiedemans Lane, however access to the site would be established via Wenham Cox Road if the CPF was to be constructed at this site.

CPF Site 7 is located on land currently owned by Gloucester Coal, on a parcel of land adjacent to a rail loop which currently services the Stratford Colliery. The site is currently vacant and consists predominantly of grassland with some scattered sparse vegetation. A large stand of vegetation is located in the south eastern portion of the parcel of land, however this would not be affected by the Project. Due to the limited sight distances to access this parcel of land off Parkers Road, an alternative access point access through the adjacent property to the south of Parkers Roads from The Bucketts Way would be constructed, as shown in **Figure 5.10**.

The assessed 100 m wide pipeline corridor would extend from the CPF (either Site 1 or Site 7) to Hexham, on the north-western outskirts of Newcastle. The pipeline corridor is shown in **Figure 1.1.**

The proposed pipeline corridor traverses approximately 95 km of land, coming into contact with a range of land uses including (refer to **Chapter 11**):

- Agricultural;
- Mining;
- Rural residential;
- Residential;
- National Park; and
- Industrial.

Alternatives

A range of alternatives was considered in respect of the Project including:

- Alternative CSG Resources;
- Alternative Project Development Options;
- Alternative Locations;
- Alternative Plant & Infrastructure;
- Alternative Water Management;
- Alternative Construction Techniques;
- Alternative Construction Workforce Management; and
- Consequences of Not Proceeding.

These alternatives are discussed in detail in **Chapter 4** of the EA. The "consequences of not proceeding" were considered to be a lost opportunity to contribute positively to Government initiatives such as the development of CSG resources, the National Greenhouse Strategy, petroleum exploration in NSW, and the deregulation of energy markets in Australia and as such was not considered to be an appropriate alternative.

Project Description – Concept Area

Concept Plan Approval is sought for the development of well sites and associated infrastructure to produce CSG within the Concept Area, which is primarily centred on the town of Stratford, approximately 100 km north of Newcastle.

Development of the Concept Area would be staged, with initial development occurring within the Stage 1 GFDA, for which concurrent Project Approval is sought. Subsequent stages of CSG extraction would likely be extensions of the Stage 1 GFDA, but may occur at other locations within the Concept Area and would be determined with consideration of locational principles to avoid impacts to sensitive environmental features.

Development within the Concept Area would incorporate the following components:

- Development of indicative well site locations within the Concept Area, including construction of access roads and drill pads, drilling, construction, operation and post development activities;
- Development of a gas and water gathering system to collect produced gas and water at well sites and transport to the CPF; and

- Upgrades to the water treatment facility and additional storage ponds within the CPF footprint to accommodate additional water production from gas field development within the Concept Area.

The Concept Plan also includes the following activities as part of the future development of the Concept Area:

- **Construction of infill wells:** either co-located within the pads of existing wells, or new wells (and associated infrastructure) in previously undisturbed areas of the Stage 1 (and subsequently staged) GFDA, in order to access additional reserves that cannot be completely accessed from existing wells or wellhead locations. Directional drilling may be utilised as a drilling technique where up to 4 individual wells heads could be co-located at a single location, in order to maximise access to the resource;
- **Upgrade of gas and water gathering lines:** to allow for increased production capacity, some gathering lines may require duplication along existing gathering line routes;
- **Installation of in-field compression:** in vicinity of wellheads or gas gathering routes, additional compression may be required to increase capacity and production; and
- **Discharge of treated water during times of high flow.**

While specific locations for well sites are unknown for the Concept Area, the assessment of environmental impacts for the wider Concept Area has been based on the description and identified footprint of the activities proposed in respect of the Stage 1 GFDA. Environmental safeguards and mitigation measures have been recommended in this EA which would form part of subsequent project applications for development in the Concept Area. Based upon current knowledge, approximately 200-300 wells are likely to be developed in the Concept Area over a 20 year time period.

Project Description – Project Area

Stage 1 GFDA

Project Approval is sought for the development of plant and infrastructure for the production of CSG within the Stage 1 GFDA. The Stage 1 GFDA extends from near the township of Craven in the south, to north of Stratford, encompassing an area of approximately 50 km^2. The Stage 1 GFDA would form the first phase of a staged approach to the wider development of the Concept Area.

Key construction components of the proposed development within the Stage 1 GFDA for which Project Approval is sought include the following:

- Upgrade of existing roads and tracks as required and construction of new internal access roads. Property access including formation of new and existing roads would be undertaken in consultation with the landowners;
- Preparation and construction of well site locations, including establishment of construction hardstand;
- Drilling of wells, geophysical logging, cementing and casing;
- Well completion, including but not limited to under-reaming and fracture stimulation if required;

- Production, including installation of surface infrastructure at the wellhead;
- Installation of underground gas and water gathering systems; and
- Rehabilitation of the construction well site to a reduced area as required for gas production and ongoing operations.

A temporary construction workforce camp would be required to accommodate the anticipated workforce during construction of the Stage 1 GFDA.

Up to 110 indicative well site locations are proposed for the Stage 1 GFDA, and are shown on **Figure 5.2** of the EA. The location of well sites within the Stage 1 GFDA has been based on a notional grid pattern, within which an environmental envelope approach has been adopted to position individual indicative well locations within the grid pattern. The environmental envelope approach assesses environmental constraints and potential impacts within each grid square, with the final location of well sites then determined on the basis of geological considerations, environmental constraints and landowner preferences. The environmental constraints analysis within the Stage 1 GFDA envelope is shown in **Figure 5.4**. By assessing impacts and defining constraints within each grid square, or ‘envelope’, flexibility is preserved in relation to final well locations.

The proposed construction and operational activities for each of the above key components forming part of the Project Application are detailed in **Chapter 5** of the EA.

Central Processing Facility (CPF)

The Project involves the construction and operation of the CPF on one of two proposed sites with an average capacity of 80 TJ per day to treat and compress gas produced within the Concept Area, to render it suitable for high pressure transport via the gas transmission pipeline.

The CPF may include the following:

- Up to eight compressor units and associated plant for compression and dehydration of gas;
- Gas Dehydration Equipment;
- Water treatment facility for desalination of produced water;
- Gas Filtration, Regulation, Metering and Analysis Equipment;
- Start, Instrument and Fuel Gas filtration, regulation and metering equipment
- Water treatment facility for removal of oil-in-water emulsion from the process water caused by the compression process;
- Flaring system;
- Network of storage and evaporation ponds;
- Small scale ancillary power generation with a capacity of up to 15 MW;
- Administration and accommodation facilities, and plant control room; and
- Laydown areas for the storage of pipe and equipment.

The two proposed locations for the CPF are shown in **Figure 5.2,** and conceptual site layout plans are shown on **Figure 5.9** and **Figure 5.10** for CPF Site 1 and CPF Site 7 respectively.

The CPF compressor units would primarily comprise reciprocating compressors (or screw compressors) which compress the gas in stages from pressures of less than 100 kPa up to a maximum of 15.3 MPa. The CPF would also process gas to remove impurities such as coal fines and free water.

The CPF footprint would incorporate a water treatment facility, which would include a water treatment plant and three storage ponds of up to 25 ML capacity each to store produced water, treated water and the brine waste water, respectively. The water treatment facility is described in **Section 5.5.4** of the EA.

The CPF would also incorporate a small scale ancillary power generation facility, with a nominal capacity of up to 15 MW. The power generation facility is described in **Section 5.5.5** of the EA.

A process description of each of the plant comprising the CPF is described in **Chapter 5** of the EA. **Figure 5.13** presents a schematic flow diagram depicting the treatment and compression process.

Construction of the CPF would be undertaken over a period of approximately 12 months. The CPF and associated plant and infrastructure would operate 24 hours per day. Operational personnel would generally be on site between the hours of 7 am and 5 pm. During typical operation, approximately 30 AGL staff and contractors would be on site during the hours of 7 am and 5 pm. Outside these hours one to two plant operators would attend the plant in the control room or have process alarms and emergency phone calls routed to the onsite accommodation with the on duty plant operator being continuously on call. Additionally, during operational shutdowns for maintenance or other events, operational personnel may be required to be on site 24 hours per day for short periods.

Pipeline

Project Approval is sought for the development of a gas transmission pipeline within an assessed 100 m wide corridor, within which a 30 m ROW would be developed from the CPF through to the HDS at Hexham.

The selection of the preferred pipeline route involved an assessment as described in **Chapter 4** of the EA which considered the following criteria:

- Threatened flora and fauna species;
- Protected areas such as National Parks;
- Avoidance of areas with trees including isolated clumps and significant trees where possible;
- Major topographical constraints (e.g. geology, acid sulfate soils, steep areas, erosion potential, elevated ground water levels, watercourses);
- Heritage Issues (Aboriginal and non-Aboriginal);
- Land use (existing and future) and legislative constraints;
- Building and infrastructure;
- Social impacts;
- Length of pipeline – the shortest length usually being the most efficient and economical; and
- Existing easements – utilised where possible as they provide a corridor with pre-existing encumbrance to the land, minimising the impact to the land use and development potential.

Land owner consultation, ground truthing and aerial surveys of the route were undertaken to further refine the pipeline route.

The construction of the pipeline would typically involve a progressive, rolling work front carrying out the following works:

- Clearing and grading;
- Trenching and earthworks.
- Pipe stringing;
- Bending and welding;
- Radiography and joint coating;
- Cathodic protection;
- Padding;
- Lowering-in and backfilling;
- Hydrostatic testing;
- Clean up and rehabilitation; and
- Commissioning.

Pipeline construction would be staged, and spread along the length of the pipeline corridor. This approach would be taken in approximately 20 km segments with each 20 km segment of pipeline taking some 8 to 12 weeks to complete depending on terrain and subsurface conditions. The construction activities described in the sections above would be undertaken in a sequence commencing with site preparation activities and excavation of the trench, followed by construction of the pipeline commencing with pipe stringing, through to clean up and rehabilitation. Each activity involved in the construction process would be undertaken for the full length of the working segment of the pipeline, with the next consecutive activity commencing immediately after the previous activity has been completed.

The proposed pipeline would cross a number of major and minor watercourses, roads and railways. The crossing method would vary depending on the sensitivity of the area, the relevant Australian Standards and other relevant guidelines. Infrastructure crossings would be managed through standardised mitigation measures which are incorporated into standard pipeline construction procedures in accordance with Australian Standards. A summary of the watercourses and infrastructure (roads and rail) which would require to be crossed for the proposed pipeline route and the proposed crossing method are provided in **Section 5.6.4** of the EA.

Construction of the gas transmission pipeline would be undertaken over a period of approximately 12 months, however this would be dependant upon weather. Extended construction may be required if inclement weather is experienced. It is anticipated that a majority of construction would be undertaken during the driest months of the year, typically winter and spring.

Construction works would typically be undertaken on a 37 day cycle with crews working 28 days on followed by 9 days off. During the 28 day work cycle, construction works would typically occur between 7.00am to 6.00pm, seven days per week with the exception of HDD. Once commenced, HDD would need to be continued to ensure the integrity and safety of the process. As such, HDD may need to continue beyond typical construction hours in certain situations.

Approximately 300 personnel would be required at peak of the construction phase of the pipeline. A temporary construction workforce camp would likely be required during the construction of the pipeline. The pipeline construction workforce camp would have capacity to accommodate up to 300 people during peak construction of the pipeline. The construction workforce camp would be located approximately mid way along the pipeline route, and would be determined based on the applicable locational principles described in **Section 5.2** of the EA, and in consultation with relevant landowners.

The operation of the pipeline would be in accordance with approval documentation, an Operations Environmental Management Plan (OEMP), Australian Standard 2885 and the APIA Code of Environmental Practice – Onshore Pipelines (APIA, 2005). The pipeline would also be constructed and operated according to the Pipeline Protection Safety Measures and in accordance with an Emergency Response Plan which would be developed.

During the operation of the pipeline two pipeline operators on rotation would be required. The pipeline operators would be responsible for patrolling the pipeline and landowner liaison. They would also issue permits for construction work inside the pipeline easement. This activity would include locating the pipeline and witnessing excavation work to ensure the pipeline is not damaged.

When the infrastructure is no longer required, the pipeline may be suspended or abandoned in accordance with AS 2885 requirements and accepted industry and environmental practice of the day.

Hexham Delivery Station

The HDS would be the custody transfer point for CSG extracted from the Gloucester Gas Project and would be located within land zoned for industrial use. High pressure CSG would be transported from the CPF via the transmission pipeline to the HDS. The site location at Hexham and conceptual site layout are shown on **Figure 5.11.**

Project Staging

The Stage 1 GFDA is anticipated to be developed over a period of 18 months to 5 years dependant upon the development scenario adopted as described in **Section 4.2** of the EA with campaign drilling undertaken throughout this period. The 18 month timeframe would represent the most intense construction period and therefore the worst case scenario. Drilling on a 24hr basis would typically reduce the time on location by 50%. For example, it is expected that vertical drilling activities for each well site would typically occur over a period of approximately one week. Should vertical drilling take place during typical construction hours, a period of two weeks or more may be required per well. Two or more drilling rigs may be in operation at any one time, though the cumulative impacts associated with noise, air quality and traffic would be considered in planning activities within the Stage 1 GFDA. A project timeline for the construction of Stage 1 GFDA and pipeline components is provided in **Figure 5.17.**

Statutory Planning

Commonwealth Legislation

A referral was lodged with the Department of Environment, Water, Heritage and the Arts (DEWHA) to ensure that due consideration was given to the potential impacts upon matters of National Environmental Significance (NES) and that the requirements of the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) were adequately met. A response from the DEWHA was received on 30 September 2008 and deemed that the proposed Project was a ‘controlled action’ as it was considered likely to have a significant impact on:

- Wetlands of international importance; and
- Listed threatened species and communities.

As the Project has been deemed to be a ‘controlled action’ under the EPBC Act, approval is required from the Commonwealth Minister for the Environmental, Water, Heritage and Arts as discussed in **Section 6.1.10** of this EA. The ‘*Agreement between the Commonwealth of Australia and the New South Wales Government under section 45 of the Environment Protection and Biodiversity Conservation Act 1999 relating to environmental assessment’* (The Agreement) provides for the accreditation of the NSW environmental impact assessment process (including assessment under Part 3A of the EP&A Act), enabling the Commonwealth to rely primarily on the NSW assessment process in assessing actions under the EPBC Act.

DEWHA was formally requested by the DoP to provide notification of any additional requirements to the be addressed in the preparation of the EA. DEWHA’s response via email dated 15th October 2008 confirmed the addition of the following points to the EARs for the Project:

- In Surface and Groundwater add in a point:
  - reference to the ecological character of the Ramsar listed Hunter Estuary Wetlands, including a discussion of any potential impacts on the ecological character from the proposed action,
  - where Potential Acid Sulfate Soils (PASS) are encountered, include information on the elevation of the affected area, the depth and extent of drilling and proposed methods for soil management; and identify risks and provide details of mitigation measures in relation to impacts from PASS, including impacts on the Hunter Estuary Wetlands.
- In Consultation Requirements add in a point:
  - Commonwealth Department of the Environment, Water, Heritage and the Arts.

A letter was subsequently issued by the DoP (dated 19 October 2008) amending the EARs to reflect DEWHA’s response above.

Environmental Planning and Assessment Act 1979

As outlined in **Chapter 1** of this EA, the Project has been declared by the Minister to be a ‘major project’, eligible for assessment under Part 3A of the EP&A Act.

In accordance with the provisions of Part 3A of the EP&A Act, the Proponent is seeking Concept Plan approval, and concurrent Project approval for defined components of the Project for which more detailed planning and development have been undertaken as summarised in the table below:

Part 3A Approvals Sought

Project Component	Concept Plan Approval	Project Approval
Concept Area – PEL 285	✓	✓ Stage 1 GFDA between Gloucester and Craven for 110 wells
CPF		✓ Capacity approximately 30 PJ per year (average 80 TJ/day) and associated ancillary infrastructure
Pipeline		✓ 100 m wide pipeline corridor
HDS		✓

The Minister for Planning is the approval authority for the Concept Plan and Project applications.

Environmental Planning Instruments

A range of environmental planning instruments (EPIs) created under the EP&A Act provide further detailed guidance and regulation for development at a State, regional and local level.

In accordance with Clauses 75J and 75O of the EP&A Act, in deciding whether or not to approve a Concept Plan or the carrying out of a Project, the Minister may (but is not required to) take into account the provisions any EPI that would not apply if the Project were approved. As this is a discretionary matter for the Minister, a range of EPIs have been considered in relation to the Concept Plan/Project.

The following SEPPs are of relevance to the Project:

- *State Environmental Planning Policy (Major Development) 2005;*
- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007;*
- *State Environmental Planning Policy (Infrastructure) 2007;*
- *State Environmental Planning Policy No. 14 – Coastal Wetlands;*
- *State Environmental Planning Policy No. 33 – Hazardous and Offensive Industries;*
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection;*
- *State Environmental Planning Policy No. 55 – Remediation of Land; and*
- *State Environmental Planning Policy No. 71 – Coastal Protection.*

These policies are discussed in relation to the proposed Project in **Section 6.5** of the EA.

The following Local Environmental Plans (LEPs) apply to land subject of the Concept Plan and Project applications:

- *Gloucester Local Environmental Plan 2000;*
- *Draft Gloucester Local Environmental Plan 2009;*
- *Great Lakes Local Environmental Plan 1996;*
- *Dungog Local Environmental Plan 2006;*
- *Port Stephens Local Environmental Plan 2000;*
- *Maitland Local Environmental Plan 1993; and*
- *Newcastle Local Environmental Plan 2003.*

The application of these plans to the Project is discussed in **Section 6.7** of this EA.

There are a number of land use zones within the Concept and Project Areas. The permissibility of the proposed works within each of the land use zones affected by the Concept Plan application is summarised in the table below.

Permissibility of Project

Relevant Instrument	Land Use Zone	Permissible?	Comment*
Gloucester LEP 2000	Rural 1(a)	✓	In accordance with Clause 7(2) of the MPPEI SEPP*.
	Environmental Protection 7(d)	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
Draft Gloucester LEP 2009	RU1 Primary Production	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
	IN3 Heavy Industrial	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
Great Lakes LEP 1996	Rural 1(a)	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
Dungog LEP 2006	Rural 1(a)	✓	In accordance with Clause 53 of the Infrastructure SEPP**.
	Rural Lifestyle 1(l)	✓	In accordance with Clause 53 of the Infrastructure SEPP.
	Environment 7(a)	✓	In accordance with Clause 53 of the Infrastructure SEPP.
	Transition 9(a)	✓	In accordance with Clause 53 of the Infrastructure SEPP.
Port Stephens LEP 2000	1(a) Rural Agriculture “A”	✓	In accordance with Clause 53 of the Infrastructure SEPP.
Maitland LEP 1993	1(a) Prime Rural Land	✓	In accordance with Clause 53 of the Infrastructure SEPP.
Newcastle LEP 2003	4(b) Port and Industry	✓	In accordance with Clause 53 of the Infrastructure SEPPand Clause 7(2) of the MPPEI SEPP.
	5(a) Special Uses	✓	In accordance with Clause 53 of the Infrastructure SEPP and Clause 7(2) of the MPPEI SEPP.
	7(a) Conservation Zone	✓	In accordance with Clause 53 of the Infrastructure SEPP.
	7(b) Environmental Protection	✓	In accordance with Clause 53 of the Infrastructure SEPP.

* MPPEI SEPP - *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*

** Infrastructure SEPP - *State Environmental Planning Policy (Infrastructure) 2007*

NSW Petroleum Onshore Act 1991

The Concept Area is subject to a Petroleum Exploration Licence (PEL) issued under the *Petroleum Onshore Act 1991* (PO Act), known as PEL 285. Future operations within the Concept Area would require the issue of a Petroleum Production Lease (PPL). Application for specific PPLs would be made once relevant approvals were issued under the EP&A Act.

A PPL would be required for the commencement of the proposed petroleum production operations within the Stage 1 GFDA. Should approval be granted for the proposal under Part 3A of the EP&A Act, a PPL cannot be refused and must be generally consistent with the Part 3A approval. An application would be made for a PPL to cover the proposed activities to take place within the Stage 1 GFDA following the issue of Project approval.

NSW Pipelines Act 1967

Construction and operation of the proposed pipeline would require a licence under Part 3 of the *NSW Pipelines Act 1967*. Should Project approval be granted for the pipeline, an application for a Pipeline Licence would be made in accordance with clause 13 of the Act. Should Project approval be granted under Part 3A of the EP&A Act, the Pipelines Licence cannot be refused and must be generally consistent with the Project approval.

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 DECCW.

The annual production of more than 5 PJ of methane gas is a scheduled activity under clause 31 of Schedule 1 of the POEO Act and therefore requires an Environment Protection Licence (EPL).

If approval is granted for the proposed Project, an application for an EPL for the Project cannot be refused and must be substantially consistent with the Part 3A approval.

NSW Water Management Act 2000

The *Water Management Act 2000* (WM Act) applies to parts of the State which are subject to Water Sharing Plans. Those areas of the State not covered by such plans are managed in accordance with the *Water Act 1912.*

The northern section of the Concept and Project Areas is largely located within the Lower North Coast Water Management Area, within which two Water Sharing Plans currently exist. The remainder of the Concept and Project Areas is generally located within the Hunter Water Management Area within which a number of Water Sharing Plans have been commenced. The WM Act is therefore relevant to the Project.

Section 75U of the EP&A Act exempts Part 3A projects from the need to obtain water use approvals under section 89, water management works approval under section 90 and activity approvals under section 91 of the WM Act. Therefore no such approvals are required for the Project. However, an access licence under section 56 of the WM Act may be required in respect of the proposed gas wells within the Stage 1 GFDA.

Consultation and Issues Identification

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, the Director-General’s EARs have been addressed as required by Clause 75F of the EP&A Act. The key matters raised by the Director-General for consideration in the EA are outlined in **Chapter 7** of the EA.

Planning Focus Meeting

A Planning Focus Meeting (PFM) was held on 23 July 2008. The PFM provided an opportunity for statutory authorities to establish the requirements for the form and content of the EA. The minutes from the PFM are provided in **Appendix D**. Issues raise by statutory authorities at the PFM are addressed **Section 7.2.1** of the EA.

Agency Consultation

The proponent has undertaken consultation with key local and State Government agencies as specified in the EARs to seek input into matters they would like to see addressed in the EA.

In this regard, face to face meetings, where possible, were held with relevant statutory agencies and written comments sought from those parties identified in the EARs to assist with the preparation of the EA. **Table 33** in **Section 7.2.2** of the EA summarises the responses received together with the relevant section of the EA which addresses the matter.

A proportion of the stakeholders and agencies engaged by the proponent are also land lessees, land managers or landholders in the Stage 1 GFDA. Discussions with these stakeholders, along with those undertaken with private landholders have influenced and changed the siting and design of a number of the proposed well site locations and supporting infrastructure.

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 open days and community information sessions and meetings.

Consultation took place from February through October 2008, with the aim of ensuring community views have been captured, for incorporation into the EA.

A variety of consultation techniques were used to enable information about the Project to effectively reach target audiences.

Details of the community consultation program undertaken by AGL are provided in **Section 7.3** of the EA.

Consultation with Utility Providers

AGL has undertaken extensive consultation with utility providers, including Energy Australia, TransGrid, and Country Energy, regarding the engineering design requirements for co-locating the gas pipeline adjacent to existing infrastructure. AGL is currently completing an Electrical Induction Report which would assist with design requirements to mitigate electrical induction through the pipeline.

Consultation with utility providers would be ongoing through the detailed design process of the Project which would include mitigation measures to address design concerns raised by utility providers.

Issues Prioritisation

The prioritisation of issues for the proposed Project undertaken by GHD (2008), and submitted with the Project application, was based on the need to recognise that a higher degree of assessment is required for the issues with the highest severity and greatest consequences. This prioritisation of issues has been based on the Preliminary Environmental Assessment, with a ranking system applied by AECOM for consistency with the EA and Residual Risk approach (refer to **Chapter 27**) so that a comparison may be drawn with the level of risk remaining after mitigation has been applied.

An issues prioritisation matrix was used to identify priorities. Each issue was given a ranking between one and three for the severity of effects and the perceived consequences of those effects if left unmanaged. These two numbers were added together to provide a numerical ranking for the issue that was used to categorise each issue into high, medium or low priority.

The table below identifies that the prioritisation of environmental issues, and therefore the focus of assessment for the proposed Project should be as follows:

Prioritisation of Issues

Low	Medium	High
Heritage Socio Economic Resource Implications Waste management	Water management Hazard and Risk Land Use Noise Visual Geology and Soils Traffic and Transport	Air Quality Ecology

As per the above table, the most detailed assessment for the EA is focussed on air quality and ecology, followed by those issues classified as medium priority which would also be subject to a detailed assessment. Whilst heritage has been ranked as a low priority issue due to the relative ease with which impacts in this regard can be avoided, a detailed heritage survey of the Project Area has been undertaken in order to identify potential impacts and ensure appropriate mitigation measures are implemented as part of the Project. Resource implications are addressed in other chapters of the EA as relevant such as socio economic, traffic and transport and water management.

Air Quality

Air quality impact from the Project has been assessed by means of an air quality impact assessment (AQIA). The impact assessment was prepared in accordance with NSW DECCW Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DECC, 2005) and is presented in full in **Appendix F**.

Air quality emissions from the proposed CPF at both Site 1 and Site 7 and Stage 1 GFDA well sites have been assessed during both construction and operation. Construction emissions, due to their temporary nature and variability, were not assessed quantitatively and would be addressed through the development and implementation of an AQMP as part of the broader CEMP for the Project. The results of the Air Quality Impact Assessment (AQIA) undertaken in respect of the Stage 1 GFDA and CPF indicated that:

- Ground level pollutant concentrations resulting from operation of the proposed facilities would be below the relevant DECCW criteria for both proposed CPF sites at all modelled locations;
- Emissions resulting from the flaring of the wells during commissioning were predicted to be below the DECCW criteria, provided the recommended distance between simultaneously flaring wells is adhered to.

In relation to the pipeline component of the Project, the AQIA concluded that some emissions would be expected during the construction of the pipeline corridor and would be managed through the development and implementation of the CEMP for the Project. Operational emissions resulting from the pipeline would be limited to the potential for escape of CSG which is addressed in **Chapter 21** of this EA.

Air quality emissions from the HDS are expected to be minimal.

The potential air quality impacts of the development of the Concept Area would be similar to those predicted for the development of the Stage 1 GFDA and CPF and would be further assessed as part of future project applications in respect of subsequent stages of the gas field development.

Ecology

An Ecological Assessment was undertaken by AECOM which considered threatened species, populations and communities listed under both State and Commonwealth legislation that have been recorded within the Concept and Project Areas. This assessment identified potential impacts on threatened species and detailed measures to avoid or mitigate impacts identified. Residual ecological risks associated with the construction and operation of the proposed infrastructure were identified and discussed. The Ecological Assessment is provided in full in **Appendix G** and discussed in the sections below.

Subsequent to the Ecological Assessment being undertaken, amendments to the pipeline route and location of the CPF were made by AGL. A further ecological survey was undertaken by AHA Ecology as an addendum to the original Ecological Assessment. The Ecological Addendum is provided in **Appendix G.**

A description of the existing ecological environment of the Concept and Project Areas, including recorded protected areas, species and ecological communities is provided in **Sections 10.1** and **10.2** of the EA.

Potential ecological impacts during the construction phase of the Project are primarily related to removal of native vegetation, and the disturbance of surface soils resulting from earthworks, vegetation clearing, watercourse crossings, vehicle movements on unformed tracks and other machinery operations.

Once operational, the Stage 1 GFDA and CPF are not expected to result in notable ecological impacts. Some activities involved with ongoing easement maintenance during the operation of the pipeline are recognised as threats to some listed flora species in NSW. Maintenance activities which can cause potentially negative impacts include:

- Slashing and clearing of regrowth;
- Spraying of weeds;
- Wild fire;
- Soil compaction;
- Erosion, sedimentation and dust emissions;
- Trampling by vehicles and machinery.

A more detailed account of the potential ecological impacts is provided in **Sections 10.3** and **10.4** of the EA.

Potential impacts of the future development of the Concept Area upon local ecology may occur as a result of the construction of additional well sites, water and gas gathering lines, and access tracks. The nature and extent of impacts would be similar to the potential impacts identified in relation to the development of the Stage 1 GFDA, which are described in **Section 10.3**. The locational principles discussed in **Section 5.2** have been designed specifically to minimise potential impacts resulting from the future development of the Concept Area by guiding the placement of infrastructure so as to avoid sensitive ecological features. Generally, infrastructure would be placed to avoid potential impacts upon vegetation through the targeting and utilisation of existing cleared areas. Further detailed ecological assessment would be undertaken as part of future Project Applications

An extensive range of environmental safeguards, mitigation measures and monitoring and management programmes have been identified and would be undertaken in accordance with the Ecological Assessment and Ecological Addendum (**Appendix G**) as part of the Project in order to avoid or minimise impacts. Provided that these mitigation measures are implemented effectively, residual ecological impacts are anticipated to be limited to:

- Clearing of approximately 18.17 ha of native vegetation;
- No significant impacts to EECs. Some minor impacts to one population of Small-flower Grevillea would be required in accordance with multi-faceted management plan;
- Minor impact to the Hunter Lowland Redgum Forest EEC (0.23 ha removed), however mitigation measures would be implemented to minimise impacts;
- No significant impacts to National Parks or nature reserves;
- No significant impacts to threatened flora and fauna species listed at both State and Commonwealth levels;
- No significant impacts on EPBC Act Protected Matters;
- No significant impacts to migratory and marine species;
- No significant impacts to RAMSAR wetlands; and
- No significant impacts to SEPP 14 wetland areas.

Residual ecological impacts would be managed through the development of an offset strategy. As such, the activities associated with the Project are not likely to significantly impact ecological values within the Concept Area or Project Areas.

Land Use

The Project encompasses an area running from Gloucester in the north to Hexham in the south and thus has the potential to impact upon a variety of different land uses and activities. The Project passes through six LGAs including Gloucester, Great Lakes, Dungog, Port Stephens, Maitland and Newcastle.

The proposed Stage 1 GFDA and CPF are situated within Gloucester Shire on predominantly rural land currently zoned 1(a).

The gas pipeline traverses all six LGAs and follows an established power easement for part of its length. The proposed corridor traverses approximately 201 parcels of land, largely zoned for rural purposes but including land zoned for special uses, residential development and environmental protection. The southern extent of the pipeline, at the site of the proposed Hexham Delivery Station, is zoned for industrial use.

The proposed Stage 1 GFDA, CPF and pipeline are permissible within the relevant land use zones, as detailed in **Chapter 6** of this EA. In addition, extensive consultation has been undertaken with local Councils and affected landowners in relation to the siting and design of the various project components. The views of landholders and the local community have been given careful consideration in relation to the location of wells, gathering lines, the CPF and the pipeline to ensure that impacts upon landowners and other stakeholders are minimised. Further, flexibility has been built into the Project to allow for potential land use issues to be accommodated in the final stages of design, construction and operation of the Project.

The Project would require the crossing of and/or access to properties and the disturbance of land which has the potential to disrupt normal farming activities and cause some potential nuisance to residents. These impacts would be temporary and short-term during the construction period only. Upon completion of construction, land would be rehabilitated as detailed in **Chapter 22** of the EA. Further mitigation measures would be included in a detailed CEMP for the Project which would address (amongst other measures) access arrangements and relevant work details with individual landholders and stakeholders.

Longer term, more permanent impacts would occur in relation to the restriction of certain land uses and activities within the final pipeline easement and within the final well compounds, however the location of this infrastructure has been chosen to minimise such impacts and the large majority of landowners have agreed to the location of the infrastructure on their properties. Many agricultural activities can still take place within the pipeline easement and land use activities outside of the final well compounds would be generally unrestricted. Further, appropriate compensation would be paid to affected land owners in relation to the pipeline easement. The potential amenity impacts of the Project in terms of both construction and operation are discussed in detail in **Chapters 9, 12, 13, 14, 15, 16 and 18** of this EA and are considered to be manageable with the implementation of recommended mitigation measures.

Given the proposed mitigation measures including rehabilitation and consultation, it is not expected that the Project would result in adverse impacts to land use within the region. Some minor short term impacts are anticipated during construction, however immediately upon completion of the installation works the areas would be rehabilitated to allow normal practices to resume.

In relation to open cut coal mining activities, the Project is not anticipated to result in conflicting land use due to the different coal seams targeted for each operation as further discussed in **Section 11.3.1** of the EA. It is recognised that operational protocols would be required in areas where CSG operations and coal mining activities co-exist, but this should not be a major barrier to efficient extraction of the respective target resources.

Given the proposed mitigation measures including rehabilitation and consultation, it is not expected that the Project would result in adverse impacts to land use within the region.

Surface Water

The Avon River, within the Manning River catchment, is the primary watercourse which passes through the Stage 1 GFDA. The Avon River rises to the south west of Gloucester and joins the Gloucester River north of Gloucester. Waukivory Creek and Dog Trap Creek are also located within the Stage 1 GFDA, in addition to a number of smaller unnamed tributaries. These watercourses form part of the Manning River Catchment. All of the rivers and creeks in the Manning River Catchment are unregulated and most water users rely on natural flows for their water supplies.

Works associated with the construction of the Stage 1 GFDA, CPF and related infrastructure and the pipeline would cross these and other watercourses as described in detailed in **Chapter 12** of the EA.

Potential impacts to surface water quality in relation to the construction and operation of the Stage 1 GFDA and CPF and the future development of the Concept Area include:

- Increased turbidity / sedimentation from various earthworks, watercourse crossings for the gas and water gather lines and other activities;
- Contamination of surface waters from activities;
- Increased salinity of surface waters and detrimental impacts to surrounding vegetation as a result of accidental release of saline drill, frac and/or produced waters during drilling and well development; and
- Diversion / alteration of natural drainage patterns through the construction of access roads and grading / development of areas.

The potential impacts of the pipeline upon water quality are largely related to the potential for erosion/sedimentation/turbidity during the construction phase where earthworks and crossing of watercourses would take place.

Impacts related to the crossing of waterways for the purposes of laying infrastructure such as the gathering lines and pipeline have been minimised through the site selection process and further through the selection of appropriate construction techniques. Open trenching would be used for watercourses of low sensitivity or those with no to low water flow, whilst horizontal directional drilling (HDD) would be used for major watercourses with continual high water flow, or those containing sensitive remnant riparian vegetation.

The potential impacts upon surface water in minor watercourses would be generally negligible if the construction works (open trenching) occur while the watercourses are dry and the appropriate mitigation measures are incorporated, as described in **Section 12.5** of the EA. Open trenching with stream flow diversion may also be used to reduce impacts to surface water where water flows typically over 1000 L/s are present in watercourses. As described above, HDD would be utilised for major, highly sensitive watercourses with constant high flows in order to significantly reduce impacts to the surface water of these watercourses.

The potential surface water issues associated with the development would be managed through construction and operational environmental management plans. Upon implementation of mitigation measures, residual impacts would mainly be limited to the construction phase of development and are not expected to be significant.

The proposed extraction of CSG within the Stage 1 GFDA is anticipated to result in the production of water from well sites, known as ‘produced water’, being water contained within the coal seams which flows readily during gas extraction. Scenario modelling of well water production has indicated that during the operation of the proposed Stage 1 GFDA, produced water could be expected to equate to an average of 2 ML/day. This is considered to represent a conservative upper bound for water production for the Stage 1 GFDA.

The quality of produced water is likely to vary across the basin, though results to date from the pilot project have indicated that the water is generally quite saline with a high Sodium Adsorption Ratio (SAR). As such water treatment would be required prior to disposal of the water. This treatment is likely to involve desalination via reverse osmosis (RO) and brine evaporation. It is proposed that treated water be reused for irrigation providing benefits to downstream users including the local community and local industry. Investigations are also currently underway into the potential downstream use of the solid salt produced from the RO desalination and brine evaporation treatment. There is potential for this product to be transported to a salt producer for further processing into saleable products.

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

Groundwater

Based on review of existing data, a conceptual model of the hydrogeological regime within the Project Area has been developed allowing an assessment of the potential impacts of the proposed project upon groundwater.

The hydrogeology of the Project Area is strongly influenced by the geology which comprises steeply dipping strata and major faulting and fracturing. The faulting and fracturing present may be providing connectivity between aquifers and possibly also compartmentalising groundwater flow in some areas.

The construction of the CPF and the gas pipeline are not expected to adversely impact the groundwater regime. The use of appropriately lined surface water storages to store saline groundwater extracted from the coal seams would prevent the infiltration of saline waters to shallow aquifers. This would mitigate impacts to the groundwater as a result of leaching or seepage.

Impacts to the groundwater regime including increased permeability and lowering of water levels may be experienced within the deep bedrock aquifer following hydrofracturing and groundwater extraction from the target coal seams. As the deep aquifer is not used for any beneficial use within the vicinity of the Project Area, these impacts are expected to be of no consequence.

The implementation of a Groundwater Management Plan as part of the Project would enable the groundwater regime in the vicinity of the Stage 1 GFDA and CPF to be monitored and any adverse impacts readily identified and managed.

Noise

An assessment of the potential noise and vibration impacts of the Project was undertaken by Atkins Acoustics and Associates Pty Ltd (Atkins). The assessment considers the construction and operational noise associated with the various project components.

The assessment determined that the Project would result in some noise impact during the construction phase, with exceedances predicted for certain activities at certain distances from the location of construction. The implementation of recommended mitigation measures during the construction period would aim to minimise these impacts and maintain noise levels within the Project noise goals as far as possible. Exceedances experienced during the construction period would be temporary and generally short-term, ceasing upon completion of construction activities. Given the generally low density of population in the area surrounding the Stage 1 GFDA, CPF sites, pipeline, and HDS, residual impacts associated with the construction period would not be widespread and would likely be limited to isolated residences.

Operational noise impacts related to the Stage 1 GFDA and pipeline are manageable with appropriate mitigation to meet noise goals. Operational noise impacts associated with the CPF and HDS would generally be managed through plant selection and site layout to be finalised during the detailed design phase and would be subject to a monitoring program to ensure that no significant residual impacts remain.

Decommissioning and rehabilitation of the Stage 1 GFDA may result in certain minor and temporary noise impacts, similar to those predicted for the site clean up activities during the construction phase and would be similarly managed to ensure no significant residual impacts.

Potential noise impacts associated with the future development of the Concept Area are expected to be similar to those predicted for the Stage 1 GFDA and would be managed in a similar fashion. Detailed noise assessment of future stages of the Project would be undertaken as part of subsequent project applications, however the results of the noise assessment undertaken as part of this EA and any future monitoring undertaken in respect of the Stage 1 GFDA would be used to inform the design and siting of future stages within the Concept Area.

Hazard and Risk

As the Project is not defined as 'industry' under the applicable Environmental Planning Instruments (i.e. the Local Environment Plans), SEPP 33 does not strictly apply. However, a PHA has been prepared by Sherpa Consulting despite this, in order to adequately assess the potential hazards and risks in support of appropriate site location and management and mitigation protocols.

The PHA was prepared in accordance with relevant NSW Department of Planning guidelines including *Hazardous Industry Planning Advisory Paper* (HIPAP) No. 6 – *Guidelines for Hazard Analysis*, HIPAP No. 4 – *Risk Criteria for Land Use Safety Planning* and *Multi Level Risk Assessment.*

The PHA identifies potential hazards which could arise from the different components of the proposed development. A comprehensive hazard identification table for the well sites, gathering lines, CPF (both sites), pipeline and HDS is provided as an appendix to the PHA, attached to this EA as **Appendix I**.

The major potential hazards associated with the components of the Project, including the gas wells and gathering lines, CPF, gas transmission pipeline and HDS are largely related to the potential for release (and ignition) of methane, a highly flammable (hydrocarbon) gas and simple asphyxiant. However, the PHA undertaken shows that these risks meet the relevant criteria established by the NSW DoP and can be adequately managed through the implementation of mitigation measures such that residual risks are minimal. The PHA concludes that the off-site risk of fatality, injury and accident propagation posed by the various project components meets the NSW DoP Land-Use Safety risk tolerability criteria and is therefore considered to be acceptable.

Potential hazards and risks associated with the Concept Area would be associated with future development of gas wells to be constructed in future stages of the Concept Area. There would be a need for an update to the PHA to reflect the future stages of the Project and this would be undertaken as part of future project applications.

Traffic and Transport

It is anticipated that there would be an increase in local traffic during the construction phase of the Project as a result of deliveries of plant, equipment and materials, personnel transport and construction activities. Deliveries during the construction period of major plant, equipment and materials would be undertaken outside of peak transport times, and would be carried out as required throughout the Project. Where possible, vehicle movements would be restricted to the internal road network created for the Stage 1 GFDA and the along the pipeline ROW, reducing potential impacts upon the surrounding road network. Traffic management would be in accordance with a Traffic Management Plan as described in **Chapter 16** of this EA.

Permanent, ongoing traffic movements associated with the operation of the various project components are expected to be minimal. It is therefore not expected that the Project would adversely impact on the current operation of the local and regional transport network in the medium term.

Traffic volumes and road usage for future development of the Concept Area are anticipated to be similar to the requirements of the Project Area in relation to well field development and the future development and operation of the CPF and associated infrastructure. Specific details on predicted traffic volumes and an assessment of the potential traffic impacts of future development within the Concept Area would be undertaken as part of subsequent traffic assessments in support of future project applications.

Staging of the Project would be such that construction works for the CPF and gas transmission pipeline would be largely complete prior to the commencement of further development of the gas field infrastructure within the Concept Area. This would minimise the potential for cumulative traffic impacts.

Overall the impact of the proposal on traffic and transport of the local and regional surrounds is considered to be manageable through implementation of a Traffic Management Plan and the recommended mitigation measures outlined in **Chapter 16** of the EA.

Soils and Geology

Soils within the Stage 1 GFDA are predominantly alluvial, high in compounds and dark in colour. Potential soil landscape limitations related to the Stage 1 GFDA that have the potential to affect construction include:

- High erosion potential;
- Dispersible soils; and
- Seasonal water logging.

Other limitations that have the potential to influence the construction activities are the presence of acid soils and poor soil drainage, including swamps. These limitations are likely to increase the water content of the drilling process and may impact on the suitability of well locations and manoeuvrability of vehicles around the Stage 1 GFDA. Consideration of these factors was included in the site selection study for well location to reduce the likelihood of bogging and excessive water. These factors would also be integral to future well site locations within the Concept Area.

Potential soil related limitations to the construction of the northern section of the gas transmission pipeline include:

- Water logging;
- Swamps;
- Erosion hazards;
- Acid soils;
- Localised rock outcropping; and
- Potential aluminium toxicity.

These limitations may have an impact on the engineering and construction of the pipeline through excessive water, reactivity of soils and the potential to encounter rock material during excavation. Planning for the construction activities has considered these limitations and an appropriate route has been identified through the pipeline corridor selection study to minimise the incidence of these limitations. Should additional factors / limitations be identified during the works, the proposed route of the pipeline could be varied (within the approved corridor) where possible to a location of higher suitability.

The central section of the gas transmission pipeline may encounter the following soil related limitations:

- Steep slopes;
- Water erosion hazard;
- Stony soils;
- Rock outcropping; and
- Foundation hazard (predominantly around waterways and terraces).

These areas present the only hilly area of the proposed route with likely issues mainly associated with the excavation of the trench for the pipe. It is anticipated that the limitations of the central pipeline areas would be mitigated through stringent erosion and sedimentation controls, careful selection of the pipeline route and minimisation of works in proximity to waterways. Should factors / limitation not identified in the planning stage arise during works, the relocation of the pipeline within the approved corridor would be considered to reduce the impact of these limitations.

Potential limitations for the southern section of the gas transmission pipeline include:

- High water tables;
- Water logging;
- Flooding;
- Localised foundation hazard; and
- Acid sulfate soils.

The presence of high groundwater levels and estuarine landscape features (such as tidal creeks and swamps) along with the presence of acid sulfate soils make the management of works in this area a primary issue for the Project. Management of these limitations would be through management plans and erosion and sedimentation controls to limit the impacts of the works to the landform. Additionally, an Acid Sulfate Soils Management Plan would be created to mitigate potential sulfuric acid impacts and leaching during the construction works. Acid sulfate soils management is further detailed in **Section 17.5.4** of the EA.

The proposed works would involve drilling, excavation, clearing and infrastructure which would impact the soils and geology in the short to medium term, however the post-commissioning and decommissioning phase would include regeneration and rehabilitation activities which would return disturbed areas to as close as possible to their pre-development state. On completion of the decommissioning phase it is not anticipated that there would be lasting impacts to the soils or the landscape resultant from these works.

Visual

The project components in the Stage 1 GFDA would include up to 110 well sites, as well as gas and water gathering lines, and access roads. Visual impacts are likely to be associated with the preparation and construction of the well sites, gas and water gathering lines, and access roads, as well as the visual impacts associated with the operational infrastructure at well sites.

An assessment of the visibility of project components within the Stage 1 GFDA and the visual absorption capacity of the surrounding landscape has been undertaken to assess the potential visual impacts of the Project on sensitive visual receptors. Visual impacts along the pipeline corridor have been assessed qualitatively based on the type of activities and potential receptors. A discussion on the potential visual impacts of the pipeline corridor is provided in **Section 18.5.3** of the EA.

A visibility assessment was undertaken to assess the number of well sites visible from a single receptor location. This was a desktop assessment based on distance separation and topography. The visibility assessment for the well site locations (refer **Figure 18.1**) indicates the greatest number of well sites visible from a single receptor location would be no greater than four, which would be the case at two receptor locations. A further 26 receptors would have three or two well sites visible within their viewshed, and 30 receptors would have one proposed well site located within their respective viewsheds. Visibility of these well sites would be greatest during the construction period when drill rigs and other equipment are present at these sites. Given this construction would be for a limited period, impacts are not considered to be significant. Sixty of the 118 identified receptors would not have a well site located within their respective viewsheds; therefore potential visual impacts would be negligible at these receptors. The overall visibility of the well head infrastructure is considered to be limited during operation, and impacts are not significant.

A visibility assessment was also undertaken for the proposed CPF Site 1 and Site 7 locations using Vertical Mapper and topographic data. It should be noted that the visibility assessment does not take into consideration the effects of built structures and vegetated areas that may act to screen views of the CPF.

The visibility assessment of Site 1 indicates that 9 receptors within a 2 km radius would potentially have views of the CPF at this site. A further three receptors would not have views of the CPF within the 2 km radius at this location. The visibility analysis for Site 7 indicates that 18 receptors within a 2 km radius would potentially have views of the CPF. A further receptor would not have views of the CPF at this location.

The assessment was based on the 30m height of the lightning diverter poles and poses a worst case scenario. The majority of the CPF infrastructure is less than 10m in height and would not be visible from some of the locations identified. In addition, aerial photography indicates that there are a number of vegetated areas and built structures that would screen views to the CPF from some locations, including receptors located within the CPF viewshed at Stratford. As such, the visibility assessment provides a conservative assessment of potential visual impacts.

Development of the Stage 1 GFDA and CPF would result in short term visual impacts associated with construction of project components. Following construction, the scale and nature of activities would be significantly reduced, thereby minimising potential impacts. Operation of the Project is not likely to significantly affect the visual characteristics of the landscape. The CPF is considered to be visually consistent with the industrial nature of Stratford Colliery, and is not likely to represent a significant visual impact.

Future development of the Concept Area would involve the development of well sites in a manner consistent to that proposed for the Stage 1 GFDA. The potential visual impacts of the future development of the Concept Area would therefore be similar to those predicted for the Stage 1 GFDA and would be subject to further detailed assessment in future project applications.

The construction of the pipeline would result in temporary, short term impacts associated with vegetation clearing and the presence of heavy vehicles along existing roads and access tracks, temporary storage facilities and communications systems, machinery, plant and equipment, and vehicle movements. Given the transient nature of construction of the pipeline, potential visual impacts at particular points along the route would be temporary at receptors, thereby minimising potential visual impacts. Operation of the pipeline is not anticipated to result in significant visual impacts.

A Landscape and Rehabilitation Management Plan and environmental safeguards have been recommended to further minimise potential visual impacts. Provided these are implemented, the proposal is not anticipated to result in significant visual impacts to the surrounding environment.

Heritage

A heritage assessment was undertaken to investigate Aboriginal and Historic heritage issues associated with the Concept Area and the Project Area, including the Stage 1 GFDA, CPF (two potential sites) and the pipeline corridor as further detailed in **Appendix K**.

An Aboriginal heritage survey was conducted, according to the Director General's EARs and Aboriginal community consultation was undertaken in accordance with DECCW's *Interim Community Consultation Requirements for Applicants* (ICCRs) (DEC, 2004).

A search of the DECCW Aboriginal Heritage Information Management System (AHIMS) database revealed that there are five sites recorded within the Concept Area, with two of these sites being located in the Stage 1 GFDA. Fieldwork relating to potential Aboriginal and historic heritage and artefacts within the Concept Area was not undertaken as part of the EA and further investigation would be required for future development within the Concept Area.

In addition to the Aboriginal sites identified on the AHIMS database, there are several other known sites within the Stage 1 GFDA, which were identified during an Aboriginal heritage assessment for the Stratford Pilot Project (FLALC 2007). Three stone artefacts (isolated finds) were identified, however, these sites have not yet been recorded on the AHIMS database.

The CPF Site 1 is located within the Tiedemans Property. The FLALC (2007) report identified three stone artefacts (isolated finds) likely to be located within the Tiedemans Property although their specific locations were not identified. There were no Aboriginal or historic heritage sites identified within CPF Site 7 footprint.

The AHIMS search revealed four Aboriginal sites located within a 1 km buffer of the pipeline corridor.

The Aboriginal heritage survey identified a total of nine Aboriginal sites with artefactual evidence in the Stage 1 GFDA or along approximately 103.5 km of the pipeline route (total length of potential pipeline route considering either CPF Site 1 or CPF Site 7 locations) surveyed. In addition, 14 potential archaeological deposits (PADs) were also identified (one PAD in the Stage 1 GFDA and 13 along the pipeline corridor). No sites were identified in relation to either of the potential CPF sites.

Activities associated with the construction, operation and rehabilitation phases of the Project may potentially have direct impacts to archaeological sites through the movement of topsoil and subsoil. Indirect or accidental impacts may also occur with the potential for equipment being located or placed outside the areas previously investigated.

Initial mitigations were implemented in the design stages of the Project, such as re-aligning certain sections of the pipeline, in order to avoid potential impacts to the identified heritage items. As a result, the proposed development is unlikely to require the removal or destruction of any identified Aboriginal or heritage sites identified within this EA. Additionally, the environmental envelope assessment approach allows for the location of infrastructure to be altered slightly should an adverse impact to heritage items be identified.

However there is potential for impact to subsurface Aboriginal objects in some areas of PADs where realignment of the pipeline is unfeasible, particularly where the pipeline crosses creeks. Environmental safeguards have been recommended in addition to the preparation of an Aboriginal Heritage Management Plan in order to minimise potential impacts. Provided these are implemented, the proposal is not anticipated to result in significant impacts to Heritage sites.

The Aboriginal and historic heritage assessment indicated that the potential for impacts to heritage items would be minimal due to the recommended mitigation measures which have already been incorporated into the design of the Project. Furthermore, potential impacts would be minimised through the implementation of the general environmental safeguards and management options for Aboriginal and historic 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. Further, it is considered that there would be no detrimental impacts to the Vale of Gloucester on a historic heritage basis.

Socio Economic

A socio-economic assessment was undertaken, particularly focussing on the potential impacts within the Gloucester Shire and Great Lakes LGAs as further detailed in **Chapter 20**. Given that potential impacts would be similar for both the Stage 1 GFDA and Concept Area, the assessment considered both the Concept and Project Areas.

Potential socio-economic impacts during the construction phase of the Project would include:

- Short-term positive impacts for the local economy;
- Potential short-term increase in the demand for public health facilities and other local infrastructure and services in the region;
- Potential noise, air quality, traffic, hazard and risk and visual impacts to sensitive receivers.

During the operational phase, the Project would result in a number of overall beneficial impacts to the Hunter Region and State, primarily as a result of the provision of an indigenous gas supply for NSW. The Project would also have the potential to support industrial and economic growth in the Hunter Region, particularly Newcastle and the Lower Hunter. Productive land affected by the construction of pipeline corridor would be returned to pre-construction land uses where possible, and would be managed through ongoing consultation with landowners. Aboveground infrastructure would be removed during the decommissioning of the Project, followed by the rehabilitation of the land, thereby minimising potential long term impacts.

The Project may result in some benefits to the local community in terms of a possible supply of treated water which could potentially be used for irrigation, however investigations into reuse of treated water are ongoing. The Project may also result in benefits to local landowners where opportunities exist to upgrade internal access tracks and roads, as well as other road upgrades and improvements which may include The Bucketts Way and Black Camp Road.

The proposed Project is not anticipated to result in significant negative impacts to the socio economic environment of the local Gloucester Shire or the five other local government areas affected by the Project, Hunter Region or NSW. The project is likely to have a positive impact on regional and State economies due to the provision of an indigenous gas supply, while the Gloucester Shire also may experience positive impacts associated with demand for local goods and services during both the construction and operation phases of the Project.

Greenhouse and Climate Change

An assessment of the potential impacts of climate change on the Project and the potential impacts of the Project on greenhouse and climate change was undertaken as detailed in **Chapter 21** of the EA.

The potential for the Project to be affected by Sea Level Rise (SLR) and direct wave action is considered to be low because the pipeline is buried and the southern portion of the pipeline and the HDS are located at Hexham, approximately 19 km from where the Hunter River meets the sea. Other components of the Project including the Stage 1 GFDA and CPF would not be impacted by the anticipated SLR due to their elevation, however, these areas may experience more intense precipitation and storm events. Mitigation measures for flooding events in the vicinity of the Stage 1 GFDA and CPF have been incorporated into the design of the infrastructure as detailed in **Chapter 12** of the EA. Changes in rainfall and higher evaporation rates due to climate change are likely to lead to a less predictable pattern of water for the Hunter region. The proposal may, therefore, have positive impacts to the community by providing a reliable source of water from the treated produced water. The Project is anticipated to be decommissioned by approximately 2040, and as such, long term changes in sea level rise, temperature and water availability would not impact the Project.

Total greenhouse gas emissions resulting from operation of the Project were estimated to be approximately 492,000 t CO_2-e per year. This represents approximately 0.32 % of the total greenhouse gas emissions from NSW in 2007 (151.6 Mt CO_2-e) and 0.42% of the NSW emissions from the energy sector (117.2 Mt CO_2-e).

The beneficial aspects of the Project should be considered. If the power to be supplied by the Project was generated by coal-fired power stations, the associated greenhouse gas emissions would be approximately double. Methane is a powerful greenhouse gas, with a potency of around 25 times that of carbon dioxide; removing this methane from the coal seams for use as a power source not only reduces the amount of coal needed to be extracted to provide power, but prevents the release of the methane to atmosphere, reducing net greenhouse gas emissions (burning of natural gas emits primarily CO_2 emissions which has a greenhouse gas potency 25 times lower than Methane).

Likely greenhouse gas emissions from the Project are not considered to have significant impact on increasing greenhouse gas emissions, but rather assist in stymieing growth and contribute to achieving Australia's emissions reduction targets.

Rehabilitation

A rehabilitation program is proposed for the Project which would involve initial rehabilitation following the construction of the well site locations, the gas and water gathering system and the pipeline corridor, including watercourse crossings. Final rehabilitation would also be undertaken at the decommissioning phase of the Project as detailed in **Chapter 22**.

Rehabilitation is inherently a mitigation measure for potential impacts associated with the development, including erosion, sedimentation and turbidity. The proposed rehabilitation activities would result in areas affected by the proposal being returned to pre-operational and productive land uses following the initial and final rehabilitation phases. Specific safeguards, including the development of a Rehabilitation Management Plan, have been identified to reduce the potential for adverse environmental impacts during the rehabilitation process and, provided these are implemented, the proposal is not anticipated to result in significant adverse impacts in this regard.

Waste

The Project incorporates the principles of the *NSW Waste Avoidance and Resource Recovery Strategy 2003* by encouraging efficient resource use alternatives, re-use and recycling. The potential for wastes to be generated by the Project, the relevant legislative requirements and safeguards in relation to waste management are detailed in **Chapter 23** of the EA.

The proposed development of the Stage 1 GFDA, CPF and the pipeline corridor are likely to result in the generation of wastes, in particular during the construction phase. Waste management procedures would be developed as part of the CEMP for the Project which would ensure waste is handled and stored appropriately and ultimately reused, recycled or disposed of in accordance with legislative requirements and best practice.

Reusable wastes such as excavated topsoil, cleared and mulched vegetation, produced water from the wells within the Stage 1 GFDA, and other reusable materials such as timber and sand would be managed and reused onsite or recycled where appropriate, including treated water. Waste requiring offsite disposal (including residual salt from the water treatment process) would consequently be minimised with remaining waste disposed of in an appropriate manner. As such significant, residual impacts in relation to waste are not anticipated.

Cumulative Impacts

The cumulative impacts of the Project have been considered in relation to each of the identified environmental issues in **Chapter 9** to **Chapter 23** of this EA.

The cumulative impacts of the Project have been considered with respect to impacts associated with the proposed development, in addition to impacts associated with other projects in the region. The cumulative impact assessment concluded that the construction phase of the Project is temporary in nature, the operational phase of the Project would have negligible cumulative impacts and that there would be no significant net residual impacts associated with the interaction of the Project with other known projects in the area.

Statement of Commitments

In accordance with the EARs issued under Part 3A of the EP&A Act, a Statement of Commitments (SoC) for the Project is included in **Chapter 26** of the EA. Two SoCs have been developed covering the Concept Area and Project Area respectively.

The SoC for the Concept Area describes further investigation and design considerations in respect of the future development of this area, whilst the SoC for the Project Area outlines environmental management, mitigation and monitoring which would be undertaken as part of the Project to ensure that the potential impacts identified in this EA are adequately managed. As the Project Area comprises three distinct components – the Stage 1 GFDA, the CPF and the pipeline, the SoC has been split up into the component parts of the Project in order to differentiate specific commitments relating to individual project parts from more general measures applicable to all three project components.

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 Concept and concurrent Project approvals.

Residual Risk

The Residual Environmental Risk Analysis for the proposed Project is based on a process adapted from Australian Standard AS 4360:2004 Risk Management. The process is qualitative and is based on a Residual Risk Matrix.

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 residual risk analysis undertaken for the Project indicates that the proposal presents an overall low to medium risk in relation to each of the identified environmental issues, provided that the recommended mitigation, management and monitoring measures are implemented.

Project Justification

The Director-General's EARs issued for the Project require justification for the Project to be provided, having regard to environmental, social and economic considerations together with the principles of ESD. The environmental impact assessment of the Project undertaken in this EA has addressed the relevant biophysical, economic and social considerations and concludes the following:

- With the implementation of the environmental safeguards and management measures recommended throughout the EA the Project would not have a significant adverse impact on the biophysical environment. The Project is therefore considered to be justifiable taking into account potential residual biophysical impacts on the environment.
- The Project represents a significant investment in the region and stands to provide substantial positive economic impacts in terms of securing an indigenous gas supply for the State, generating jobs and investments and providing the local community with the impetus to plan for future business and service opportunities in the area. Given the economic benefits, the Project is considered to be justifiable on economic grounds.
- A range of socio-economic issues have been considered in relation to the Project and it is considered that, provided appropriate mitigation and management measures as outlined in the SoC are implemented, the Project would have a minimal and acceptable impact on socio-cultural issues. The Project is likely to have a positive impact on regional and State economies due to the provision of an indigenous gas supply, while the Gloucester Shire may also experience positive impacts associated with demand for local goods and services during both the construction and operation phases of the Project. The Project is therefore considered to be justifiable taking into account potential socio-cultural impacts.

The Project has been considered against the principles of ESD (refer to **Section 28.3** of the EA) and is found to be generally consistent with these principles. The Project would also assist in the achievement of several State energy objectives and initiatives which are formulated to provide safe efficient, secure and indigenous 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 gas supply within the Hunter region;
- The loss of resulting economic and social benefits to the local community of the Hunter region and the wider New South Wales community; and
- The likely future shortfall in the gas supply to the 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.

Undertaking the Project in the manner proposed is justifiable taking into consideration potential health, biophysical, economic and socio-cultural issues and benefits. Additionally, the proposal accords with the principles of ESD. Consideration of the Project against a wide range of criteria demonstrates that the Project is environmentally sustainable and justifiable.

Conclusion

The Project comprises the development of wells for the extraction of CSG from the Gloucester Basin, development of one CPF at either Site 1 or Site 7 in the area identified as the Stage 1 GFDA, and the construction and operation of a gas transmission pipeline from the CPF to Hexham, NSW.

This EA demonstrates the environmental acceptability of the Project, provided the recommended safeguards are implemented, and that the Project would have significant environmental, economic and social benefits.

This EA satisfies all requisite statutory requirements regarding the Concept Plan and Project Applications. It is considered that the construction and operation of the proposal is justified taking into account biophysical, socio-cultural and economic considerations and is in accordance with the principles of sustainability.

1.0 Introduction

The Gloucester Gas Project (the Project) includes the development of wells for the extraction of coal seam gas (CSG) from the Gloucester Basin, NSW, within an area covered by Petroleum Exploration Licence (PEL) 285. PEL 285 was previously held by the Joint Venture (comprising both Lucas Energy Pty Limited and Molopo Australia Limited) and was sold to AGL Energy Pty Ltd in December 2008. Its related company AGL Gloucester LE Pty Ltd (AGL) is the operator of PEL 285. AGL is the Proponent for the Project.

The Project involves the development of gas wells and associated infrastructure, the development of a Central Processing Facility (CPF), and the construction and operation of a high pressure gas transmission pipeline from Stratford to a new delivery station at Hexham, NSW.

The Project has been declared by the Minister for Planning (the Minister) as a development to which Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) applies. Furthermore, the Minister has authorised the submission of a Concept Plan for the Project under Part 3A.

Concept Plan Approval is sought for staged well field development including development of wells, gas and water gathering lines, and associated infrastructure within the area known as the Concept Area, approximately $210m^2$ in size and represents the known coal measures of the Gloucester Basin.

Concurrent Project Approval is sought for the development of 110 gas wells within a portion of the Concept Area, known as the Stage 1 Gas Field Development Area (Stage 1 GFDA); construction and operation of a CPF located at one of two potential locations for gas compression and treatment with a capacity of approximately 30 petajoules (PJ) per year, equating to a daily average of 80 Terajoules (TJ) along with ancillary infrastructure including a water treatment plant, water storage ponds, and 15 megawatt (MW) ancillary power generation facility; and construction and operation of a gas transmission pipeline within an assessed 100 m wide corridor from the CPF at Stratford to a new delivery station at Hexham, NSW.

AECOM Australia Pty Ltd (AECOM), has been engaged by AGL, to prepare this Environmental Assessment (EA) to assess potential impacts associated with the Project. This EA has been prepared in accordance with the provisions of Part 3A of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), together with the Environmental Assessment Requirements (EARs) issued by the Director-General of the Department of Planning in August 2008 and supplementary EARs issued in October 2008 and October 2009 (refer **Appendix C**).

1.1 Overview of the Gloucester Gas Project

The Project is located near Stratford, NSW, approximately 100 km north of Newcastle. The Concept Area is located within PEL 285, issued under the *Petroleum (Onshore) Act 1991.* The Concept Area and Project Area, located within PEL 285 are shown in **Figure 1.1**. The Concept Plan comprises the staged well field development with the Concept Area.

The Project for which Project approval is sought primarily involves four integrated components:

- Gas Field Development – development of producing wells and associated infrastructure within the Concept Area and Stage 1 GFDA;
- CPF – treatment and compression of gas up to approximately 30 PJ per year with an average of 80 TJ/day, water treatment facility including associated storage and evaporation ponds, 15 MW ancillary power generation facility, and ancillary infrastructure;

- Gas Transmission Pipeline – high pressure gas pipeline from Stratford to Hexham; and
- Hexham Delivery Station (HDS) - custody transfer point for gas from the gas transmission pipeline to the NSW gas market.

Project Approval is sought for development of the CPF at one of two potential sites within the Stage 1 GFDA. The two sites are known as CPF Site 1 and CPF Site 7. While Project Approval is sought for each of these sites, the CPF would ultimately be constructed at only one location. As such, both Site 1 and Site 7 have been assessed in this EA in accordance with the EARs. The Project Area comprises the Stage 1 GFDA, two potential CPF sites, gas transmission pipeline and HDS.

An overview of historic exploration activities in the Gloucester Basin is provided below, followed by an overview of activities proposed within the Concept Area and Project Area.

1.1.1 Overview of Historic Exploration Activities

Exploration in the Gloucester Basin began in the early 1970s with Noranda Australia Ltd drilling in excess of 300 shallow holes in search of open cut coal deposits. BMI Mining Pty Ltd and Esso Australia Ltd continued exploration into the mid 1980s. In respect of CSG exploration, Esso-BMI conducted exploration in the north of the basin and drilled four fully cored stratigraphic holes up to 512 m deep which have provided information on geology and coal development.

PEL 285 was previously held by the Joint Venture (comprising both Lucas Energy Pty Limited and Molopo Australia Limited) and was sold to AGL in December 2008. PEL 285, now held by AGL Gloucester LE Pty Ltd was granted under the *Petroleum (Onshore) Act, 1991* in 1992 for a period of one year, and subsequently renewed. The most recent renewal was for a period of four years to 15 April, 2012. The licence enables investigation of the potential for further development of CSG resources in the Gloucester Basin, with the view to possible development of CSG production. Pacific Power undertook three separate CSG drilling programs in the Stratford Prospect between 1993 and 1999, with depths ranging from 444-895 m. The purpose of these drilling programs was to evaluate the potential for commercial CSG recovery at the Stratford Prospect.

The first three dedicated production evaluation wells were drilled by the Joint Venture in 2004 within the Stratford Prospect. One well, known as LMG03, was subsequently hydraulically stimulated using fracture stimulation (also referred to as ‘fraccing’) and placed on production test. A second set of CSG evaluation holes were drilled in 2005 which allowed testing of coal seams for CSG properties. Further exploration boreholes were drilled in 2006 and 2007.

In 2007, the Stratford Pilot Project was established by the Joint Venture with the Stratford Prospect area on land known as The Tiedeman Property, for production evaluation testing from a number of exploration wells. The pilot project enabled further testing of coal seam and gas characteristics, and to define the methane resources of the area. The results of the pilot project have informed the location of the Stage 1 GFDA. The pilot project remains ongoing for production of CSG. The six wells currently comprising the Stratford Pilot Project would be continued and incorporated within the Stage 1 GFDA, comprising six of the 110 wells included in this project application.

In 2009, a further five wells were drilled for production testing by AGL. Three of these additional wells are located within the Stage 1 GFDA and if they prove to be successful, would form part of the 110 wells proposed within the Stage 1 GFDA and as such are included in this project application. The remaining two wells are located within the Concept Area, and would be included in future project applications if successful.

The remaining two production test wells are located outside the Stage 1 GFDA, but within the broader Concept Area and have been constructed with separate infrastructure including generators, flare and a water storage pond. These wells would be incorporated into future project applications for the staged development of the Concept Area but would form part of the 200-300 wells proposed under the Concept Plan.

1.1.2 Overview of Proposed Activities

Works proposed under the Concept Plan and concurrent Project Approval would involve the construction and operation of a well field, CPF and associated infrastructure, gas transmission pipeline and delivery station. The range of activities for which approval is sought can be broadly described within the following elements:

- **Construction:** Activities necessary to develop the Project infrastructure, including CSG wells, underground water and gas gathering lines, electricity supply, access roads, the CPF and ancillary activities, gas transmission pipeline, and HDS. Two construction workforce camps would be required to provide temporary accommodation for the construction workforce. One construction workforce camp would be located within the Stage 1 GFDA, with a second located approximately midway along the pipeline corridor.
- **Production, Operation and Maintenance:** Production of CSG from wells, to be transferred through gas gathering lines to the CPF for compression and dehydration, before delivery via gas transmission pipeline to the existing gas network at Hexham. Other activities that may be required to maintain production efficiency include: development of infill wells; upgrade of gas and water gathering lines; well work-over (including fracture stimulation, where required); installation of infield compression; maintenance of gas and water processing facilities; and walkover and aerial surveys of the transmission pipeline.
- **Decommissioning and rehabilitation:** Rehabilitation would be undertaken in two stages:
  - Initial rehabilitation of well site construction pads, and construction areas for the CPF and pipeline, following completion of construction.
  - Final rehabilitation following decommissioning involving removal of above ground infrastructure and abandonment of underground infrastructure.

These activities are discussed in greater detail in **Chapter 5** and summarised in **Table 1-1** below.

Table 1-1: Overview of Activities Proposed in Concept Area and Project Area

Construction	Production / Operation	Decommissioning and Rehabilitation
Stage 1 GFDA		
• Construction of access routes, well site construction footprint and installation of environmental controls; • Establish construction laydown areas; • Establish construction workforce camp for construction of the Stage 1 GFDA; • Construction of water and	• Commissioning, including well completion and production activities to bring individual wells into production; • Operation of wells in accordance with the Petroleum Production Lease; • Maintenance of wells, including well work over;	• Decommissioning of wells at the conclusion of their production life; • Removal of wellhead infrastructure from site; • Decommissioning of wells in accordance with Department of Primary Industries' requirements; • Final rehabilitation of well site locations, gas and water

Construction	Production / Operation	Decommissioning and Rehabilitation
gas gathering system and laying of electricity cables; • Construction and drilling of wells; • Installation of wellhead surface infrastructure; • Well completion, including fracture stimulation where required; • Connection of wells to underground gas gathering network; • Reduction of drill pad area following construction to permanent hardstand dimensions, and initial rehabilitation of area used during construction; • Assumed flaring for 4 weeks at each well location.	• Maintenance of gas and water gathering system and access roads.	gathering lines and access roads.
Central Processing Facility		
• Preparation of access roads and environmental controls; • Construction of 15 megawatt (MW) ancillary power generation facility; • Construction of gas compression facility; • Connection of gas compression facility to the trunk gas gathering lines; • Construction of water treatment facility, including water storages and evaporation ponds as required; • Connection of water treatment facility to trunk water gathering lines.	• Commissioning; • Operation of CPF in accordance with appropriate licences and approvals; • Production, metering and sale of gas; • Operation of water treatment facility; • Periodic maintenance of all equipment.	• Decommissioning of central processing facility at completion of production life; • Removal of gas compression and water treatment equipment from the site; • Final rehabilitation of the site.
Gas Transmission Pipeline		
• Upgrade of roads and access tracks as required; • Establishment of temporary work areas for pipe and equipment storage, as required; • Establish construction laydown areas;	• Commissioning, including hydrostatic testing, pipeline purging, drying and loading. • Operation of pipeline in accordance with Australian Standards and relevant codes of practice; • Periodic patrolling and	• Suspension or abandonment in accordance with Australian Standards and accepted environmental practice of the day.

Construction	Production / Operation	Decommissioning and Rehabilitation
• Establish construction workforce camp; • Right of Way (ROW) clearing, including removal of topsoil; • ROW grading and preparation of work and laydown areas, including environmental controls; • Trenching and earthworks; • Pipe stringing (bending and welding of individual pipes into lengths of up to 1km); • Radiographic inspection of weld integrity, before application of protective coating to joins to inhibit corrosion; • Padding base of trench with fine material prior to laying the pipe and backfilling the trench; • Where necessary for road, utility or watercourse crossings, employment of drilling technologies such as Horizontal Directional Drilling (HDD) and thrust-boring; • Following backfilling, rehabilitation of the ROW to near original condition; • Installation pipeline marker signs to identify pipeline route.	inspection of pipeline corridor; • Line of sight clearance of ROW to maintain pipe marker visibility, as required; • Weed control, as required; • Periodic cathodic protection and coating integrity surveys; • Operation of Supervisory Control and Data Acquisition (SCADA) to monitor and remotely control pipeline conditions; • Periodic inspection of internal pipeline conditions by propelling a pipeline inspection gauge, known as an ‘intelligent pig’ through pipeline.	

1.2 Approval Process

The EP&A Act and the EP&A Regulation regulate development in NSW. Prior to any approval to proceed with a proposed development, a detailed assessment of the likely impacts of the Project must be undertaken.

Pursuant to *State Environmental Planning Policy (Major Development) 2005* (SEPP 2005) the Project has been declared by the Minister for Planning (the Minister) as a development to which Part 3A of the EP&A Act applies (see **Appendix A** for a record of the 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. In addition, the Minister has authorised the preparation of a Concept Plan for the proposed project (**Appendix B**).

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

- Concept Plan Approval for:
  - Staged well field development within the Concept Area, including development of wells, gas and water gathering lines, and associated infrastructure; and
- Concurrent Project Approval for:
  - Construction and operation of gas wells at proposed well site locations within the Stage 1 GFDA, access roads, gas and water gathering system and associated infrastructure;
  - Construction and operation of a CPF with an annual capacity of approximately 30 PJ, which equates to an average of 80 TJ per day, on one of two potential sites within the Stage 1 GFDA, as well as associated water treatment plant, ancillary 15MW power generation plant, storage ponds and associated infrastructure; and
  - Construction and operation of the gas transmission pipeline within an assessed 100 m corridor, within which a 30 m ROW would be developed from Stratford to Hexham; and
  - Construction and operation of a delivery station at Hexham (HDS).

This EA has been prepared as a requirement of the Concept Plan and concurrent Project Applications. By obtaining Concept Plan Approval for the development of the Concept Area, and the CPF, the likely extent of the Project is known at the outset. A flow chart demonstrating the approval process for Concept and Project approvals is provided in **Figure 1.2**.

1.2.1 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. The EARs were requested from the Director-General in June 2008, and issued in August 2008. In addition, supplementary EARs were issued on 19 October 2008, as a result of the Project being declared a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and on 25 August 2009 in response to alterations to the Project, including 15MW power generation. Copies of these EARs are provided in **Appendix C**.

1.2.2 Planning Focus Meeting

The Department of Planning advised that a Planning Focus Meeting (PFM) would be required in order for the Proponent to seek the views of relevant statutory authorities in respect of potential impacts of the proposal and issues to be addressed during preparation of the EA.

The PFM provided an opportunity for statutory authorities to establish the requirements for the structure and content of the EA. The minutes from the PFM are provided in **Appendix D**, and are further discussed in **Chapter 7**.

1.3 Purpose of this Report

This EA has been prepared by AECOM, on behalf of the Proponent for the Project, and in accordance with Part 3A of the EP&A Act and the EARs issued by the Director-General under Section 75F.

The purpose of this report is to explain the nature of activities proposed as part of the Project and assess the potential impacts of these activities on the affected physical, social and economic environments. The nature and extent of potential impacts are assessed, and environmental safeguards and mitigation measures to be implemented during construction and operation are identified to minimise potential impacts.

Where Concept Plan Approval is sought for particular activities which may occur in the future, this EA addresses potential impacts of likely activities based on a worst-case scenario to provide a conservative assessment. Where potential impacts are identified that require more detailed studies, these would be undertaken at subsequent project application stages.

1.4 Environmental Assessment Approach

1.4.1 Concept Plan

Concept Plan Approval is sought for a staged gas field development within the Concept Area. The Concept Plan represents a strategic overview of future works likely to occur within the Concept Area. The purpose of the Concept Plan is to provide an overview of likely future activities to be established in the Concept Area, while allowing further time for detailed design and project planning. This approach is intended to provide agencies and the community with an understanding of where the future works may occur.

The environmental assessment associated with the Concept Plan is based on a more strategic approach and deals with key issues. Concept Plan Approval provides for more complex projects to be considered based on an assessment of strategic issues rather than a detailed assessment of physical impacts in order to determine broad scale potential impacts and requirements up front.

Given the strategic nature of the Concept Plan, locational principles have been developed to guide the future placement of well sites and associated infrastructure, as well as activities associated with construction and operation. Locational principles are discussed in **Section 5.2**.

Activities proposed within the Concept Area would require Project Approval prior to development once future project elements have undergone detailed design. Subsequent project applications would provide assessment of key environmental issues and would be required to be undertaken in accordance with the terms of the Concept Plan Approval. **Section 6.2** further discusses the Concept Plan and Project Approvals process.

1.4.2 Project Approval

Concurrent Project Approval is being sought for specific components of the Project for which more planning and design has been undertaken. Indicative well site locations and associated infrastructure within the Stage 1 GFDA, the location of the CPF (including Sites 1 and 7), and the alignment of an assessed 100 m corridor for the gas transmission pipeline (within which a 30 m Right of Way (ROW) would be developed) have been identified, through detailed environmental constraints analysis and environmental assessment.

Given the spatial nature of the development of the Stage 1 GFDA, an 'environmental envelope' approach has been adopted to assess and avoid or minimise potential impacts. The steps involved in developing the environmental envelope are described below:

- Establishment of Envelope

  The location of the Stage 1 GFDA footprint is based on geological considerations. A 600 x 600 m well grid is established within the Stage 1 GFDA, with each 600 x 600 m grid square comprising an individual environmental envelope.

- Constraints Analysis

  Environmental constraints are identified and assessed within each environmental envelope. Constraints include ecological, archaeological, landforms, water courses, infrastructure, noise, visual amenity and land use. Environmental constraints mapping is undertaken utilising geographical information systems (GIS) to spatially identify constraints and develop an overall site suitability model.

- Indicative Well Site Locations

  Constraints mapping is utilised to determine indicative placement of well site locations within each grid square, and to avoid and minimise potential environmental impacts. Indicative placement of wells also takes into consideration land owner consultation and commercial considerations. Final well site locations would avoid environmentally sensitive areas identified through the constraints mapping and in consultation with respective land owners.

As noted above, each grid square of 600 x 600 m was assessed as an "environmental envelope" as a basis for systematic assessment. Each grid square is located back to back so in effect, the entire grid becomes one larger environmental envelope. As such, the Proponent has a degree of flexibility to locate, and re-locate infrastructure within the assessed envelope to accommodate both landowner and commercial considerations, without affecting the surrounding environment or requiring further approvals. As such, while the current indicative well locations represent the current project plan, as long as constraints are avoided and sensitivity criteria observed, the Proponent would be able to establish final locations anywhere within the overall environmental envelope.

A similar approach has been adopted for the pipeline corridor. A pipeline corridor selection study was undertaken, which utilised a combination of GIS and Multi Criteria Analysis (MCA) methods to determine the preferred pipeline corridor utilising numerous sensitivity criteria. Major constraints identified during this process were avoided where possible during the selection of the final pipeline route. This is further discussed in **Section 4.2.1**.

1.5 Structure of this EA

This EA has been divided into four volumes, as detailed below. This EA (**Volume1**) should be read with reference to **Volumes 2 and 3 Appendices** and **Volume 4 Figures**.

- **Volume 1: Environmental Assessment**

This document comprises Volume 1 and contains the EA documentation, including the sections described below.

- **Chapter 1 Introduction** – provides an overview of the Project and the planning and approvals process.
- **Chapter 2 Strategic Context and Project Need** – describes the current Australian and NSW gas markets, predicted energy demands and the need for the Project as a means to enhance security of gas supply to NSW.
- **Chapter 3 Site and Context** – provides an overview of the Project location and legal description of land affected by the proposal.
- **Chapter 4 Assessment of Alternatives** – provides detail on the alternatives considered for the Project, including alternative CSG resources, location of project components, plant and design, and alternative construction techniques.
- **Chapter 5 Project Description Concept Area and Project Area**– provides an overview of the proposed activities within the Concept Area and a detailed description of the proposed activities within the Project Area, including construction and operation of the Stage 1 GFDA, CPF and pipeline.
- **Chapter 6 Statutory Planning** – addresses State and Commonwealth Statutory requirements relevant to the Project and details the planning and approval framework under which the Project is being assessed.
- **Chapter 7 Consultation and Issues Identification** – provides details of stakeholder and agency consultation undertaken, and details the key issues for assessment based on the Concept Plan and Preliminary Assessment Report (GHD, 2006), and the EARs issued by the DoP.
- **Chapter 8 Issues Prioritisation** – provides a prioritisation of the issues identified in the Preliminary Environmental Assessment (PEA) based on a risk assessment matrix.
- **Chapter 9 Air Quality** – this section provides an overview of the potential impacts to air quality from the proposed project as requested in the EARs, and summarises the findings of the Air Quality Impact Assessment undertaken for the proposal, provided in **Appendix F**.
- **Chapter 10 Ecology** – this section addresses potential ecological impacts and constraints as requested in the EARs. Potential impacts to habitat values, and threatened and endangered species are addressed. The Ecology Assessment is provided in **Appendix G**. Note there is an ecology assessment undertaken for the original pipeline alignment (AECOM, 2009). Subsequent pipeline re-alignments required an addendum report to be prepared (AHA, 2009). **Chapter 10** reflects the updated results for the gas transmission pipeline.
- **Chapter 11 Land Use** – this section provides an assessment of potential impacts to land uses directly and indirectly affected by the proposed project as requested in the EARs.
- **Chapter 12 Surface Water** – this section addresses potential impacts to surface water quality and management and treatment of produced water from the Stage 1 GFDA.

- **Chapter 13 Groundwater** – this section addresses potential impacts to groundwater, including management of extracted groundwater from well sites as requested in the EARs.
- **Chapter 14 Noise and Vibration**– this section provides an assessment of potential noise impacts from the proposed project as requested in the EARs and summarises the findings of the Noise Impact Assessment undertaken in respect of the Project, provided in **Appendix H**.
- **Chapter 15 Hazard and Risk** – this section summarises the Preliminary Hazard Analysis (PHA) undertaken in respect of the Project to assess potential hazardous impacts to surrounding land uses. The Preliminary Hazard Analysis is provided in **Appendix I**.
- **Chapter 16 Traffic and Transport**– this section provides an assessment of traffic, transport and access arrangements for the Project as requested in the EARs.
- **Chapter 17 Geology and Soils** – this section addresses potential impacts to geology and soils including management of construction and operation to minimise the potential for sedimentation and erosion.
- **Chapter 18 Visual** – this section provides an assessment of the potential impacts to visual amenity that may result from the proposal. A viewshed analysis has been undertaken to demonstrate visibility.
- **Chapter 19 Heritage** – this section provides an assessment of potential impacts to Indigenous and non-Indigenous heritage that may be affected by the Project. The Heritage Assessment is provided in **Appendix K**.
- **Chapter 20 Socio Economic** – this section addresses the social and economic environments affected by the Project and provides an assessment of potential impacts.
- **Chapter 21 Greenhouse and Climate Change** – this section provides a quantitative assessment of greenhouse gas emission levels from the proposed project.
- **Chapter 22 Rehabilitation** – this section addresses the rehabilitation of land affected by the Project following decommissioning of project components.
- **Chapter 23 Waste** – this section addresses the likely types of waste generated by various components of the Project and details management measures to be implemented.
- **Chapter 24 Cumulative Impacts** – this section provides an overview of known existing and proposed developments and land uses that may result in similar impacts to this proposal, and discusses the likely implications of cumulative impacts with this project.
- **Chapter 25 Environmental Management** – provides details for the CEMP, OEMP and associated management plans.
- **Chapter 26 Statement of Commitments** – provides a draft Statement of Commitments for the Project.
- **Chapter 27 Residual Risk Assessment** – this section provides an assessment of residual risks from the issues prioritisation undertaken in **Chapter 8** following the implementation of mitigation measures and environmental safeguards proposed in this EA.

- **Chapter 28 Proposal Justification** – this section addresses the justification for the Project including the strategic context, and consideration of biophysical, economic and socio-cultural issues.
- **Chapter 29 Conclusion** – provides a concluding statement for the Project.
- **Chapter 30 References** – provides a list of references utilised throughout this EA.

- **Volume 2: Appendices A to G**
- **Volume 3: Appendices H to K**
- **Volume 4: Figures**

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2.0 Strategic Context and Project Need

This Chapter describes the strategic context of the Project including the current Australian and NSW gas markets, current and predicted supply and demand for gas, and the need for the Project as an indigenous CSG supply for NSW.

2.1 Overview

The proposed Project provides a means of commercially developing the CSG resources of the Gloucester Basin. The Project would result in benefits to both the region and the State, particularly through its potential contribution to meeting current and future energy needs for NSW.

The Project represents an important development of State resources for the following reasons:

- NSW currently imports approximately 90% of its gas usage from other States;
- The Gloucester Basin is located close to markets, and in particular the fast growing region of Newcastle and the Hunter;
- Natural gas has been identified as the transition fuel for power generation in response to climate change; and
- The proposed development provides an important and significant new energy source for NSW.

2.2 Current Australian Gas Market

Natural gas consumption in Australia has been continually increasing since the mid–1960s with Australian gas consumption in 2005-06 being some 1,184.6 PJ. Growth in domestic use of natural gas is projected to remain strong (growing at 4.0 % per annum in the medium term to 2010–11 and thereafter at 2.5 % per annum) to reach 1,740 PJ in 2019–20 (Roarty, 2008). In terms of primary energy consumption, in 2004–05 natural gas comprised 19.7% of Australia's primary energy consumption. This share is forecast to increase to 24.1% by 2019-20, and to 25.2% by 2029–30.

2.3 NSW Gas Market

In 2007, NSW consumed approximately 152 PJ of gas (Core Energy Group 2009). Of this 152 PJ, less than 5% was sourced from within NSW. The majority of the total natural gas in NSW was used by industry (some 55%), with the remainder used by domestic and commercial customers.

Natural gas usage in NSW has been developed through gas pipeline connections from gas reserves located outside of the State. The majority of the NSW supply is currently provided from the Cooper Basin in South Australia via the Moomba to Sydney pipeline and the Gippsland Basin via the Eastern Gas Pipeline. In 1976, gas from the South Australian Cooper Basin was supplied into NSW and Sydney, following construction of the Moomba to Sydney pipeline system. More recently, gas has been imported into NSW from Victoria via the NSW Interconnect, built in 1999, joining the Victorian Gas Network to the Moomba Sydney pipeline at Culcairn, and the Eastern Gas Pipeline, commissioned in 2000. The Eastern Gas Pipeline extends from Bass Strait to Sydney.

CSG production in NSW commenced in 1999, with the establishment of the Camden Gas Project. In 2004, Eastern Star Gas commenced generation of electricity at Narrabri based upon CSG produced in the area. In recent years, there has been significant exploration and appraisal work undertaken across the state in various locations looking to commercially develop CSG resources, including the Stratford Pilot Project within the Gloucester Basin.

2.4 Natural Gas Consumption

In 2005–06, the two largest natural gas consumers Australia wide were the manufacturing sector, including minerals and metals processing, using some 425.9 PJ or 36% of total gas consumption, followed by electricity generation using some 384.9 PJ (32.5%). A breakdown of national gas consumption by sector is provided in **Table 2-1**.

Table 2-1: National gas consumption by sector

Sector	Consumption (%)
Manufacturing	36.0
Electricity generation	32.5
Mining	12.6
Residential	12.0
Commercial	3.8
Transport and storage	3.2

The industrial and commercial sectors are characterised by a few large consumers. The largest natural gas consumers are the metal product industries (predominantly alumina kilns and ore smelting), the chemical industry (where natural gas and ethane are used as a feedstock for fertilisers and plastics), and the glass, brick and cement industries where natural gas is used mainly in the kilns (Roarty, 2008).

In the residential sector, the major uses are for water heating, space heating and cooking, with the pattern of use characterised by a high number of small consumers. Residential gas consumption is concentrated in States such as Victoria where the climate and pipeline infrastructure adequately supports the demand for gas. Victoria currently accounts for more than two-thirds of total Australian residential consumption. Significant residential consumption is also seen in NSW, the Australian Capital Territory, South Australia and Western Australia.

2.5 Predicted Future Energy Demand

The Lower Hunter is the sixth largest urban area in Australia and one of the State's major centres of economic activity and growth, indicating an increasing energy demand for the area. This fast growing region of NSW is expected to continue to grow along with the energy needs of the area. The Lower Hunter Regional Strategy (LHRS) (Department of Planning, 2006) provides a 25-year land use strategy for the region. Amongst other provisions it identifies:

- 115,000 new homes to cater for a projected population growth of 160,000 people;
- 66,000 new jobs and an adequate supply of employment land;
- A focus on attracting new investment and capital to NSW to promote job creation; and
- Alternative forms of energy supply aimed at addressing the State's energy needs.

Production of CSG from the coal measures of the Gloucester Basin would provide for the increasing energy demands within the Hunter and Sydney region, would augment and supplement existing gas supplies from within NSW and account for the decreasing reserves and supply from the Cooper Basin. The Project would also provide a cleaner energy source benefiting the environment compared to coal fired power generation.

2.5.1 Power Generation

Power generation in eastern Australia and NSW in particular, has historically been based upon coal as a fuel. However, the level of greenhouse emissions from coal fired power stations means that for future power station development, gas is now favoured over coal. The impediment to the development of gas fired power stations in the past has been the availability of fuel at economic prices given the significant transportation burden of imports from other states.

The majority of energy consumed in NSW is generated from the combustion of black coal. Natural gas (including CSG) produces roughly half the greenhouse gas emissions relative to coal, making it lower carbon intensive. Gas typically costs more per gigajoule than coal but it is a more efficient fuel so a competitively priced gas supply would reduce local reliance on more greenhouse gas intensive fuels.

In 2003, a 790MW gas-fired power station was approved near Muswellbrook using a mix of open cycle and combined cycle gas turbine technology. More recently in 2008, two new gas fired power stations commenced operation at Tallawarra and Uranquinty totalling 1000 MW. In addition Delta Electricity has recently completed construction of its peaking plant at Colongra on the Central Coast. These power stations would require gas supplies in addition to the current NSW market. An application has recently been submitted for Concept Approval for a 2000MW power station near Muswellbrook which may be either gas or coal fired (MP 09_0118).

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 Concept Area, the Hunter Region and the State. This is particularly important in the Newcastle area to support the development of new gas-fired power generation projects in the Newcastle and Hunter region. This would further support the climate change and greenhouse gas emissions initiatives of the NSW Government.

2.5.2 Other Pipeline Infrastructure

Growth in the domestic gas market has been estimated to increase at approximately 4% in the medium term (2010-11). The Queensland to Hunter Gas Pipeline (QHGP) has recently been approved (MP 06_0286; determined on 11 February 2009) to transport CSG from Queensland to Newcastle. The NSW section of the QHGP was anticipated to be completed by 2012. This is also considered as part of the assessment of the potential cumulative impacts of the Project in **Chapter 24** of this EA.

The Project would meet the imminent demand for the Newcastle and Sydney regions, and would form part of the long term (to 2040) supply for the region along with the QHGP to meet future demand which is predicted to increase with domestic growth as well as power generation needs.

2.6 Need for the Project

The Gloucester Basin currently has certified reserves of 423 PJ of 2P (Proved and Probable) Reserves and 630 PJ of 3P (Proved, Probable and Possible) Reserves. Gas from the Gloucester Basin would produce at 20 – 30 PJ per annum, which is more than 10% of the existing NSW market with potential to increase over time. This represents the additional gas demand growth projected for the underlying NSW gas market over the next three to four years (excluding fuel for power generation). CSG from the Gloucester Basin would be delivered into the existing NSW Gas Market via the gas transmission pipeline into the existing gas network at Hexham.

The development of new gas supplies to the growing Sydney and NSW market is important to guarantee supply. Without additional indigenous gas supplies to NSW, there are risks associated with an event that causes an unexpected interruption to a major supply. Unexpected interruptions to major supplies may result in disruption to NSW's gas supply which could consequently result in a material impact on residential, manufacturing and industrial sectors. The Project would provide the next step in ensuring that supply to the Sydney/Newcastle and wider NSW market is maintained in the future.

At the end of FY09, total 2P Gas Reserves for the east coast of Australia (including Queensland and NSW) were 25,578 PJ comprising of 65% CSG and 35% conventional gas (Core Energy Group, 2009). Analyses of Australia's future natural gas reserves and production have been reported by the Australian Bureau of Agricultural and Resource Economics *(*ABARE*)* and show that based on gas demand forecasts in 2002, most reserves of conventional gas in major Australian gas producing basins would be substantially reduced by 2019 (Fainstein *et al.,* 2002).

It is therefore vital that current Australian supplies of gas are supplemented from additional sources. CSG from the Gloucester Basin would be delivered into the Sydney Newcastle trunk pipeline, therefore the Proponent is well placed to assist in bringing additional gas to the market from this Project.

Overall, the Project would be a benefit to the State as it provides:

- Commercial production of CSG for energy supply to the Sydney and Hunter regions and NSW as a whole;
- Local production and regional economic development – employment and service;
- Development of NSW's natural resources in an environmentally sustainable manner;
- Reduced greenhouse gas emission fuel source for power generation in the Hunter region; and
- Commercially competitive indigenous power supply to the State.

3.0 Site and Context

The Project and its component parts cross a range of environments within the Hunter Region. As such, this section provides an overview of the Hunter Region, and provides a description of the location of project components in order to provide a greater understanding of how the Project fits with the regional context.

3.1 Regional Overview

The Project is located within the Hunter Region. The Hunter Region is located approximately 200 km to the north-north-east of Sydney and covers an area of approximately 31,000 km^2 as shown in **Figure 1.1.** The region encompasses a diverse range of geographic landforms, environments, land uses, industries and population centres. The Hunter Region comprises 11 Local Government Areas (LGAs), which are broken up into three subdivisions; the Lower Hunter, Upper Hunter, and Other Hunter. The project traverses six LGAs, including Maitland, Port Stephens and Newcastle in the Lower Hunter and Gloucester, Dungog and Great Lakes in the Upper Hunter region. The major road access routes into the Hunter Region are:

- The Sydney to Newcastle Freeway/Pacific Highway from the south;
- The New England Highway from the west; and
- The Pacific Highway from the north.

Much of the Hunter Region has been cleared for agricultural production since European settlement. The majority of cleared land in the region is managed by private landholders comprising family owned and operated farms, corporate farms and small lifestyle farms. Land uses in the Hunter Region include pasture, cultivation, viticulture, dairying, beef cattle farming, and coal mining in the northern and western LGAs, with residential, commercial and industrial land uses dominant towards Newcastle in the south (refer to **Chapter 11)**.

Large areas of land, mostly in steep rugged terrain, have been set aside as National Parks and State Forests for conservation, preservation, recreation, wilderness and forestry purposes. The two largest National Parks in the region are the Yengo and Wollemi National Parks. The Barrington Tops National Park is located to the west of the Concept Area and is Commonwealth Heritage listed and a World Heritage Site. Other significant land in the region includes Nature Reserves, Island Nature Reserves and State Conservation Areas.

There are three river catchments in the Hunter Region; the Hunter, Karuah, and Manning River catchment areas as further described in **Chapter 12**. The Hunter River catchment is almost wholly contained within the region, occupying approximately 75 per cent of the area. The catchment is separated from the Namoi catchment in the north-west by the Liverpool Ranges and in the west by the Great Dividing Range. To the north-east, the catchment boundary runs through the Liverpool Range, the Mount Royal Range, and the Barrington Tops, continuing to the large coastal plains separating Newcastle Harbour and Port Stephens. In the south, the Hunter Range and the Watagan Mountains separate the Hunter from the Hawkesbury catchment.

A portion of the Karuah River Catchment is located in the Hunter Region in the area between Dungog and Gloucester, which comprises the upper reaches of the Karuah River. Waters from the Karuah River drain south to Port Stephens.

A portion of the Manning River Catchment is located to the north east of the Hunter River Catchment in the Gloucester LGA. The major tributaries of the Manning River catchment flow in a south-easterly direction through alluvial valleys before entering the Manning River which drains towards Taree and enters the ocean at Manning Point.

3.2 Concept Area

Concept Plan Approval is sought for the development of new wells and associated infrastructure within the Concept Area. The Concept Area is situated within the Gloucester and Great Lakes LGAs approximately 100 km north of Newcastle.

The Concept Area comprises approximately 210 square kilometres (km^2) as shown in **Figure 5.1**, and encompasses the known coal measures of the Gloucester Basin. The land comprises largely rural/agricultural land, however the township of Gloucester and certain land zoned for environmental protection is also included within this area, which extends as far north as Barrington but lies just to the east of the village. Land use is further detailed in **Chapter 11.**

3.3 Project Area

3.3.1 Stage 1 GFDA

The Stage 1 GFDA for which Project Approval is sought covers an area of approximately 50 km^2 (including the area comprising the Stratford Pilot Project), broadly located between the township of Stratford and Gloucester as shown in **Figure 5.2**.

The landscape of the Stage 1 GFDA consists of slightly undulating low hills on Permian sediments in the Stroud-Gloucester Basin region characterised as Relief <50 m, Elevation <200 m and Slopes <10%. The soils are moderate to deep, moderately well-drained Brown Sodosols (Yellow Soloths) and moderately well-drained Grey Kurosols (Yellow Soloths) on imperfectly to moderately well drained side slopes and crests shallow to deep, as detailed in **Chapter 17**.

The majority of the original open-forest vegetation, which once covered most of this landscape, has already been cleared and replaced with improved pasture. Land use includes improved and semi-improved pasture, agricultural activities including dairying, beef cattle production, and some cultivation (Lucas Energy, 2007).

The Stage 1 GFDA also includes the Stratford Pilot Project currently comprising six pilot wells, water and gas gathering system and two 20 ML storage ponds. The Pilot Project is principally located on land known as the Tiedeman Property, which is owned by the Proponent as previously discussed in **Section 1.1.1.** It is situated to the north of the Stratford Colliery, within the existing PEL number and within the Gloucester LGA. The six pilot wells forming part of the Pilot Project comprise the first of the 110 wells making up the Stage 1 GFDA.

In 2009, a further five wells were drilled for production testing by AGL. Three of these additional wells are located within the Stage 1 GFDA and if they prove to be successful, would form part of the 110 wells proposed within the Stage 1 GFDA and as such are included in this project application. The remaining two wells are located outside the Stage 1 GFDA, but within the broader Concept Area, and would be included in future project applications if successful.

3.3.2 Central Processing Facility

The CPF would be located within the Stage 1 GFDA. AGL is currently investigating two potential CPF site locations, known as Site 1 and Site 7. The locations of each of these sites are shown on **Figure 5.2**. These sites were selected based on a Site Suitability Assessment undertaken for the CPF as part of the Project. Further discussion on the assessment of alternative CPF locations is provided in **Chapter 4** of this EA.

Both Site 1 and Site 7 have been assessed in this EA, however it is intended that only one CPF would be constructed for the Project. As such, Project Approval is sought for the construction of one CPF and associated infrastructure at one of the assessed locations. The two assessed sites are discussed and considered in the assessment of alternatives in **Chapter 4** of this EA.

CPF Site 1

CPF Site 1 is situated on land currently owned by the Proponent, known as the Tiedeman Property. Site 1 is currently vacant, consisting of mainly grassland on relatively flat terrain. The property also contains the Stratford Pilot Project, as discussed in **Section 1.1.1**. Access to the Stratford Pilot Project is currently via Tiedemans Lane, however access to the site would be established via Wenham Cox Road if the CPF was to be constructed at this site.

CPF Site 7

CPF Site 7 is located on land currently owned by Gloucester Coal, on a parcel of land adjacent to a rail loop which currently services the Stratford Colliery. The site is currently vacant and consists predominantly of grassland with some scattered sparse vegetation. A large stand of vegetation is located in the south eastern portion of the parcel of land, however this would not be affected by the Project. Due to the limited sight distances to access this parcel of land off Parkers Road, alternative access would be constructed to gain access through the adjacent property to the south of Parkers Roads from The Bucketts Way as shown in **Figure 5.10**.

3.3.3 Pipeline Corridor

The proposed pipeline corridor extends from the CPF site to Hexham, on the north-western outskirts of Newcastle. The extent of the pipeline corridor is shown in **Figure 1.1.**

The pipeline corridor is approximately 100 m wide, and extends approximately 95 km from CPF Site 7, to the HDS at Hexham. An alternative section of pipeline corridor has been assessed which extends to CPF Site 1, should this be the final CPF location. The final corridor would be dependent on the selected CPF site. Within the 100 m wide corridor, a 30 m ROW would be developed for the gas transmission pipeline.

Land uses encountered along the length of the pipeline corridor include (refer to **Chapter 11**):

- Agricultural;
- Mining;
- Rural residential;
- Residential;
- National Park; and
- Industrial.

The Proponent has undertaken an extensive program of stakeholder consultation with affected landowners along the proposed pipeline corridor. The proposed pipeline corridor has been determined following a rigorous site suitability assessment process undertaken by the Proponent as described in **Section 4.3.1**.

3.4 Land Ownership and Legal Description

The project traverses six LGAs, including Maitland, Port Stephens, Newcastle, Dungog, Great Lakes and Gloucester.

A constraints analysis was undertaken as part of the envelope approach (see **Section 5.2)** to determine the most suitable locations for the siting of wells. The nearest sensitive receptor (nearest occupied residence) or sensitive land use would be located no closer than 200 m from a well site (based on the applicable locational principles detailed in **Section 5.2**) and approximately 1300 m from CPF Site 1 and 460 m from CPF Site 7. The locational principles detailed in **Section 5.2** have been developed specifically for this project.

Details of the properties located within the Stage 1 GFDA, at the CPF locations and along the pipeline corridor are identified in **Appendix E**.

4.0 Assessment of Alternatives

This Chapter provides a discussion of various alternatives considered for the Project including consideration of alternative locations with access to CSG resources, alternative pipeline routes, alternative siting for the CPF and wells, alternative use of plant, alternative construction techniques, alternative water management and the "Consequences of not Proceeding". Each of these is addressed in the following sections:

- *Alternative CSG Resources;*
- *Alternative Project Development Options;*
- *Alternative Locations;*
- *Alternative Plant & Infrastructure;*
- *Alternative Water Management;*
- *Alternative Construction Techniques;*
- *Alternative Construction Workforce Management; and*
- *Consequences of Not Proceeding*

4.1 Alternative CSG Resources

Various NSW sedimentary basins contain stratigraphic sequences that have been shown to contain natural gas reserves, both conventional and CSG. Gas reserves have been identified in the following basins:

- Clarence – Moreton Basin, to the east of the New England Tableland.
- Gunnedah Basin, around Narrabri, Coonabarabran and Gunnedah.
- Sydney Basin.

The AGL Energy operated Camden Project and the Eastern Star Gas Narrabri Power Project are the only ventures currently producing gas. The Gloucester Gas Project is located within the Hunter Region, close to energy intensive users in the region. This provides an indigenous gas source and reduces the transportation costs compared with more remote projects. Infrastructure essential to the Project such as the Sydney Newcastle trunk pipeline, roads, powerlines, and nearby service businesses, already exist in the area, in contrast with consideration of similar projects in more remote regions, thereby providing increased commercial viability to the Project. Additionally, extensive exploration and investigation has been previously undertaken in the Gloucester Basin as described in **Section 1.1.1**. This has involved the recent Stratford Pilot Project, which further confirmed the viability of the CSG resources in the basin and assisted in determining the location of the Stage 1 GFDA.

4.2 Alternative Project Development Options

For the Stage 1 GFDA, three development options are currently being evaluated to determine which option provides the most commercially viable gas field development to deliver gas into AGL's gas portfolio whilst meeting corporate Heath, Safety and Environment objectives. These options include:

Development Option 1 – Field development would occur so that peak production is reached (approximately 80TJ/day) within a 12 month ramp up period with drilling being completed for the entire Stage 1 within 18 months.

Development Option 2 - The field development schedule would be matched to meet the market demand. Therefore well infrastructure and upgrades to CPF capacity (if required) would be scheduled in line with the market demand. Under this option, construction of the wells would likely occur over three years.

Development Option 3 – Under this option, the objective is to minimise development risks associated with reservoir performance and land access approvals. The field development schedule would be designed to optimise reservoir performance and minimise impact on the community. For this option, construction of the wells would likely to occur over 5 years.

Development Option 1 represents the most intense construction period and so has been used in this EA as the basis for assessing potential impacts.

4.3 Alternative Locations

4.3.1 Alternative Pipeline Route

The proposed gas transmission pipeline would transport gas produced in and around Stratford (from within PEL 285) to Hexham. At Hexham, the gas would be delivered into the Sydney Newcastle trunk pipeline, which forms part of the principal gas reticulation network of the Newcastle and Sydney regions.

Investigations related to pipeline route selection commenced at an early stage due to the varied land use, land ownership and physical constraints existing in the region. As such, a preliminary corridor selection study was undertaken.

This assessment first identified a broad "Initial Study Area", consisting of a 10 km wide straight-line corridor from Stratford to Hexham in order to commence the route selection process.

Within the Initial Study Area, four iterative route options were formulated comprising:

- Straight Line (Stratford to Hexham);
- Computer Model generated using ArcMap modelling with input of criteria that avoided slopes >10%, sensitive areas (e.g. National Parks, State Forests and land parcels < 2 ha);
- Preliminary Route - a computer generated model refined to include further constraints; and
- Initial Preferred Pipeline Route - determined by review and reconnaissance of the preliminary corridor route.

The pipeline route selection study utilised a combination of GIS and Multi Criteria Analysis (MCA) methods to determine the preferred pipeline route utilising numerous sensitivity criteria. The criteria utilised in the study included:

- Threatened flora and fauna species;
- Protected areas, including:
  - RAMSAR wetlands
  - Flood Prone Areas
  - Reserves, National Parks
  - State Forests
  - Regional Forest Agreements
  - SEPP 44 – Koala Habitat Protection
  - SEPP 71 – Coastal Protection
  - SEPP 14 – Coastal Wetlands
  - SEPP 26 – Littoral Rainforest;
- Major topographical constraints including;
  - Geology;
  - Acid Sulfate Soils;
  - Steep areas;
  - Erosion;
  - Elevated ground water levels; and
  - Watercourses;
- Heritage Issues (Aboriginal and non-Aboriginal) – items of heritage significance would be avoided where possible;
- Land use and legislative constraints;
- Building and infrastructure – the pipeline route aimed to avoid existing and planned buildings and proposed major infrastructure;
- Social impacts – minimise potential noise, vibration, dust, traffic and public amenity impacts;
- Length of pipeline – the shortest length would be the most efficient and economical; and
- Existing easements – would be utilised where possible as they provide a corridor with pre-existing encumbrance to the land, minimising the potential impacts upon land use and development potential.

Major constraints identified were avoided where possible during the selection of the pipeline route. The options were further verified by aerial survey and by ground truthing. The final proposed pipeline route is shown in **Figure 1.1**. The 100 m wide pipeline corridor for the Project Area is designed to allow for some flexibility for the 30 m ROW within which the gas transmission pipeline would be constructed, in order to avoid direct impacts on most known issues and to account for new issues which may arise during the detailed design and construction phases.

Two alternative pipeline routes are proposed at the start of the pipeline, the final selection of which would be dependent on the final site selection for the CPF (either Site 1 or Site 7, discussed in **Section 3.3.2** and **Section 4.3.2** below). Should CPF Site 1 be chosen as the final location for the CPF, the pipeline corridor would be approximately 100km in length. Should CPF Site 7 be the preferred option, the pipeline would extend for some 95 km to the HDS near Newcastle.

The refinement of the preferred pipeline route within the Project Area has been an iterative process involving extensive consultation and negotiation with landholders and informed by a range of specialist surveys. The ecology surveys undertaken have assisted in determining areas containing vegetation of importance which the pipeline route should avoid and have also assisted in determining the preferred method of watercourse crossings (see **Chapter 12)**. The pipeline route has been diverted from its original course in a number of locations to avoid areas of significant vegetation (Refer to **Chapter 10** and **Appendix G** of the EA which includes an assessment of the original pipeline alignment as well as an addendum addressing later changes). Heritage surveys were also conducted to identify sensitive areas to be avoided and other heritage issues which may be encountered as detailed in **Chapter 19**. As such, the pipeline route has been aligned to avoid sensitive environmental areas as much as possible. Additionally, the pipeline route surveys undertaken allow for a 50 m envelope on either side of the proposed route to account for minor route realignments which may be necessary should other issues be identified prior to and during the construction period.

4.3.2 Alternative Siting of CPF

Options for the siting of the CPF were based on site selection studies. The CPF is required at the inlet to the proposed gas pipeline to dehydrate and compress the gas produced from the Stage 1 GFDA, prior to it being injected into the pipeline for transmission to Hexham and beyond. Five potential locations for the CPF were originally identified. A site selection study (Lucas Energy, 2008) was subsequently undertaken assessing various criteria for each option in order to formulate a suitability model with a suitability score (expressed as a percentage) for each proposed location. The site selection study utilised a combination of GIS and MCA methods to analyse and compare siting criteria. The criteria assessed in the model were:

- Vegetation;
- Waterway and wetlands;
- Terrain and erosion (slope);
- Land and Heritage;
- Visual exposure from dwellings;
- Noise exposure;
- Transportation infrastructure;
- Electricity infrastructure;
- Existing mining operations; and
- View sheds.

The initial suitability model considered five potential sites for the CPF location in the vicinity of Stratford. The model indicated that Site 1 (mean score 86%) and Site 4 (mean score 84%) were deemed as the most suitable locations for the CPF. Site 5 (mean score 79%) and Site 3 (mean score 71%) both included areas of relatively high constraint as indicated by the large score range across each site and low minimum value. Site 2 was eliminated from further consideration due to the encroachment on waterway buffers.

Following consultation with key stakeholders such as the community and Gloucester Shire Council, and in consideration of the results of the site selection study, it was apparent that none of the potential CPF sites were unanimously favoured by all parties. As such, an alternative location was considered adjacent to the rail loop servicing Stratford Colliery, operated by Gloucester Coal. This site, known as Site 7, was deemed suitable due to its location within an area earmarked by Gloucester Shire Council for potential future industrial development (Gloucester Shire Council, 2006) and its close proximity to existing mining land uses. Under the *Draft Gloucester Local Environmental Plan 2009*, which was publically exhibited in August 2009, Site 7 would be located within an area zoned for heavy industrial use (refer **Figure 4.1**). Furthermore, Site 7 also demonstrated a score greater than 80% on the suitability model, indicating limited environmental constraints.

Based on the site suitability model and a number of other considerations including land ownership and existing and proposed surrounding land uses, two sites, Site 1 and Site 7, were considered most suitable for the development of the CPF. As such, both of these sites have been assessed in this EA, on the basis that Project Approval would be granted for construction of one CPF on one of the two assessed sites.

4.4 Alternative Plant and Infrastructure

4.4.1 Alternative Use of Plant

A range of different plant has been considered for the CPF and other infrastructure. Considerations include:

- The use of different types of engine driven compressors to evaluate against flexibility, environmental factors and cost;
- The potential re-use of waste heat generated to processing equipment. Waste heat from the compressors may potentially be used to evaporate concentrated wastewater although this is still under investigation;
- The use of various types of water processing equipment to review potential uses for the waste brine system;
- The use of water distribution pipework for both produced water production, water balancing and distribution of fraccing water; and
- The use of small scale generators at each well site, or the installation of underground electricity cables to each well site for the supply of power.

Modelling has shown catalytic convertors will need to installed to the compressors to reduce air emissions to within regulatory requirements whilst operating at maximum production.

4.4.2 Alternative Water Management

Produced Water Management

There have been numerous alternatives considered regarding management of produced water for the Project. The approach taken by the Proponent relating to produced water management is one that enables the gas production to proceed unhindered, while providing some benefit to the environment and local community through sustainable disposal or re-use of water produced as a by-product of core operations.

The various options for the management of produced water which have been considered include:

- Aquifer Re-injection – This option would require a licence from the Department of Environment, Climate Change and Water (DECCW) and would require further assessment into the relationship between the relevant aquifers and the identification of a suitable aquifer for re-injection.

- Discharge to surface water – This option would require a licence from the DECCW and would likely require treatment of produced water to meet acceptable criteria prior to discharge.
- Irrigation – This option would be suitable as long as the water meets acceptable criteria, therefore, treatment would likely be required.
- Sale of water – This option would require licences for each borehole and may require water to be treated or not, depending on the water quality and the requirements of the user.

Based upon the quality of produced water from the pilot wells, as described in **Chapter 13**, it is likely that produced water would require treatment prior to appropriate disposal. The extent of treatment would depend on the final use of the produced water and the quality requirements of that use. Treating produced water would result in a waste stream (e.g. concentrated brine, crystalline waste, etc), which would require further management. Treatment options which were considered include:

- Sterilisation – This treatment option addresses the pathogenic and bacterial content of product water, with the use of either UV light or chemical treatment (usually chlorination) to remove disease-causing bacteria, viruses, protozoa and other organisms. Sterilisation would not address other aspects of water quality, particularly salt content. Sterilisation may therefore only be applicable as, for example, a requirement for aquifer re-injection. It may also be employed post-treatment to avoid algal growth in pipes, if necessary.
- Evaporation - Some form of assisted evaporation would likely be required to dispose of the concentrated waste ('brine') stream that would result from the treatment process, since the local climate is not conducive to solar evaporation. It may be feasible to dispose of the entire volume of produced water by this method, particularly if volumes are low and waste heat from the CPF can be utilised in some way. However, the capital cost of evaporators is very high, with large energy requirements also leading to high operating costs. As such, it is unlikely that evaporating the total produced water flow would be economically viable, even with some form of heat exchange.
- Filtration - Physical filtration involves the passage of water through a filtration media, such as sand or activated carbon, in order to reduce the suspended solids content of water. However, media pore size is typically not small enough to impact substantially on Total Dissolved Solids (TDS) and is therefore inappropriate for treatment in this case. Some form of filtration (probably microfiltration utilising membranes) may be required as pre-treatment for salt removal. Artificial wetlands are sometimes employed for filtration of wastewater, though again principally for removal of suspended solids. The salt content of produced water would potentially create a long-term loading concern for artificial wetlands, which would also require identification of suitable land in the area and an ongoing water source to sustain the ecosystem once water production ceases. Wetlands are not considered a viable treatment option.
- Desalination - The fundamental water quality issue for water produced during gas extraction in the Gloucester Basin is likely to be elevated TDS, as well as the related issue of sodicity. Some form of desalination would be required to reduce the salt content – whether of the entire flow, or a proportion that is then blended with the 'raw' product water – prior to its use or disposal.

  Desalination was deemed the most suitable method to manage the salinity of produced water, allowing for the treated water to be appropriately disposed. There are a number of alternative methods for desalination which were considered for the Project including:

- Reverse Osmosis (RO) – This option is a proven process for the removal of dissolved solids from saline feed water using high pressures to 'force' water through semi-permeable membranes, leaving behind the ions. A clean water stream and concentrated brine waste stream result. RO produces high quality water, but has high operating costs that increase in relation to the desired quality of the output. Recovery of up to 94% of the feedwater can be achieved (though 70 – 80% might be more reasonable), though the remaining waste stream is highly concentrated and problematic for disposal. Typically, inland RO plants dispose of waste streams by evaporation within constructed storages. Improved water quality can be achieved by making multiple passes through up to three RO units, though with obvious cost implications.
- Capacitive Desalination (CDI) – This is a new technology that involves separation of ions within the water as it passes through sheets of a carbon 'aerogel'. While a potentially cost effective alternative, this technology is yet to be substantially proven and is therefore considered unlikely to provide a risk-free solution.
- Electrodialysis Reversal (EDR) – This process involves passing water through anode and cathode plates that surround charged membranes. The reversal of polarity and flow direction provides a means of self-cleaning that can reduce chemical dosing requirements, potentially enabling EDR to operate more efficiently for longer periods of time. The process only removes ionic species and must therefore be combined with some form of filtration to remove organic compounds. Capital costs for EDR tend to be significantly higher than those of RO or nanofiltration.
- Distillation – This option provides a highly purified product by heating raw water to boiling point then condensing the vapour to near-pure water. There are various methods of distillation (including Multi-stage Flash, Multiple Effect and Thermal, Mechanical and Vacuum Compression), though they are typically very high in energy input and as such are not generally considered a viable alternative. It is generally considered that membrane processes are best suited for brackish feedwaters (1,000 – 10,000 mg/L TDS), while distillation is more efficient for highly saline feedwaters.
- Sodium Adsorption Ratio (SAR) Reduction - Water with a high SAR can cause clayey soils to disperse and lose permeability, reducing water available for plants and potentially leading to increased runoff and erosion. The SAR of water that can be safely applied to soils without leading to structural damage would depend both on the TDS of the water and the soil type. Where product water is to be used for irrigation, the SAR would require consideration when designing treatment. Typically, SAR is lowered by adding calcium to the water in the form of gypsum.

The RO desalination process is currently considered the most suitable and this would be optimised in the design phase, though it has been assumed at present that a capacity of 2ML/d would be required. As the technology is scaleable and modular, this is likely to be installed in 1 ML/d increments as required. As further described in **Section 5.5.4,** the produced water treatment process would likely consist of three key phases including pre-treatment, desalination and evaporation of the concentrated brine waste stream.

Treated Water Management

Storage scenarios for treated water that are under consideration include:

- Utilising off-site (existing or new) farm storages to take constant, year-round supply of treated water. Some farm dams are located in areas without a significant catchment, therefore capacity would likely be available for storage of treated water even during periods of above average rainfall.
- Constructing a "buffer" storage within the Stage 1 GFDA, both as a balancing storage and to store excess water during wet periods.

It is proposed that a combination of both options would be utilised, with a proposed 25 ML storage to be included at the CPF site and additional balance storage at the Tiedeman property.

Numerous options have been identified for the disposal or beneficial use of the treated water. The suitability of each option was evaluated (primarily qualitatively) based on the following criteria:

- Technical;
- Environmental;
- Social;
- Economic; and
- Regulatory.

Each option was given a score out of 25 (higher score is better) based on a number of criteria as summarised in **Table 4-1**.

Table 4-1: Options considered for water and waste stream disposal and/or reuse

Disposal / Use	Description	Treatment	Result	Comment
Water Disposal / Reuse Options				
Surface Discharge	Discharge of all produced waters to a receiving surface waterway	Salt removal to meet approval requirements	15	Treatment necessary for discharge approval. High cost for no beneficial use
Underground Re-injection	Re-injection of product water into coal seam or other aquifer	Likely to be required	7	Significant investigation would be required
Evaporation	Evaporation of all product water	Mechanically assisted process required as climate is not conducive to solar evaporation	10	Capital and energy intensive
Removal	Transport all water in trucks to licensed disposal facility	Not required	14	Costly solution that has positive and negative impacts
Recharge Ponds	Store product water in shallow ponds to allow recharge to shallow aquifers	Salt removal to meet requirements	7	Not viable

Disposal / Use	Description	Treatment	Result	Comment
Artificial Wetland	Use a constructed wetland to treat water and provide wildlife habitat	Salt removal likely to eliminate issues with long-term loading	12	Long-term loading and water supply issue.
Recreation	Constructed storage to create facility for local recreation (watersports, wildlife habitat)	Treatment required to improve quality	12	May not be suitable in local landscape. Long-term water supply issue.
Stockwatering	Supply of product water to local farms for stock watering	Some salt removal or dilution required, though less than other options	17	Impractical disposal option for all flows though viable in combination with other agriculture
Irrigation (agriculture)	Supply of product water to local farms for irrigation	Salt removal required	20	Practical beneficial use for water appropriate for local land use
Irrigation (horticulture)	Supply of product water to local horticultural or agribusiness operations	Salt removal required	20	New business opportunities. Appropriate beneficial use.
Aquaculture	Supply of product water to an aquaculture enterprise	May not be required	15	Challenging management of flows. Local operator would be required.
Industrial	Supply of product water to local industry most likely coal processing	Would be determined by end user	14	No identified demand; sharing disposal with mine influenced by expected mine life
Municipal	Supply of water to supplement local town potable supplies or for irrigation of municipal reserves and properties	High level of treatment required for potable supply	14	Not an economic alternative to existing (adequate) supplies
Waste Stream Disposal / Reuse Options				
Evaporation	Evaporation of concentrated waste stream in purpose built evaporators		14	Standard approach to waste disposal in inland areas
Aquifer Re-injection	Injection of concentrated waste stream into coal seam or other aquifers		7	Costly investigation, infrastructure and approval process
Transport	Haulage of all concentrated waste to licensed disposal facility		14	May be suitable for low volumes
Salt Production by transporting salt to a salt producer	Use of advanced yet proven technology to create a saleable salt product and zero liquid emissions		17	Ideal solution if feasible. Requires investigation and interest from third party.

The assessment indicated that the reuse of produced water for irrigation (agriculture and horticulture) and stock watering would be beneficial to the community and also result in the least potential environmental issues once the produced water is treated to meet acceptable standards.

For the final solid salt product, the assessment indicated that the transport of the product to a salt producer for re-use would be the most suitable method of disposal and this option is being pursued. However, disposal of the salt to landfill is likely in the short to medium term while a commercially feasible producer is sought. The concentrated brine solution would first need to be further evaporated in an evaporation pond as described in **Section 5.5.3** and this would also depend on the waste classification of the product as discussed in **Chapter 23.**

Process Water Management

The various options for the management of emulsified process water (generated in the compression process) which have been considered include:

- Disposal via waste oil truck- this option has been discounted due to associated costs with disposal including NSW government levies to encourage alternative disposal methods
- Use of activated bentonite process- this involves mixing bentonite and proprietary chemicals with waste stream oil-in-water emulsion. The oil is absorbed in the bentonite and the mixture is flocculated and placed on filter paper that allows treated water to be separated and forwarded to onsite storage ponds. The filter paper / oil-in-bentonite is suitable for landfill disposal. This process has been trialled with success in the Camden CSG project.

4.5 Alternative Construction Techniques

4.5.1 Watercourse Crossings

Various methods for crossing watercourses are available depending on the sensitivity of the watercourse to be crossed, as further described in **Section 5.6.4.** The least sensitive watercourses may be crossed using open trenching techniques, watercourses with larger water flows may be crossed using open trenching with stream flow diversions and sensitive watercourses may be crossed using Horizontal Direct Drilling (HDD) techniques. A sensitivity assessment was undertaken for each of the watercourses crossed as shown in **Section 12.3** to determine the type of watercourse crossing to be implemented.

4.5.2 Reduced ROW Width

In some areas deemed sensitive along the pipeline route, the ROW width may be reduced to 15 m instead of 25-30 m in order to minimise impacts to those areas as shown in **Figure 5.14.** A reduced ROW width may be used at watercourse crossings with riparian vegetation and areas consisting of remnant vegetation as further discussed in **Chapter 10.**

4.6 Alternatives for Construction Workforce Management

It is expected that at during the peak construction phase, up to 100 personnel would be required during construction of the CPF and wells within the Stage 1 GFDA, and up to 300 personnel would be required for the construction of the pipeline. Local contractors would be used where possible, however it is expected that a large number of the construction workforce would require temporary accommodation during the construction period.

A number of accommodation alternatives for the temporary housing of workers during the construction phase of the Project have been considered in terms of the potential impacts that options may have on local populations and the natural environment. These include impacts to local tourism-based industries, the local economy, the welfare of construction workers, amenity impacts to local populations, and impacts to the natural environment. Potential accommodation options which have been considered include utilising existing accommodation facilities, and the establishment of construction workforce camps. These are discussed in the following sections.

Existing Accommodation Facilities

Accommodation facilities in the vicinity of the Stage 1 GFDA have been identified including motel, hotel and caravan park facilities. These include:

- Gloucester Country Lodge Motel;
- Avon Valley Inn;
- Bucketts Way Motel;
- Gloucester Holiday Park;
- Cundle Flat Farm; and
- Gloucester Tops Riverside Caravan Park.

Existing accommodation facilities have the capacity to provide short-term temporary accommodation for construction personnel on an as-needs basis, and would be utilised where required and where appropriate. However it is expected that during the peak construction period, alternative accommodation for construction workers would be required, as an influx of workers could significantly reduce the availability of accommodation for tourists in the region on which Gloucester's economy largely relies.

Based on the expected peak construction workforce for the drilling of wells within the Stage 1 GFDA, the CPF, and construction of the pipeline, the availability of suitable accommodation within the Gloucester region and at localities along the pipeline route to accommodate the expected workforce is not considered to be adequate. In addition, given that tourism is a significant industry in the Gloucester LGA, utilising significant accommodation resources in the region to support the construction workforce could impact indirectly on tourism-reliant industries in the area.

Construction Workforce Camps

The establishment of construction workforce camps has been considered to accommodate the construction workforce during both construction of the Stage 1 GFDA well field and construction of the gas transmission pipeline. Camps would be located to minimise the commute for workers to the construction areas and associated impacts on local traffic networks. In this respect, the pipeline construction workforce camp would be situated approximately mid-way along the pipeline route.

Construction workforce camps would be located in accordance with the locational principles described in **Section 5.2**. The Stage 1 GFDA construction workforce camp would be located in the vicinity of the township of Gloucester, where practicable, to enable construction workers residing at the camp, access to the towns facilities, thereby supporting local businesses.

Construction workforce camps would comprise accommodation, a central ablution unit with toilet, laundry, wet mess recreational facilities, offices, training room, first aid facilities and a workshop and laydown area for the maintenance of vehicles and equipment. While camps would be relatively self-sufficient, they would be located within reasonable proximity to townships to allow use of amenities, but self-sufficient enough to avoid reliance on public infrastructure and amenities. Construction workforce camps are discussed further in **Section 5.6.7**.

Siting of Construction Workforce Camps

The location of construction workforce camps would be based on the applicable locational principles described in **Section 5.2**, and would be dependent on environmental constraints, construction requirements, and landowner agreements. As discussed above, camps would be located to minimise the commute for workers to the construction areas and therefore minimise the associated potential impacts on local traffic networks.

4.7 Consequences of Not Proceeding

If the Project does not proceed, the opportunity to develop a convenient and competitive natural gas supply within the Newcastle region would be stifled. Consequences for the State should the Project not proceed include:

- The continued reliance (~90 %) on gas from other States;
- The likely future shortfall in the gas supply to the growing NSW market which may in turn lead to an increase in the use of less efficient alternative fossil fuel sources that would increase greenhouse gas emissions;
- Sterilisation of a major State significant resource in an already constrained NSW gas market, contrary to the objects of the EP&A Act (refer to **Chapter 6**);
- The increased cost of gas to NSW due to the risk to long-term supply of the NSW gas market caused by dwindling reserves in the Cooper Basin in South Australia and increases in demand for gas;
- The loss of economic growth to the region, such as temporary and permanent employment that would be generated by the construction and operation of the pipeline and associated spending;
- The loss of economic benefit derived from private sector investment in electricity generation and industry resulting from a lack of a secure and affordable supply of gas to the Hunter and Newcastle regions;
- The loss of potential economic benefit that may be derived from the further development of the broader Concept Area within the Gloucester Basin; and
- Loss to the State of Royalty revenue.

Additionally, not proceeding with the Project would also be a lost opportunity to contribute positively to Government initiatives such as the development of CSG 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.

5.0 Project Description

The Proponent is seeking Concept Plan Approval for activities to develop CSG resources within the Concept Area from the geological resources within the Gloucester Basin. This section provides an overview of the activities proposed within the Concept Area and the likely timeframe and staging of construction and operation.

This section also describes the activities for which concurrent Project Approval is sought, including: the extraction and treatment of CSG from proposed well site locations within the Stage 1 GFDA; construction and operation of the CPF with a capacity of approximately 30 PJ per year (with an 80TJ per day average); the construction and operation of a gas transmission pipeline from the CPF to Hexham; and construction and operation of the HDS.

5.1 Overview

Development of the Concept Area involves the development of plant and infrastructure for CSG extraction from the Gloucester Basin and transport to markets in the Newcastle and Sydney Regions. The Concept Area is shown in **Figure 5.1**.

Concept Plan Approval is sought for a staged development within the Concept Area, including development of wells, gas and water gathering lines, and associated infrastructure and activities. The Concept Plan for the Concept Area is described in **Section 5.2**.

Concurrent Project Approval is sought for the following components of the Project:

- Construction and operation of the Stage 1 GFDA including gas wells at indicative well site locations, access roads, underground gas and water gathering systems and other associated infrastructure;
- Construction and operation of the CPF with an average capacity of 80 TJ per day at either CPF Site 1 or CPF Site 7 within the Stage 1 GFDA, comprising:
  - Up to eight compressor units and associated plant;
  - Produced water treatment facility;
  - Compression process water treatment facility;
  - Small scale 15 MW ancillary power generation facility;
  - Flaring system;
  - Storage and evaporation ponds;
  - Access roads;
  - Laydown areas; and
  - Office, control room and accommodation facilities;
- Assessment of a 100 m wide pipeline corridor within which the gas transmission pipeline would be constructed within a 30 m ROW; and
- Construction and operation of the HDS.

The estimated workforce throughout the duration of the construction period is listed in **Table 5-1** below.

Table 5-1: Construction workforce

Activity	Number of Personnel
Field construction and drilling	50 – 60
CPF construction	40 – 50
Pipeline construction	200 – 300
Management and office staff	10 – 15

Temporary portable toilets and amenities would be provided at the various construction sites for use by construction workers during the construction program. Wastes from services and amenities would be disposed of at a licensed facility as described in **Chapter 23**. Typical site construction well site layouts include a site office with first aid equipment and other amenities.

Two construction workforce camps would be required to provide temporary accommodation for the construction workforce. One construction workforce camp would be located within the Stage 1 GFDA, with a second located approximately midway along the pipeline corridor.

The main project components are described in further detail in the following sections.

5.2 Concept Plan and Project Staging

Development of the Stage 1 GFDA would be dependant upon the development scenario adopted as described in **Section 4.2**, and would therefore be undertaken over somewhere between an 18 months to 5 years period. The 18 month timeframe would represent the most intense construction period and therefore the worst case scenario.

The CPF and the pipeline to Hexham are required to deliver gas to the market and therefore would be undertaken in Years 1 and 2 of the Project. The construction of the CPF and the pipeline is anticipated to occur over a 12 month period. Staging of the Project is shown in **Figure 5.17**.

Subject to subsequent Project Approvals, additional stages of well construction would be anticipated in other parts of the Concept Area, however, this would be dependant upon geology and viable coal measures to enable commercialisation. Future stages of well development would be dependant upon commercial drivers and would be completed in conjunction with AGL's gas portfolio requirements. It is anticipated that subsequent well stages would include development of well fields to the north, south and west of the Stage 1 GFDA.

As future stages of well development are further removed from the CPF, there may be a requirement for localised nodal compression (subject to noise assessment to establish relevant noise goals) to assist transferring the produced CSG to the CPF. This would most likely consist of small screw compressor packages located in the field, possibly connected to multiple well heads, to increase the gas pressure to allow for transmission to the CPF.

As the number of operational wells is increased during the development of the Concept Area, the CPF would likely require additional capacity for the treatment and storage of produced water. Increased gas capacity would result in a larger quantity of produced and of treated water and as such, Concept Plan Approval is also sought for the associated upgrade of the water treatment facility and associated storage ponds and infrastructure.

5.3 Concept Area

Concept Plan Approval is sought for the development of well sites and associated infrastructure to produce CSG within the Concept Area, which is primarily centred on the town of Stratford, approximately 100 km north of Newcastle. The proposed Concept Area is located within PEL 285 and incorporates some 210 km^2 of Permian Coal Measures within the Gloucester Basin (refer to **Figure 5.1**).

Development of the Concept Area would be staged, with initial development occurring within the Stage 1 GFDA, for which concurrent Project Approval is sought. The Stage 1 GFDA is described in **Section 3.3.1** and **Section 5.4**. Subsequent stages of CSG extraction would likely be extensions of the Stage 1 GFDA, but may occur at other locations within the Concept Area and would be determined with consideration of the locational principles discussed further below.

Development within the Concept Area would incorporate the following components:

- Development of indicative well site locations within the Concept Area, including construction of access roads and drill pads, drilling, construction, operation and post development activities;
- Development of a gas and water gathering system to collect produced gas and water at well sites and transport to the CPF; and
- Upgrades to the water treatment facility within the CPF footprint to accommodate additional water production from gas field development within the Concept Area; and
- Additional storage ponds.

Development of well site locations within the Concept Area would be undertaken based on a well spacing of between 600 to 800 m, though in practice spacing is dependant on local conditions that would be considered via an ‘environmental envelope’ approach (discussed in **Chapter 1** and below). Well sites would be interconnected in ‘pod’ arrangements via the gas gathering system which would transport produced gas to the CPF via the main spine lines, generally constructed with a north-south orientation. **Figure 5.2** illustrates the notional well site grid pattern of the Stage 1 GFDA.

With the exception of the Stage 1 GFDA for which concurrent Project Approval is sought, the location of well sites and associated infrastructure in other sections of the Concept Area has not been determined at this stage. The location of well sites and associated infrastructure would depend on a range of factors including geology, environmental constraints and land access. This level of detail would be provided as part of subsequent Project Applications.

The selection of well site locations and associated infrastructure within the Concept Area would be guided by a set of locational principles. The initial development area would be dependent on the local geology and location of CSG resources. The steps involved in developing the environmental envelope, which are described in **Section 1.4** are detailed below for the Concept Area.

- **Establishment of Envelope**

  As described in Chapter 1 the environmental envelope would be established, likely in the form of the notional grid pattern described above and based on geological considerations.

- **Constraints Analysis**

  Environmental constraints would be identified and assessed within the envelope. Environmental constraints mapping would be undertaken utilising GIS to spatially identify constraints and develop an overall site suitability model. The constraints analysis would be based on locational principles, described below.

- Not within 200m of existing residences or as required to meet project noise goals;
- Minimum 40m from a major watercourse or 20 m from a minor watercourse;
- Avoidance of significant vegetation and riparian areas;
- Avoidance of Indigenous and European heritage places or items;
- Located adjacent to existing fence lines and access tracks where possible;
- On relatively flat ground, where possible;
- Consideration of visual effects and opportunistic use of natural screening such as vegetation; and
- Land use and landowner preferences.

- **Indicative Well Sites and Location of Associated Infrastructure (including construction workforce camps, gas and water gathering system, and access roads)**

Based on the constraints analysis, an indicative location of well sites and infrastructure, including the gas and water gathering system and access roads, would be determined to avoid or minimise potential environmental impacts. The indicative well site locations and location of associated infrastructure would then be assessed as part of a subsequent Project Application.

Detailed information about the construction and operation of well sites and associated infrastructure is provided in **Section 5.4**, which details the activities proposed as part of the Project Application for the Stage 1 GFDA. These details would be predominantly the same for future development within the remainder of the Concept Area, though the requirement for some activities within the Concept Area remains uncertain. The following activities are therefore included in the Concept Plan, and any future requirement to conduct these activities within the Concept Area would be the subject of a separate Project Application and Approval.

- **Construction of infill wells:** either co-located within the pads of existing wells, or new wells (and associated infrastructure) in previously undisturbed areas of the Stage 1 (and subsequent stages) field development, in order to access additional reserves that cannot be completely accessed from existing wells or wellhead locations. Directional drilling may be utilised as a drilling technique that would enable multiple wells to be drilled from a single location. Up to four individual well heads could be co-located at a single location, in order to maximise access to the resource;
- **Upgrade of gas and water gathering lines:** to allow for increased production capacity, some gathering lines may require duplication along existing gathering line routes;
- **Installation of “in-field” compression:** in the vicinity of wellheads or gas gathering routes, additional compression may be required to increase capacity and production (this is not required in Stage 1 although could be required if development occurs further north and south); and
- **Discharge of treated water to a designated discharge point:** undertaken during periods of prolonged high rainfall and when downstream users would not have need for the treated water generated from the Project. Water to be discharged would be treated to meet acceptable standards. Further environmental studies and monitoring would be undertaken prior to future project approvals to determine a designated discharge point.

While specific locations for well sites are unknown for the Concept Area, the assessment of environmental impacts for the wider Concept Area has been based on the description and identified footprint of the activities proposed in respect of the Stage 1 GFDA. Environmental safeguards and mitigation measures have been recommended in this EA which would form part of subsequent project applications for development in the Concept Area. Based upon current knowledge, approximately 200-300 wells are likely to be developed in the Concept Area over a 20 year time period.

5.4 Project Area – Stage 1 GFDA

Project Approval is sought for the development of plant and infrastructure for the production of CSG within the Stage 1 GFDA. The Stage 1 GFDA extends from the south, near the township of Craven, to north of Stratford, encompassing an area of approximately 50 km^2. As discussed in **Chapter 1**, development within the Stage 1 GFDA would form the first phase of a staged approach to the wider development of the Concept Area. Up to 110 indicative well site locations are proposed for the Stage 1 GFDA, and are shown on **Figure 5.2**.

Key construction components of the proposed development within the Stage 1 GFDA for which Project Approval is sought include the following:

- Upgrade of existing roads and tracks as required and construction of new internal access roads. Property access including formation of new and existing roads would be undertaken in consultation with the landowners;
- Preparation and construction of well site locations, including establishment of construction hardstand;
- Drilling of wells, geophysical logging, cementing and casing;
- Well completion, including but not limited to under-reaming and fracture stimulation if required;
- Production, including installation of surface infrastructure at the wellhead;
- Installation of underground gas and water gathering systems; and
- Rehabilitation of the construction well site to a reduced area as required for gas production and ongoing operations.

The location of well sites within the Stage 1 GFDA has been based on a notional 600 x 600 m grid pattern, within which an environmental envelope approach has been adopted to position individual indicative well locations within the grid pattern. The environmental envelope approach assesses environmental constraints and potential impacts within each grid square, with the final location of well sites then determined on the basis of geological considerations, environmental constraints and landowner preferences. The environmental constraints analysis within the Stage 1 GFDA envelope is shown in **Figure 5.4**. By assessing impacts and defining constraints within each grid square, or ‘envelope’, flexibility is preserved in relation to final well locations.

Each grid square is located back to back so in effect, the entire grid becomes one larger environmental envelope. This approach would allow the Proponent a maximum degree of flexibility during the implementation of the Project for the selection of well sites, and would allow for issues arising during detailed design and construction to be accommodated while retaining certainty in the prediction of environmental impacts.

Project Approval is sought for the larger environmental envelope (including locational principles which are described in **Section 5.2** above but which apply to this Project Application) and the indicative well locations described above. Final well site location selection would be in accordance with the environmental envelope assessment approach based on the constraints analysis in **Figure 5.4** and the results of this EA.

The proposed construction and operational activities for each of the above key components forming part of the Project Application are detailed in the sections below.

5.4.1 Well Site Location Selection

The indicative well site locations have been based on a notional 600 x 600 m grid pattern within the overall environmental envelope. Given the complexity of potential social and environmental constraints such as land use, noise impacts, topography, geology, proximity of residences, and sensitive environmental features, the environmental envelope approach has been selected to provide maximum flexibility for the final location of well sites within each grid square. At wellhead locations within the notional grid pattern there would typically be one well head at each location, however where geological and environmental constraints allow, up to four wells may be co-located at each indicative well site location.

The environmental envelope approach in this EA would provide a high degree of certainty of social and environmental constraints and potential impacts, such that final well site locations within the environmental envelope could be determined prior to construction based upon consideration of the findings of the EA.

The activities involved for construction of wells (under both Concept and Project Approval) are described below. Once the well is completed, the construction area is reduced to an area of typically 15 m x 15 m for a single well head and up to 40 m x 15 m for multiple well heads at one location, with the remaining area rehabilitated. The final well compound area (within the 15 m x 15 m hardstand area) would be 6 m x 4 m for a single well head and up to 18 m by 12 m for multiple well heads at one location and would be fenced for security purposes. An example of a typical operational production well is provided in **Figure 5.15 (Photograph 1)**.

5.4.2 Preparation and Construction of Well Site Locations

The preparation and construction of well sites would be undertaken within a construction footprint of up to 8,100 m^2 (typically 90 m x 90 m) per well and would be delineated with stock proof fencing to limit the extent of site disturbance. The construction footprint would incorporate access to the centre of the site, stockpiling and storage areas, and allow space for plant and equipment to be manoeuvred on site. Upon commencement, the construction hardstand area of approximately 4,225 m^2 (65m x 65m) would first be established within the construction footprint. A typical construction footprint site layout is shown in **Figure 5.3**.

Site preparation and construction works at well site locations within the construction footprint would generally include the following works:

- Removal of topsoil and establishment of topsoil stockpile area;
- Installation of environmental controls, stock proof fencing and silt fences;
- Installation of a lined ground sump to capture run-off from the site;
- Upgrade or installation of access roads, if required;
- Earthworks as required on a site-specific basis (where appropriate, form a flat operating area for drill pads located on slopes. This generally includes an up-slope diversion drain around the site to manage surface runoff, with the profile returned as near as possible to the original profile during rehabilitation);

- Placement of temporary hard surface, such as gravel with approximately 0.3 m depth, within construction compound for vehicle access and drill pad;
- Levelling and grading within construction footprint for placement of the drill rig;
- Installation of storage tanks at each well site for the storage of drilling fluids; and
- Rehabilitation of the surplus construction area surrounding the permanent hardstand wellhead at the completion of construction.

A flow chart indicating the well construction and establishment activities and indicative timeframes is shown in **Figure 5.5.**

5.4.3 Drilling

Drilling activities are those subsurface procedures for the construction of the subsurface well. These drilling activities include the drilling process, well casing, and borehole logging.

A range of technologies are available for drilling of wells, providing some flexibility within land access and environmental constraints, and geological conditions. While drilling would typically be vertical drilling, directional and horizontal drilling techniques may also be employed where appropriate to individual locations.

The drilling processes and associated activities are described below, and shown on **Figure 5.6.**

Drilling Techniques

Typical drilling technologies currently utilised in the industry are described below.

- **Vertical Drilling:** Drilling of vertical wells would be undertaken using a drilling rig. Drill rigs may include equipment for the following: raising and lowering drillpipe in the borehole; air compressors and pumps for the circulation of drilling fluids; and blow out prevention. Well depths are anticipated to be up to 1000 m below the ground surface, but would vary at each well site dependent on the location of the CSG resource at different locations.

  The boreholes would be drilled utilising either a circulation fluid of water with appropriate additives to improve wellbore condition, or pressurised air. Where water is the drilling fluid adopted, approximately 60,000 - 80,000 L of water per borehole would be required to initially fill onsite tanks, and a similar additional amount may be required during the drilling to maintain circulation fluid levels.

  Water based drilling fluids would be contained in a series of tanks at each well site. Water would be delivered to site either via tanker, or utilising water gathering lines.

- **Directional or Horizontal Drilling:** These techniques allow the targeting of reserves that are difficult to access utilising vertical drilling due to surface or subsurface constraints. In addition the techniques may allow multiple wells to be drilled from a single surface location.

  Directional drilling requires similar surface equipment to that required for vertical drilling, though downhole directional drilling equipment is added to allow control of the drilling angle and direction, dependant on underground geology.

The proposed development of the Stage 1 GFDA is based upon vertical drilling in most circumstances, as undertaken for the Stratford Pilot Project.

Drill Cuttings Management

Management of drill cuttings following well construction activities would be dependent on the method of drilling. Where pressurised air is used in the drilling process, drill cuttings would be buried in an excavated pit within the construction footprint of the well site location. This would be below the root zone of crops and other species that would be used in revegetation.

Where mud drilling is undertaken mud fluid and drill cuttings would be stored in tanks at the well head. The mixture would be separated and fluid would be transferred to the storage ponds on the Tiedeman Property or the CPF in tankers for treatment and disposal, while the remaining solids comprising drill cuttings would be buried within the construction footprint at the well site as per the option described above.

5.4.4 Well Casing

Typical vertical well design would include:

- Drilling and installation of conductor casing from the surface to the base of the alluvial sediments where bedrock is encountered. The depth of this casing may range from less than 1 m up to approximately 50 m in depth. The annulus of the casing would then be filled with cement and left to set.
- Drilling and installation of a surface casing within approximately the first 10% of the proposed total depth of the well. The annulus of this casing would then be filled with a cement and left to set. The purpose of this casing is to isolate shallow formations and provide structural support for the remaining surface and subsurface equipment to be installed on a well.
- Installation of a production casing (post-borehole geophysical logging) within the surface casings to the total depth of the well which is pressure cemented to seal the well. The steel casing and cement would isolate aquifers and other formations that may be encountered during the drilling process. This would ensure that there would be no interaction between aquifers or strata and the targeted coal seams, and would ensure no cross-contamination between aquifers. The tubing, rods and pump required for extraction would then be placed within this casing once well completion has been carried out.

Cementing and casing may be required to be continued beyond typical construction hours in order to ensure the integrity of the wellbore.

5.4.5 Borehole Geophysical Logging

Once the borehole has been drilled, geophysical logging would be undertaken to record strata characteristics. The results of the logging allows for targeted gas extraction from only applicable strata (i.e. coal seams). Geophysical logging would involve the lowering of special purpose probes into the boreholes to record strata characteristics. The drilling rig may remain on the site during logging operations. Geophysical logging would be undertaken over a two day period for each well site once drilling has been completed. To ensure the integrity of the logging procedure and the wellbore, it may be continued beyond typical construction hours.

5.4.6 Well Completion

There are a range of well completion techniques which can be employed to establish production of gas comprising:

- Perforation and fracture stimulation; and
- Under-reaming.

Both of these methods would be considered for the completion of wells in Stage 1 GFDA. The existing pilot wells were perforated and fracture stimulated.

Perforation and Fracture Stimulation

Perforating operations would be carried out by specialised service companies, and the number and location of perforations would be dependent on the results of the geophysical logging.

Perforation is required to allow communication between the production casing and the target zones. In cased hole completions, the well would be drilled down past the formations desired for production and would have a casing or a liner run in, isolating the formation from the well bore. Perforating involves lowering in perforating guns, which is a string of shaped charges, down to the desired depth and firing them to perforate the casing. A typical perforating gun can carry many dozens of charges. There are other methods that may be employed to establish communication between the target zones and the casing. Commonly, perforation guns are run on wire -line as it is traditional to use electrical signals from the surface to fire the guns.

Specialized coil tubing rig may also be utilised to slot the casing at the coal seams instead of perforation. This involves running a specialized steel pipe to the required depth and injecting a mixture of sand and water at high pressure which cuts slots into the steel casing at the coal seams to allow access to the CSG resource for the purpose of fracturing

The well may be stimulated by a number of techniques, referred to as hydraulic fracture stimulation, or ‘fraccing’. Hydraulic fracture stimulation involves the injection of a stimulation fluid (typically water based), and sand into selected zones at high pressure. This technique widens paths in the coal seams to provide a conductive path for gas to flow freely to the well. The frac sand is locked in place by the pressure within the coal formation, while the injected and produced water is allowed to flow back to the well for pumping to the surface. As the water is removed, the resulting drop in reservoir pressure enables the gas to begin to desorb from the coal and flow to the wellbore.

Fracture stimulation would occur over three to four days for each well site including establishment and set up of equipment, however the actual fracture stimulation process would only take three to four hours, (dependent on number of targeted zones), and would be carried out by specialised oilfield service companies. Well casings would be pressure tested and if required the integrity of the cement bond behind the well casing would be evaluated by running a cement bond log (or similar) prior to fracture stimulation operations. The well also requires a work-over to clean the wellbore following fraccing, prior to installation of production equipment.

Under-reaming

Under-reaming is an alternative method of well stimulation for wells drilled conventionally and cased across the seams of interest. The under-reaming tool is run in-hole on a conventional drillpipe and hinged cutting tools are opened through rotation or by applying hydraulic pressure. This stimulation technique is best suited to higher-permeability coals where the reservoir connectivity to the wellbore is restricted due to near wellbore damaged caused during the initial drilling operations and is aimed at maximising the well’s contact area with the reservoir and removing such restrictions.

5.4.7 Drill and Frac Water Management

Drilling and fraccing water would be reused throughout the drilling campaign. Initially, water would be sourced from storage ponds at the Proponent's existing pilot operation site, though it may also be sourced from licensed stand-pipes or other approved sources within the local area.

During fraccing campaigns, a number of options for sourcing frac water would be available, including:

- Transfer of water from storage ponds at the pilot operation site via the water gathering system or tankers;
- Transport of potable water via tanker to well site locations; and
- Transport of water via tanker from local landowners to well site locations (where available).

The installation of the gas and water gathering system would enable water for fraccing campaigns to be transferred from existing storage ponds to individual well site locations via these water gathering lines during construction (prior to the commencement of production). The water gathering system could also be used to transfer water between the well site locations as required, where it would be stored in above-ground tanks for use during well construction, completion, workover or other well site operations.

Where water tankers are required to transport water to storage tanks at well site locations within the Stage 1 GFDA, vehicle numbers would be in the order of 100 tankers per well site (assuming an average capacity of 25,000 L), which would be distributed over several days.

Following the completion of drilling and fraccing activities, water would be removed from storage tanks at the well site via tanker for storage in ponds at the pilot operation site or via the gathering system.

5.4.8 Site Reduction and Initial Rehabilitation

Following completion of these activities at each well site, the construction compound would be reduced from 90 m x 90 m to approximately 15 m x 15 m. The initial construction compound area surrounding the hardstand area would be rehabilitated.

The final well compound area (within the 15 m x 15 m area) would be approximately 6 m x 4 m and would be fenced for security purposes. Screening and landscaping would be provided where appropriate, in consultation with landowners and with consideration to future land use. Vegetation species endemic to the local area would be used. **Figure 5.3** provides an indicative site layout indicating the final well site layout.

5.4.9 Production

Following completion of wells, dewatering would commence. Dewatering the coal seam lowers reservoir pressure that gradually releases the methane adsorbed on the coal seam. Commissioning may require production of produced gas and water initially on site for a short period prior to connection to the gas and water gathering system. The gas would be burnt in an enclosed flare and water would be pumped into an enclosed tank. Gas would be produced into the gas gathering system as soon as practical dependant on the condition of the well to ensure efficient commissioning practices are maintained to maximise gas production.

Extraction of gas from the coal seams targeted by this project is expected to result in the production of formation waters from the coal seams. Wells may be installed with downhole pumps to enable water collected in the bottom of the borehole to be pumped to the surface and to the water treatment facility.

The following plant and equipment may be installed at each well site, and is likely to remain throughout the operational life of the well:

- Progressive Cavity Pump (PCP) powered by a well head mounted drive head controlled by a variable speed drive (VSD);
- Electric Submersible Pump (ESP) with electric connection down hole controlled by surface VSD;
- Skid-mounted control system that controls the VSD and performs gas metering calculations and wellhead shutdown valve control;
- Rod-insert or tubular pump hydraulic ram assembly installed on the wellhead powered by onsite hydraulic skid;
- Carbon steel gas piping connection to the gas gathering system, including:
  - Wellhead isolation valve or ratigan (pump blow out preventer) depending on well completion;
  - Wellhead shutdown valve configured to close on process fluctuations (pressure, flow & level) as determined in the Hazard and Operability Study (HAZOP);
  - Wellhead control valve (manual choke or automatic positioned flow control valve) to control well pressure / flow as determined in the HAZOP;
  - Wellhead 2-phase separators to remove free water from the gas;
  - Full flow relief valve sized for full wellhead gas flow; and
  - Gas flow meter for measuring wellhead gas flowrate.
- Carbon steel liquids line, including the following:
  - Isolation valve;
  - Waterflow meter; and
  - Pump to deliver water to the treatment facility through the water gathering system.
- Onsite tank to collect produced water for disposal through the water gathering system or through truck.

Electricity supply would be required at the wellheads to operate the surface facility pumps. Electrical supply would be either small power generators and hydraulic skids (either separate or integrated) or connection to mains power. Power generators and hydraulic skids would remain on site as long as dewatering of the well is required. This would depend on the quantity of water produced by the well.

A typical well site layout upon completion of production is shown in **Figure 5.3**. A photograph of a typical well site showing typical well head infrastructure is shown in **Figure 5.15 (Photograph 1).**

5.4.10 Field Infrastructure

Field infrastructure for the Stage 1 GFDA primarily incorporates the gas and water gathering system. The gas and water gathering system would collect gas and water produced at well sites. It would comprise two separate gathering lines for the collection of gas and water produced by wells, respectively, installed in trenches generally running alongside access roads. A third water line may be installed to transport water back to the well sites for fracture stimulation activities.

Gas Gathering System

Gas gathering lines would connect well sites to four main spine lines within the Stage 1 GFDA, which would transport produced gas from well sites to the CPF. The gas gathering system (gathering lines and the main spine lines) would be constructed in accordance with *Australian Standard AS 4130:2009 Polyethylene (PE) Pipes for pressure applications*, and would be buried at a minimum depth of 750 mm. The indicative location of the gas gathering system is shown in **Figure 5.7**.

Surface marker posts would be placed at bends and at intervisible positions not more than 250 m apart to assist with identifying the location of the gathering system.

Construction of gas gathering lines (for both Concept Plan Approval and Project Approval) would typically involve the following work:

- Survey of pipeline corridor;
- Clear and grade ROW pipeline corridor including stripping of topsoil (where required);
- Stringing of pipe;
- Welding of pipe;
- Trenching and under-boring, where necessary;
- Lowering in of pipe strings (including trench preparation and padding);
- Installation of tracer lines to enable future pipe detection (as PE 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
- Registration of gas gathering line on “Dial before you dig”.

Low water traps would be installed in low areas of the gas gathering system to enable removal of water that may collect. These would be emptied into a container as required to prevent runoff to any watercourse.

Water gathering system pressure relief valve would be installed to relieve pressure caused by residual gas from the water gathering system into the gas gathering system. This arises from solution gas bubbling out of the water phase that hasn’t been removed in the well site separators.

The gas gathering system would be inspected annually utilising gas detection equipment capable of performing a leakage survey of below ground pipelines. The survey would be conducted at a sensitivity of 10 parts per million (PPM), reflecting the capability of detection equipment. This level does not arise from Australian Standards, but is considered industry best practice.

In the event of unexpected additional production raising operating pressures of the gathering system, sections of the gathering system may have to be looped (lines running in parallel). This would involve modifications to the gathering system adjacent to the existing underground gas line.

Water Gathering System

The water flow rate and volume varies with both location and time, but cumulatively it is expected that water volumes of up to 2 megalitres (ML) per day may be produced from the Stage 1 GFDA, although these levels are then likely to reduce over time.

Construction of water gathering lines would typically involve the same stages identified above for gas gathering lines. Water gathering lines would be constructed of polyethylene pipe and, where possible, would be co-located in the same trench as gas gathering lines.

The water gathering system would connect well sites during production and operation to water storage ponds at the Tiedeman property and at the CPF. Depending on the water volumes encountered during production additional water storage may be required. Additional storage ponds could be developed at the Tiedeman property. Water produced by the wells in the Stage 1 GFDA would then be transferred from well sites to the water storage ponds for treatment. The indicative location of water gathering lines is shown on **Figure 5.7**. Treatment of produced water is discussed in **Section 5.5.4**.

Electricity Supply

Electricity supply is required to be connected to the well heads. Electricity supply to the well heads would initially be provided via small power generators and hydraulic skids (either separate or integrated). Electricity may be generated and supplied via the CPF, or alternatively taken from the existing electricity distribution network operated by Country Energy. Well site electrical supply would be further investigated and the final supply approach would be confirmed during detailed design.

Rehabilitation

The preferred method of removal/rehabilitation for the gas and water gathering system at the completion of the Project would be to purge with air or water to remove remaining gas/water, prior to sealing the pipeline and leaving it in place to prevent further disturbance. This approach would be subject to consultation with the landowner. Should removal of the gathering lines be required, the excavated trench would be backfilled and rehabilitated, including contouring and revegetation as appropriate.

5.4.11 Site Access

Access routes to well site locations within the Stage 1 GFDA would be via existing roads and tracks, where possible. Where new access roads are required, these would be constructed along fence lines where possible, however the alignment would be determined in consultation with landowners to determine the most beneficial location. Existing roads and tracks which would be utilised, and proposed access routes to the indicative well locations that would be constructed as part of the Project are shown on **Figure 5.8.**

During the preparation, construction and drilling of well sites, plant and equipment would remain within the Stage 1 GFDA, and would utilise public and private roads and constructed routes to access well sites.

5.4.12 Plant and Equipment

There would be up to 62 vehicle movements per well associated with the mobilisation of equipment from one well site location to another (in addition to the arrival / departure of the rig and equipment) for the drilling phase of the Project of up to 110 wells. Mobilisation would be primarily via the internal access tracks within the Stage 1 GFDA, however there may be a need for equipment to be moved a short distance via the local road network to access certain well sites. The estimated traffic movements generated by the drilling, construction and operational equipment are provided in **Table 5-2**.

Table 5-2: Estimated Traffic Movements

Equipment	Estimated Traffic Movements
Drilling rigs	8 – 12 trucks per well location for initial equipment mobilisation (it is noted that wells would be developed gradually over a minimum 18 month period, not simultaneously)
Frac equipment	14 trucks per well location
Frac tanks	14 trucks per well location
Water (if not transported via gathering system) tankers for stimulation operations	100 trucks per well
Water tankers	Up to 8 – 10 tankers operating across several well sites
Cementing equipment	8 trucks per well location
Production equipment	4 trucks per well location
Personnel vehicles	4 - 6 per day well location

The following equipment would be required during construction of the gas and water gathering system:

- 2 x bulldozers;
- 2 x grading machines;
- 4 x excavators for trenching and pipe installation;
- 20 x tipping truck and dog combinations;
- 6 x articulated dump trucks (internal road use only);
- 2 x rollers (internal road use only);
- 2 x trenching machines (internal road use only);
- 1 x HDD rig;
- Hand held plant and machinery (compactors);
- Electric generators for fusion welding;
- Fusion welding machines; and
- Water trucks for dust control.

Construction of gas and water gathering lines may involve two or more teams working at different locations. At each location, traffic movements would involve initial mobilisation of the graders, excavators and major plant. Daily movement of personnel may consist of 4 – 6 private vehicles per location, or 1 – 2 buses as required from the temporary construction workforce camp (refer to **Section 5.4.15**).

5.4.13 Construction Hours

Construction works within the Stage 1 GFDA would be completed over a period of 18 months to 5 years dependant upon the development scenario adopted as described in **Section 4.2** with drilling undertaken sporadically throughout this period. Construction hours would be generally 7.00 am to 6.00 pm, Monday to Saturday. Generally construction work would not be undertaken on Sundays or public holidays, however, the following exceptions would be necessary:

- Drilling activities would require work to be undertaken on Sundays, as well as during evening and night time hours. Such activities would be undertaken in consultation with affected landowners and with appropriate mitigation, such as the use of portable acoustic screens, and management measures in place as described in **Section 5.4.3** and **Section 14.6**.
- Fraccing would require work to be undertaken 7 days a week during daylight hours subject to geological conditions. Fraccing at times would be required to extend into the evening as the frac process can not be interrupted once commenced. Scheduling would be required to ensure that adequate daylight is remaining prior to commencing the frac process. Secondary noise controls such as portable acoustic screens would be utilised for fraccing activities where necessary.
- Activities that necessarily require completion outside of normal construction hours for safety or to ensure the integrity of the work, such as well casing, borehole geophysical logging and workovers.
- The delivery of oversized plant or structures that may require special arrangements to transport along public roads.
- Any emergency work that may be required.

5.4.14 Construction Environmental Controls

Construction of project components within the Stage 1 GFDA would be undertaken in accordance with a Construction Environmental Management Plan (CEMP) to manage potential environmental impacts. In addition, the mitigation measures proposed in **Chapters 9** to **25** of this EA in addition to the Statement of Commitments in **Chapter 26** form part of the proposed activities and would be implemented to minimise potential impacts.

Additionally, a site specific Construction Workforce Management Plan would be prepared to address site management principles which would be designed to consider minimise impacts of construction personnel on the local population, while not encouraging the potential economic benefits that the presence of the temporary construction workforce may have on local communities through indirect benefits to the local economy.

5.4.15 Temporary Construction Workforce Camp

A temporary construction workforce camp would likely be required during the construction of well sites and the CPF within the Stage 1 GFDA. A temporary construction workforce camp with capacity to accommodate up to 100 people during peak construction is proposed as part of the Project. The construction workforce camp would be located proximate to the Stage 1 GFDA in order to minimise transport of workers to and from the Stage 1 GFDA and CPF during construction. The location of the construction workforce camp would be determined based on the applicable locational principals described in **Section 5.2** and based on consultation with the relevant landholder. The camp would aim to use existing cleared or disturbed areas.

The construction workforce camp would comprise accommodation, recreational facilities, kitchen, dining and office areas, laydown / service areas and a sewage treatment system. A conceptual construction workforce camp layout is shown in **Figure 5.12**. Potable water would be supplied from nearby existing Hunter Water mains pipes, or alternatively if required, potable water could be transported to the site by tanker.

A transportable sewage treatment unit would be required to treat domestic effluent/sewage. A Sewage Effluent Management Plan (SEMP) would be prepared as part of the CEMP which would detail management measures for the treatment and disposal of sewage from the sites.

5.4.16 Operational Activities

Once the well sites are connected to the gas gathering system and CPF and gas production commences, operational activities at well sites would be minimal. Operational activities that would be undertaken throughout the life of the wells would include routine maintenance of wellhead infrastructure, and maintenance / work-over of wells where required. Routine regular visual inspections of wellheads would be conducted to ensure the well head is in safe working order.

Maintenance / Work-over

It may be periodically necessary to undertake a work-over on wells during their production life in order to maintain the efficiency of gas production. The work-over typically involves a truck or trailer mounted rig and associated equipment required to clear the well bore of fill (typically frac sand) or obstructions. Work-over activities generally require a team of up to ten personnel and may vary between one day and two weeks in duration depending on the extent of the work-over. Workovers would occur over a seven day working week.

Re-completion

It may be necessary to re-complete or re-drill some wells after a period of operation, which may involve similar operational procedures to those undertaken for initial well completion (refer **Section 5.4.6**). This procedure would only be undertaken where a production issue or additional reserves are identified and is therefore unlikely to be undertaken at all well locations over the operating life of the wells.

5.4.17 Well Closure and Rehabilitation

Wells within the Concept Area are anticipated to have a production life of 15 to 25 years, depending on the extent of the CSG resource. Once a well has reached the end if its operational life, wellhead infrastructure would be removed from the site, and the well would typically be plugged and abandoned in accordance with the requirements of the NSW Department of Primary Resources (DPI) (DPI now forms part of Industry and Investment NSW (I&I NSW)). The ground surface would be re-contoured and rehabilitated to a state consistent with the surrounding land use, and in consultation with the respective land owner.

Where wells are installed in an area that may impact future underground mining in ‘mineable’ seams, the Proponent is required by the DPI as part of its title conditions to remove the steel pipe/casing from a potentially mineable coal seam, and to log the location of the well, or leave the wellbore in such a condition that would not adversely affect future mining operations as agreed with the mining company within a Cooperation Agreement. If required, these activities would be undertaken during the closure and rehabilitation phase.

5.5 Project Area – Central Processing Facility (CPF)

The proposed project involves the construction and operation of the CPF with a capacity of 80 TJ per day on average to treat and compress gas produced within the Concept Area to render it suitable for high pressure transport via the high pressure gas pipeline.

The CPF may include the following:

- Up to eight compressor units and associated plant for compression and dehydration of gas;
- Gas Dehydration Equipment;
- Water treatment facility for desalination of produced water;
- Gas Filtration, Regulation, Metering and Analysis Equipment;
- Start, Instrument and Fuel Gas filtration, regulation and metering equipment
- Water treatment facility for removal of oil-in-water emulsion from the process water caused by the compression process;
- Flaring system;
- Network of storage and evaporation ponds;
- Small scale ancillary power generation with a capacity of up to 15 MW;
- Administration and accommodation facilities, and plant control room; and
- Laydown areas for the storage of pipe and equipment.

The two proposed locations for the CPF are shown in **Figure 5.2,** and conceptual site layout plans are provided in **Figure 5.9** and **Figure 5.10** for CPF Site 1 and CPF Site 7 respectively.

The CPF compressor units would primarily comprise reciprocating compressors (or screw compressors) which compress the gas in stages from pressures of less than 100 kPa up to a maximum of 15.3 MPa. The CPF would also process gas to remove impurities such as coal fines and free water. The processes undertaken at the CPF are described in further detail in following sections.

The CPF footprint would incorporate a water treatment facility, which would include a water treatment plant and three storage ponds of up to 25 ML capacity each to store produced water, treated water and the brine waste water respectively. The water treatment facility is described in **Section 5.5.4**.

The CPF footprint would also incorporate a small scale ancillary power generation facility, with a nominal capacity of up to 15 MW. The power generation facility is described in **Section 5.5.5**.

5.5.1 Plant and Equipment

Construction plant and equipment would be delivered to the CPF site at the commencement of construction works, and would typically include the following:

- 1 x bulldozer;
- 2 x graders;
- 2 x rollers;
- 2 x excavators;
- 2 x bobcats;
- 1 x piling rig
- 2 x tip trucks (for transporting imported fill and base course material);
- Welding machinery;
- Electric generators for construction equipment;
- 4 x cranes for heavy lifts;
- 1 x cranes for small lifts;
- 1 x franner for pipe spool placement; and
- 1 x forklift for moving equipment.

Where possible it is anticipated that the plant components of the CPF would be delivered to the Port of Newcastle and transported via road as prefabricated units with assembly undertaken on the site. The following components would be delivered during the construction phase:

- Compressor Units – the compressor units would be transported on low loaders with trucks used for the other equipment. There are up to 8 potential units. Each unit would include the following:
  - 100 tonne central skid on low loaders with escorts;
  - 2 x 50 tonne wing skids on low loaders with escorts;
  - 1 x 30 tonne cooler skid; and
  - 2 x 40 foot containers.
- Dehydration Unit – The dehydration unit would be transported on trucks. The following preliminary equipment sizes have been supplied:
  - 15 tonne contactor weight;
  - 30 tonne regeneration skid; and
  - 15 tonne container
- Five 3 MW power generation units;
- Miscellaneous containers and equipment – on the assumption of three separate delivery trucks per week during the construction phase of approximately 6 months.
- Concrete Trucks – the approximated volume of concrete is 1100 m^3. Assuming the average load is 6-8m^3 per truck this equates to approximately 183 concrete truck deliveries during construction.

The plant components of the water treatment facility would also be largely delivered as prefabricated units to be assembled on the site. Pre-treatment (filtration) and reverse RO units would be delivered and likely contained within standard shipping containers, which would be mounted on a standard concrete slab. Up to three containers would be required. Various pipework, electrical and miscellaneous equipment would also be delivered to site for the assembly stage.

The other major aspects of the water treatment component of the CPF are the produced and treated water storages, as well as evaporation ponds for the waste stream. Three ponds of up to 25 ML capacity each would be constructed using a cut-and-fill approach and would be fully lined with a high density polyethylene (HDPE) liner to prevent leaching. The detailed design and construction of the ponds would be undertaken in accordance with the relevant guidelines.

The first pond would store produced water, the second would store treated water and the third would be for the evaporation of the brine stream. The evaporation pond would be designed as a series of smaller enhanced evaporation ponds. The evaporation pond would contain plastic or polyethylene pipework to transfer waste heat from the compression process to the wastewater, thereby enhancing the evaporation process. At least one pond may also be covered to prevent rainfall diluting the concentrated brine. The total area initially required for the evaporation ponds is estimated at approximately 10,000 m^2 (one hectare), however further expansion areas for water storage ponds have been identified on the CPF site layout plans on **Figure 5.9** and **Figure 5.10**.

5.5.2 Construction Hours

Construction of the CPF would be undertaken over a period of approximately 12 months, with typical construction hours between 7 am and 6 pm, Monday to Friday and 8 am to 1 pm on Saturdays. Construction work may continue with noise restricted activities only after 1 pm on Saturdays and all day Sundays and on public holidays. This would be further detailed in a CEMP and would include restrictions such as no bulk earthworks or heavy equipment to be undertaken during these times.

5.5.3 CPF Operation

The CPF would include the following components:

- Inlet manifold connecting the four spine lines followed by gas filtration;
- Multistage reciprocating or screw gas compression plant;
- Gas dehydration system using a glycol based system to absorb water from the gas;
- Water separation system to remove oily contaminants from process water;
- Produced water treatment plant;
- Bulk liquid storage facilities for liquid chemicals used in CPF processes;
- Flare system for burning off gas in the event of an emergency or a process shutdown;
- Small scale ancillary power generation facility;
- Regulation, metering and analysis equipment;
- Start, instrument and fuel gas filtration, regulation and metering equipment;
- Control room; and
- Office/administration area and staff amenities
- Accommodation facilities.

A process description of each of the plant components comprising the CPF is provided below. **Figure 5.13** presents a schematic flow diagram depicting the treatment and compression process which is described in the sections below.

Gas Compression Plant

The CPF would be connected to the four main spine lines of the gas gathering system via a suction header at the inlet to the gas compression plant within the CPF. Gas would enter at a relatively low pressure (approximately 100 kpa) via an inlet filter vessel, which would remove coal fines and free water from the gas.

Gas would then enter the compression plant, which comprises a reciprocating multistage compressor powered by a gas engine equipped with fan coolers. Gas would undergo up to four stages of compression. At each stage, gas would be heated and compressed, and then cooled and treated by a gas scrubber before the next stage of compression. During this process, dewatering of the gas would occur, and is referred to as interstage dewatering. Water would be transferred to the separation system, discussed below.

Following compression of the gas in the compression plant, compressed gas would be transferred to the dehydration system.

Dehydration System

Following compression, gas would be dehydrated using Triethylene Glycol (TEG). The TEG dehydration system would use TEG to absorb moisture from the compressed gas stream in accordance with the required pipeline specifications. Compressed gas is counter-flowed with dry hot glycol in a contactor column, water vapour is removed from the gas and absorbed by the glycol.

The wet glycol, referred to as wet rich glycol, is regenerated in a tube heater to boil off absorbed water vapour. Once the absorbed water has been removed, the glycol is then reinjected into the contactor vessel for re-use.

Process Water Treatment System

Water captured during the processes described above may become mixed with oil from the plant and equipment used in each of the processes. The purpose of the separation system is to separate oil and water, with oil to be stored for transport offsite to be recycled, and water transferred to the water treatment facility. Water collected from the inlet filter vessel, interstage scrubbers during compression, and the discharge filter from the dehydration system would be connected to the separation system.

The separation system would include:

- Distribution pipework for connecting the vessels to the separator;
- Separator vessel designed for oil water separation;
- Clean water connection connected to the water processing facility; and
- Connection to oil storage tanks for transport offsite and recycling.

In the event that severe emulsions are generated, a specialised waste water treatment facility would be installed. Such a plant would break down an oil-water emulsion by utilising a chemical that, when activated, binds oil and flocculates, generating treated water suitable for disposal. The waste chemical-oil residue is suitable for disposal at a landfill facility, and has been successfully trialled at other AGL operations.

Flare System

The CPF would be connected to a flare system, which would connect the compressor station suction and discharge pipework and the compressor blowdown. The flare system would allow gas in the gathering system and CPF to be burnt, or 'flared' in the event of an emergency that requires the evacuation of gas from the system. Scheduling of maintenance and production outages would be planned and timed to minimise the amount of gas flared. Due to the difficulties in shutting down the CSG wells it is expected that some flaring may be required to accommodate routine maintenance activities.

Flaring of the entire plant would only be required in the unlikely event of a process malfunction or emergency shutdown situation where the wells need to remain on production. Flaring is a controlled system and in the event of a prolonged shutdown (greater than 24 hours), the gas wells in the field would be shutdown, eliminating the need for further flaring. Testing of emergency shutdown procedures (involving flaring of the entire plant) would be undertaken on average once per year.

Control Room

A control room would be located on the CPF site containing the Supervisory Control and Data Acquisition (SCADA) interface for field, pipeline and compressor station telemetry. Field telemetry comprises equipment monitoring gas flow, water flow and downhole pressure. This information is transmitted via a radio link back to the CPF control room. This allows for monitoring of well behaviour, assists with production optimisation and gives improved operational response in the event of an emergency. Various data from the CPF and pipeline would be captured by the SCADA system to allow safe operation of the facilities.

Bulk Liquid Storage

The CPF would provide suitably bunded areas for the storage and containment of the following liquids used at the CPF:

- Compressor lube oil – up to 20,000 litre tank above ground in a bund;
- Engine oil – up to 20,000 litre tank above ground in a bund;
- Waste oil tank – up to 20,000 litre tank above ground in a bund; and
- Chemical storage area - 44 gallon drums or Intermediate Bulk Containers of glycol in a bunded enclosure with a roof and storage for up to 15,000 litres of glycol.

Administration Facilities and Accommodation

The CPF footprint includes general administration/office facilities (refer **Figure 5.9** and **Figure 5.10**). Additionally, as the site would be attended 24 hours a day, the layout also includes accommodation facilities.

5.5.4 Water Treatment Facility

As previously discussed, the Project is anticipated to result in the generation of up to 2 ML per day, at peak, of produced water during the extraction of CSG from the Stage 1 GFDA. A water treatment facility would form part of the CPF to treat produced water from the Stage 1 GFDA. The treatment process and technology would be finalised during the detailed design phase, but the key phases of the treatment process are likely to include:

- Produced water storage;
- Pre-treatment (if required);
- Desalination; and
- Disposal of the concentrated brine waste stream.

A conceptual process flow diagram for the treatment of produced water is shown in **Figure 5.13** and described below.

Produced Water Storage

Produced water collected from the wellheads would be transferred to storage ponds through water gathering lines. Produced water storage for some 40 ML of produced water exists at the Stratford Pilot Project on the Tiedeman property, which would be utilised as part of the Project. An additional balancing storage pond may be required for produced water, and would be constructed at the CPF site and at The Tiedeman Property, depending on water production rates and operational storage requirements.

Pre-treatment

Pre-treatment may be necessary to ensure the processing efficiency and protect the integrity of membrane desalination processes such as RO. Pre-treatment would likely comprise a process such as ultrafiltration (UF) or similar, which would remove suspended solids from the feedwater. Chemical dosing may be necessary at this point to cause flocculation of certain constituents for their removal. The preferred method of pre-treatment is heavily dependent on feedwater quality and chemistry, and would be determined following detailed process engineering at the design phase.

Desalination

Various technologies exist for desalination of brackish water, including membrane-based processes such as RO; thermal processes such as distillation; and alternatives founded on exchange of charged ions, such as EDR or CDI.

RO is widely used and currently considered most suited to the anticipated flows and quality of produced water in the Gloucester Basin. RO is a proven process for the removal of dissolved solids from brackish or saline feedwater. The process uses high pressures to ‘force’ water through semi-permeable membranes, leaving behind the ions. The process results in a clean water stream, known as permeate, and a concentrated brine waste stream. Given the high quality of the permeate, it may be optimal to partially blend the treated water with the original feedwater, while still meeting quality requirements.

RO produces high quality water as permeate, with recovery of up to 70-80% of the feedwater likely to be achieved. The RO process is likely to ultimately have a capacity to treat 2 ML/d, however as the technology is scaleable and modular, this is likely to be installed in 1 ML/d increments as required.

Evaporation of the Concentrated Waste (Brine) Stream

Regardless of the desalination technology adopted, the process would result in a concentrated wastewater (brine) stream which would require disposal. A number of alternative options for the evaporation of the waste stream have been considered for the Project, as detailed in **Chapter 4.** The preferred approach would involve the evaporation of the wastewater stream in an open air basin / brine pond, with evaporation further enhanced by using waste heat from the gas compressors at the CPF to heat the brine in the pond. Initial modeling has shown that with an average of 10 MW of heat applied to the brine evaporation pond, the pond would need to be approximately 100 m by 100 m (i.e. 1 ha) for 250 m^3 / day of RO concentrated brine to be evaporated (GHD, 2008). This preferred option would be subject to further detailed design to ensure that the size of the pond would be sufficient to accommodate the anticipated concentrated brine waste stream.

Zero-liquid discharge (ZLD) technology presents a viable alternative to evaporation ponds. This is likely to include a Brine Crystal Concentrator (BCC) – which uses mechanical evaporation processes to further concentrate the brine – followed by a Crystalliser that evaporates any remaining water and produces a salt crystal product. Opportunities to utilise waste heat captured from the CPF would also be explored for this alternative.

Detailed engineering design is required to confirm the viability of the preferred approach for enhanced evaporation ponds to be constructed. The implications of each alternative are discussed further in **Chapter 4**.

Disposal/Use of Salt/Treated Water

The treatment of produced water would primarily result in two products – treated water (permeate) and salt. It is anticipated that there would be local demand for the treated water, most likely for irrigation of existing farm practices, though potentially for new, high-value horticultural applications. In order to facilitate this end-use, treated water would be of a quality suitable for irrigation in accordance with relevant guidelines. AGL is working with a local community group to investigate beneficial uses for the treated water.

Storage for the treated water would be required, and may be necessary to facilitate delivery of treated water to customers. A storage pond with a nominal capacity of 25 ML would be constructed at the CPF site to store treated water from the process.

The treatment process would result in the production of up to three tonnes of salt per day. The extent of salt production depends on quality and quantity of the feedwater. At a flow of 2 ML per day and TDS of 2000 mg/L, for example, some 3 tonnes of salt per day may be produced (depending on final treated water quality). A storage shed would be necessary to stockpile the salt and a loading point for its removal from the site. It is assumed that one to two truck loads per week (removing some 20 tonnes each) may eventually be required for salt transport.

Options for disposal of this salt are currently being investigated. In the event that the salt cannot be utilised, it would be disposed of in an appropriately licensed landfill facility. However, it is hoped in the longer term that the salt may either be transported to a salt producer for further processing, or processed locally into saleable products. Consideration in detailed engineering design would be given to adjusting the treatment process to limit the contamination of the salt product so the opportunity for its processing/re-use is maximised. Opportunities in this regard would continue to be pursued into the future.

5.5.5 Ancillary Power Generation Facility

A small scale ancillary power generation facility is proposed within the CPF footprint. The ancillary power generation facility would comprise up to five 3 MW power generator units, with a total capacity of up to 15 MW. The power generator units would be gas-fired generators that would be driven by gas produced by the Stage 1 GFDA (refer **Figure 5.9** and **Figure 5.10**). Any surplus power generated would be fed into the national electricity grid.

The ancillary power generation facility would be used for the purpose of providing power to plant such as the Water Treatment Facility at the CPF site. It is proposed that where possible, gas produced during the commissioning of well sites would be transported to the power generation facility and used for the generation of electricity rather than being flared for a short period at well sites.

5.5.6 Hours of Operation

The CPF and associated plant and infrastructure would operate 24 hours per day. Operational personnel would generally be on site between the hours of 7 am and 5 pm. During typical operation, approximately 30 AGL staff and contractors would be on site during this period. Outside these hours one to two plant operators would attend the plant in the control room or have process alarms and emergency phone calls routed to the onsite accommodation with the on duty plant operator being continuously on call. Additionally, during operational shutdowns for maintenance or other events, operational personnel may be required to be on site 24 hours per day for short periods.

The CPF would be fitted with a 2 m high security fence. The compound would be fitted with a range of security design measures which would include alarm systems and movement detection sensors connected to the SCADA system which would alert the control room of unauthorised activity.

The lighting installed at the CPF facility would be designed in accordance with Australian Standard *AS 4282(INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting*. External lighting and components would be mounted, screened, and directed in such a way so as not to create a nuisance to the surrounding environment, properties and/or road users.

5.6 Project Area – Pipeline

5.6.1 Overview

Project Approval is sought for the development of a gas transmission pipeline within an assessed 100 m wide corridor running from the CPF through to the HDS at Hexham. The gas transmission pipeline would be constructed within a 30 m ROW within the 100 m wide pipeline corridor.

The selection of the preferred pipeline route involved an assessment described in **Chapter 4** which considered the following criteria:

- Threatened flora and fauna species;
- Protected areas such as National Parks;
- Avoidance of areas with trees including isolated clumps and significant trees where possible;
- Major topographical constraints (e.g. geology, acid sulfate soils, steep areas, erosion potential, elevated ground water levels, watercourses);
- Heritage Issues (Aboriginal and non-Aboriginal);
- Land use (existing and future) and legislative constraints;
- Building and infrastructure;

- Social impacts;
- Length of pipeline – the shortest length usually being the most efficient and economical; and
- Existing easements – utilised where possible as they provide a corridor with pre-existing encumbrance to the land, minimising the impact to the land use and development potential.

Land owner consultation, ground truthing and aerial surveys of the route were undertaken to further refine the pipeline route.

Development of the pipeline would comprise the following key steps, detailed in the following sections:

- Site preparation;
- Construction;
- Operation.

5.6.2 Site Preparation

Site preparation works would typically comprise the following:

- Survey of pipeline route;
- Clearing;
- Grading; and
- Trenching and earthworks.

Survey of Pipeline Route

The pipeline route would be initially surveyed to demarcate the clearing width along the corridor. Survey stakes would be placed at inter-visible locations either side of the clearing corridor to ensure the designated work area is only disturbed. Environmentally sensitive areas would also be marked out and clearly identified and protected with high visibility temporary barricading.

Clearing

Clearing of vegetation within the ROW for the pipeline route would be undertaken where necessary using graders and bulldozers. The ROW would typically require a width 30 m with cleared vegetation that stockpiled on the non-working side of the ROW. A conceptual schematic ROW layout is provided in **Figure 5.14**. A reduced ROW of approximately 15 m to 20m may be utilised in areas with particular constraints, such as ecologically sensitive areas and river crossings. A conceptual schematic of a reduced ROW layout across a watercourse crossing is provided in **Figure 5.14** and shown in **Figure 5.15 (Photograph 2).**

Large trees away from the trench line (but within the ROW) would be cut off at ground level to preserve the root stock and thus assist with soil stabilisation and enhance natural regeneration.

Grading

The ROW would be graded, where required, to provide an even, safe working area for pipeline construction. This would involve the removal of topsoil, and possibly sub-soil in some areas, along the ROW and at the temporary laydown areas. Topsoil is typically removed from the trench area only to a depth of 100 to 150 mm and would be stockpiled adjacent to the cleared vegetation on the non-working side of the ROW as shown **Figure 5.14**. Excavated sub-soil would be stockpiled separately to the topsoil (see **Figure 5.15**, **Photograph 3**). Erosion control measures would be installed where required to ensure the stockpile is not eroded or diminished, and that the seed stock and nutrients necessary to promote regrowth are retained.

Trenching and Earthworks

A trench would be dug with the use of a specialised bucket wheel trencher or chain trencher. The trench would be dug to allow for a minimum depth of cover to 750 mm. The depth of the trench may vary according to the nature of the terrain (e.g. rock and watercourse crossings), its proximity to infrastructure and buried utilities and the land use of the area. Excavated soil would be stockpiled along with the sub-soil material from the grading process (see **Figure 5.15, Photograph 4**). A number of environmental safeguards would be implemented regarding the management of soil stockpiles including erosion and sedimentation controls, and rehabilitation procedures. Soil management is further discussed in **Chapter 17**.

5.6.3 Construction Process

Construction of the pipeline would typically comprise the following components:

- Pipe stringing;
- Bending and welding;
- Radiography and joint coating;
- Cathodic protection;
- Padding;
- Lowering-in and backfilling;
- Hydrostatic testing;
- Clean up and rehabilitation; and
- Commissioning.

Pipe Stringing

High pressure steel pipe lengths of up to 18 inch diameter and 12 or 18 m length would be delivered to the site by flatbed trucks after clearing and grading. The pipes would be unloaded and lined up along the pipeline route in preparation for welding. The pipe lengths would be placed on sandbags and raised on blocks of wood (timber skids) to facilitate subsequent handling and to protect the pipe from corrosion and coating damage.

Special pipeline handling procedures would be instigated if the studies on the effects of stray currents and touch potential indicate there is a potential risk of electric shock at locations where the pipeline is in close proximity to high voltage powerlines. This is discussed in **Chapter 15**. These handling procedures including earthing the pipeline, equipotential mats, gloves and boots rated for high voltage insulation.

Bending and Welding

Pipe lengths may be bent using a hydraulic bending machine, where necessary, to account for either changes in elevation or direction of the pipeline route. Pipe lengths would then be welded into continuous lengths of up to one kilometre, known as pipe strings. Pipe strings would be earthed to the ground using earthing stakes as well as the measures mentioned above for pipe stringing in areas identified as having increased risk of high voltage shocks.

Radiography and Joint Coating

Each weld would be inspected using x-ray or ultrasonic equipment as per AS 2885.2. Where a weld is found to be non-conforming, the joint is either removed or repaired and re-tested to confirm that it conforms. The surface of the welds would then be cleaned by grit blasting or wire brushing and a protective coating applied to each weld to inhibit corrosion.

Cathodic Protection System

The pipeline would use an impressed current cathodic protection system designed in accordance with AS2832.1. Cathode Protection test points would be installed at approximately 1.5 km intervals and would be fitted with equipotential grids for personnel protection. Where the pipeline comes above ground into the CPF and the HDS, the pipeline would be electrically isolated from the station pipework utilising monolithic insulation joints fitted with surge protection. The station pipework would be earthed.

Padding

Padding involves placing fine material at the base of the pipe trench prior to the placement of the pipe and to pad around the pipe for protection against abrasion prior to backfilling the pipe trench (see **Figure 5.15, Photograph 5**). Padding machines would be used to sift the excavated trench subsoil back into the trench, removing coarse material. In some instances (e.g. very rocky soils) imported sand may be used for bedding and padding as a padding machine may be unable to provide adequate padding.

Lowering-in and Backfilling

The welded pipe string would then be lowered into the trench using side-boom tractors and/or excavators (see **Figure 5.15, Photograph 6** and **7**). It may be necessary to dewater the trench prior to pipe laying if rainwater or groundwater from a shallow aquifer has accumulated in the trench.

Impermeable trench blocks (otherwise known as trench or sack breakers) may be installed after lowering in and prior to backfilling to control water movement along the backfilled trench line. These are commonly installed adjacent to watercourses, on steep slopes and where drainage patterns change. Trench spoil is then returned to the trench and material compacted to eliminate the likelihood of soil subsidence over the pipe.

Hydrostatic Testing

Hydrostatic testing would be performed to assess the integrity of the pipeline according to AS 2882.5. Prior to the testing, the pipe test section would be capped with test manifolds. The pipe string would then be cleaned (i.e. flushed with water), gauged, filled with water and then subject to a strength test as per AS2885.5. The pipeline would then undergo a leak test for a period between 24 and 72 hours. The pipeline would have a maximum allowable operating pressure (MAOP) of between 10.2 and 15.3 MPa during its operation.

The pipeline may be tested in multiple sections. This would relate to water availability as well as the pipeline elevation profile. The pipeline may be hydrotested in separate test sections if the elevation profile is significant and the static water head pressure is higher than the maximum allowable test pressure. The total volume of water for a single test section would depend on the size of the pipe, and would vary from 5 ML to 15 ML. Equipment and piping for pumping, testing and water transfer would be temporarily located at either end of each test section, as required.

A hydrostatic test plan would be developed and would form part of the CEMP for the construction of the pipeline.

Clean-up and Rehabilitation

The final major stages of the pipeline construction involve clean-up and rehabilitation along the ROW, associated work areas and impacted watercourses. The clean-up would involve the removal of materials such as pipe off-cuts, pipe caps and timber skids. The ROW and associated work areas would be re-contoured to match the surrounding land and erosion controls constructed where necessary. Excess soil would be removed from the ROW where required unless required by the landowner.

Separately stockpiled topsoil and any cleared vegetation would then be respread evenly across the disturbed area to assist in soil retention. Rehabilitation would include broadcast of seedstock and/or planting of seedlings, or establishment of crop cover in accordance with landowner requirements.

Stream beds and banks would be reconstructed to near original condition and provided with scour protection according to the best practices at the time. Rehabilitation of the pipeline corridor and watercourse crossing is described in **Chapter 22**.

Fences would be reinstated where required and permanent gates installed in consultation with landowners to allow access along the pipeline.

Pre-Commissioning

Pre-commissioning includes the activities required between construction and commissioning with gas. Instrumentation is calibrated and looped checked to ensure it is correctly installed. Equipment is inspected to ensure it has been installed in accordance with the design. Hydrotest and non destructive testing records are checked to ensure all equipment has been tested in accordance with the applicable standards. The pipeline CP system is commissioned to ensure pipeline potential is in accordance with the CP design. The pipeline can then be commissioned with gas.

Commissioning

Commissioning of the pipeline involves purging and pressurisation. Process calculations would be performed to calculate the purge pressure to ensure an explosive mixture of gas and air cannot be created when the pipeline is being filled. The purge process would involve injecting gas into the pipeline at a predetermined pressure and flow rate. When the appropriate level of gas is detected at the HDS the purge would be stopped and the pipeline would be pressurised. A slug of inert gas, usually nitrogen is quite often injected ahead of the gas to prevent explosive mixtures. Due to the high noise generated during venting operations, it is envisaged that venting would occur at a main line valve outside of Hexham.

5.6.4 Construction Techniques

The proposed pipeline would cross a number of major and minor watercourses, roads and railways. The crossing method would vary depending on the sensitivity of the area, the relevant Australian Standards and other relevant guidelines.

The sensitivity of watercourses has been determined based on significance criteria relating to the stream order (Strahler system), status of riparian vegetation, presence of threatened species / habitat, protected wetland areas (SEPP14), sensitivity of downstream water users and the stream class ordering for fish habitat as further described in **Chapter 12** and **Table 44.** A summary of the watercourse crossings for the proposed pipeline route and the proposed crossing method are provided in **Table 5-3** and are further described below.

Table 5-3: Summary of Watercourse Crossings for Proposed Pipeline Route

Watercourse	Proposed Crossing Method
Coal Creek	Open Trench with flow diversions if required
Spring Creek	Open Trench with flow diversions if required
Bull Creek	Open Trench with flow diversions if required
Sandy Gully	Open Trench with flow diversions if required
Chainey Flat Creek	Open Trench with flow diversions if required
Black Soils Creek	Open Trench with flow diversions if required
Groom Creek	Open Trench
Karuah River	Horizontal Directional Drilling (HDD)
Dingo Creek	Open Trench with flow diversions if required
Ramstation Creek	Open Trench with flow diversions if required
Barnes Creek	Open Trench with flow diversions if required
Black Camp Creek	Open Trench with flow diversions if required
Cedar Tree Creek	Open Trench with flow diversions if required
Little Black Camp Creek	Open Trench with flow diversions if required
Gravelly Creek	Open Trench with flow diversions if required
Bridge Creek	Open Trench with flow diversions if required
Boatfall Creek	Open Trench with flow diversions if required
Flaggy Creek	Open Trench with flow diversion if required
Williams River	HDD
Carmichaels Creek	Open Trench with flow diversion if required
Jackass Creek	Open Trench with flow diversion if required
Deadmans Creek	HDD
Scotch Creek	Open Trench
Greenways Creek	Open trench with flow diversion if required
Hunter River	Horizontal directional drilling (HDD)
Approximately 105 other minor watercourses / drainage lines	Majority Open Trenched but some may have flow diversions if required

Infrastructure crossings would be managed through standardised mitigation measures which are incorporated into standard pipeline construction procedures in accordance with Australian Standards. A summary of the infrastructure (roads and rail) which would require to be crossed for the proposed pipeline route and the proposed crossing method are provided in **Table 5-4**. Issues regarding existing infrastructure, including mitigation measures for potential environmental impacts are further investigated in **Chapter 16.**

Table 5-4: Summary of Infrastructure Crossings for Proposed Pipeline Route

Infrastructure	Proposed Crossing Method
Parkers Road	Open Trench
The Bucketts Way –several locations	Thrust Bore or HDD
North Coast Railway	Thrust Bore or HDD
Woods Road	Open Trench
Berrico Road	Open Trench
Monkerai Road	Open Trench
Reidsdale Road / Williams Road	Open Trench
North Coast Railway	Thrust Bore or HDD
Stroud-Dungog Road	Thrust Bore or HDD
Black Camp rd –several locations	Open Trench
Flat Tops Road	Open Trench
Black Camp Creek Road –several locations	Open Trench
Glen Martin Road	Open Trench
Limeburners Creek Road	Thrust Bore or HDD
East Seaham Road	Open Trench
Holmwood Road	Open Trench
Hunter Water Pipeline – Two crossings	Thrust Bore or HDD
Clarencetown Road	Thrust Bore or HDD
Hinton Road	Open Trench
Duckenfield Road	Thrust Bore or HDD
Raymond Terrace Road	Thrust Bore or HDD
Turners Road	Open Trench
Woodberry Road	Thrust Bore or HDD
Oakfield Road	Open Trench
Pacific Highway	Thrust Bore or HDD
Old Punt Road	Thrust Bore or HDD
Old Maitland Road	Thrust Bore or HDD
Crown Roads –Various Locations	Open Trench

A description of the various methods of watercourse / infrastructure crossing is provided below.

Open Trench - Watercourse Crossings

Open trenching would be applied in dry or shallow low flow watercourses, but may also be used in sensitive streams where rapid construction is considered the best means of minimising environmental impacts. This method involves standard trenching techniques using an excavator or backhoe, ensuring the watercourse bed and bank material and trench spoil would be stockpiled separately, clear of the watercourse channels. A prefabricated pipe would subsequently be placed across the watercourse, lowered and the trench immediately backfilled. The prefabricated pipe would involve the welding and placement of appropriate coating protection prior to instalment in the trench.

Design measures such as concrete casing or bolt-on weights are used at crossing locations and areas of significant inundation to weight the pipeline down in the trench to reduce buoyancy of the pipe and to protect the pipe. Tie-in points (where the section of pipe used for the watercourse crossing is connected to the adjacent section of pipeline) would be set back from the top of the banks and outside the area of the crossing (refer to **Figure 5.14**).

Open Trench with Stream Flow Diversion

Stream flow diversion techniques are used as a modification to the standard open trenching and are utilised where higher water volumes and flows are present (typically for flows up to 1000 L/s). This technique involves in-stream trenching and pipe laying undertaken within a temporarily dewatered section of the watercourse using temporary dams. Water flow would be maintained by pumping the water around the dewatered section of the watercourse or through the installation of a bypass flume. Temporary dams can be formed by a number of methods such as sheet piling, sandbags or water filled dams (e.g. Aquadam^{TM}). Dewatering may be required at the crossing area, and strategically located sumps may allow this to occur. Prefabricated pipes would be installed similarly as for open trench crossings, the trench backfilled with appropriate coating protection if required, followed by controlled removal of the downstream dam and subsequent removal of the upstream dam.

Open Trench Road Crossings

Open trench road crossings would be used for minor / intermediate roads and tracks (refer **Table 5-4)** and would involve standard trenching methods. One lane would be constructed and reinstated at a time in order to allow traffic to bypass, minimising delays. Traffic control would be utilised for the duration of the road crossing, however, the works associated with open trench road crossings would be completed without delays in order to minimise inconveniences to road users.

Thrust Boring

Thrust boring may be used as a means to install pipelines beneath infrastructure (e.g. roads, railways and buried utilities) and for some watercourse crossings. Thrust boring involves drilling from below ground within an enlarged trench area, known as a bell hole, located on either side of the area to be bored, as shown in **Figure 5.16**. The bell hole in which the thrust bore rig operates is typically 30 m long and 4 – 5 m wide to allow for the thrust bore rig in addition to a full length of pipe. The receiving bell hole is typically 4 – 5 m long and 3 m wide.

Horizontal Directional Drilling (HDD)

HDD may be used to cross major watercourses or at sites where open cut methods are not suitable. This method involves drilling a hole at a shallow angle beneath the surface, then pulling the welded pipe string pipe back through the drill hole as shown in **Figure 5.16**. Drilling mud (normally bentonite) would be used as the fluid for the hydraulic drilling, as a coolant during drilling, to return the drill cuttings to the surface and to seal and line the drilled hole to facilitate insertion of the pipe. The returning bentonite, carrying the drill cuttings, would be screened at the entry side and recycled into the system.

A cuttings settlement pit and a mud pit may be required to be excavated at each of the bore entry and exit points. Once the pipe string is installed and connected to the main sections of the pipeline, the entry and exit points would be remediated. The excess material (i.e. bentonite and drill cuttings) would be dewatered and buried on-site, where appropriate. The management of the drill cuttings would be incorporated into the CEMP. Drill cuttings containing Acid Sulfate Soils (ASS) would be handled or disposed of according to the Acid Sulfate Soils Management Plan (ASSMP) (refer to **Chapter 25**). The dewatered drill fluid and natural water-based additives would be disposed of at a licensed waste. Horizontal Directional Drilling requires the use of a specialist drill rig, equipment and operator which may vary in size depending on the length of the HDD and the site geology. Smaller HDD rigs may be self-contained (e.g. on the back of a semi-trailer) while larger HDD rigs may require a designated pad.

Crossing of Existing Underground Infrastructure

Prior to construction of the pipeline, existing underground services would be identified via “dial before you dig” and subsequently accurately located in the field by an authorised service locator to obtain position and depth. During construction, the service would typically be crossed by careful excavation around the utility and placed at a depth to satisfy the required separation distance. A representative from the utility owner would normally be present to oversee the construction activity.

5.6.5 Ancillary Activities

There are various ancillary infrastructure works required as part of the pipeline construction. These include:

Road Upgrade and Access Tracks

Some of the existing roads and tracks along the proposed pipeline route would need to be upgraded in order for construction vehicles and plant to safely access the ROW. In areas where existing roads and tracks do not currently exist, access tracks may need to be constructed which would typically be 4m wide. Some access tracks may be required to be retained during the operation of the pipeline for maintenance purposes, while others would be remediated after the construction of the pipeline in accordance with the CEMP. Access tracks on private land would be sited to minimise environmental impacts (as described in the locational principles in **Section 5.2**) and subject to consultation with landowners.

Temporary Laydown Areas

Temporary work areas would likely be required at HDD sites and for pipe storage. It is anticipated that three pipe laydown areas would be required along the length of the Project. The position of the pipeline laydown area would be confirmed prior to construction, however would be generally located at the start (Stratford), approximately halfway, and the end (Hexham). These areas would be selected subject to the following locational principles:

- Cleared areas would be sought to avoid impacts upon vegetation;
- Proximity to existing access tracks with reasonable accessibility to the regional road network;
- Appropriate distance from watercourses;
- Maximise distance to potentially sensitive receivers to minimise noise impacts; and
- Rehabilitation upon completion of construction activities in accordance with the CEMP.

Marker Signs

Pipeline information marker signs would be installed along the route to ensure the pipeline can be properly located and identified in accordance with AS 2885.1. Marker signs would be placed at regular intervals so that a marker sign can be clearly seen in both directions (see **Figure 5.15, Photograph 8**). Signs would be placed closer together on either side of road crossings, at bends, at fences and at watercourse crossings.

Static Earth Systems

All above ground pipework is earthed to local earthing grids. The pipeline would be electrically isolated from the above ground earthing systems using monolithic insulation joints. Cathodic protection equipment would be connected to the pipeline. These cathodic protection test points would be fitted with equipotential earthing grids to ensure touch potentials remain within safe limits. Sections of pipeline subject to higher risk from earth potential rise would be isolated using insulation joints. Any maintenance on these sections would require equipotential earthing mats and PPE including gloves and HV rated boots. The risk along the pipeline would be based on calculations using software developed for calculating touch potential and induced current in pipelines. Further mitigation and management measures are provided in the PHA (**Appendix I**) and **Section 15.6**.

5.6.6 Plant and Equipment

Equipment typically required during the construction of the pipeline would include:

- Bulldozers;
- Grading machines;
- Trenching machines;
- Rock saw;
- Semi trailers (for pipe and materials movements);
- Excavators for trenching and lifting;
- Tip trucks;
- Mobile padding machines for backfill processing;
- Water trucks for dust control;
- Mobile welding units on trucks for pipeline welding;
- Lowering in machines or sidebooms;
- Thrust boring machine; and
- HDD rig.

The pipeline equipment would use roads to access the site. The pipeline construction equipment would then largely work along the pipeline ROW during construction, however certain machinery may need to be moved short distances on the surrounding road network to access new work fronts.

5.6.7 Temporary Construction Workforce Camp

The pipeline construction workforce camp would have capacity to accommodate up to 300 people during peak construction of the pipeline.

The location the construction workforce camp would be approximately mid way along the pipeline route, and would be determined based on the applicable locational principles described in **Section 5.2** and with relevant landowner consultation.

The construction workforce camp would comprise accommodation, recreational facilities, kitchen, dining and office areas, laydown / service areas and a sewage treatment system. A conceptual construction workforce camp layout is shown in **Figure 5.12**. Potable water would be supplied from nearby existing mains pipes, or alternatively if required, potable water could be transported to the site by tanker.

A transportable sewage treatment unit would be required to treat domestic effluent/sewage. A SEMP would be prepared as part of the CEMP which would detail management measures for the treatment and disposal of sewage from the sites.

5.6.8 Construction Hours

Construction of the pipeline would be undertaken over a period of approximately 12 months, however this would be dependant upon weather. Extended construction may be required if inclement weather is experienced. It is anticipated that construction would be undertaken during the driest months of the year, typically winter and spring.

Construction works would typically be undertaken on a 37 day cycle with crews working 28 days on followed by 9 days off. During the 28 day work cycle, construction works would typically occur between 7.00am to 6.00pm, seven days per week with the exception of HDD. Once commenced, HDD would need to be continued to ensure the integrity and safety of the process. As such, HDD may need to continue beyond typical construction hours in certain situations.

Approximately 300 personnel would be required at peak of the construction phase of the pipeline.

5.6.9 Staging of Pipeline Construction

Pipeline construction would be staged, and spread along the length of the pipeline corridor. This approach would be taken in approximately 20 km segments with each 20 km segment of pipeline taking some 8 to 12 weeks to complete depending on terrain and subsurface conditions. The construction activities described in the sections above would be undertaken in a sequence commencing with site preparation activities and excavation of the trench, followed by construction of the pipeline commencing with pipe stringing, through to clean up and rehabilitation. Each activity involved in the construction process would be undertaken for the full length of the working segment of the pipeline, with the next consecutive activity commencing immediately after the previous activity has been completed.

The overall construction timeframe for the transmission pipeline is anticipated to be approximately 12 months.

5.6.10 Pipeline Operation

The operation of the pipeline would be in accordance with approval documentation, an Operations Environmental Management Plan (OEMP), AS 2885 and the APIA Code of Environmental Practice – Onshore Pipelines (APIA, 2005). The pipeline would also be constructed and operated according to the Pipeline Protection Safety Measures and in accordance with an Emergency Response Plan which would be developed.

The pipeline would be managed by a pipeline operator(s) who would be responsible for patrolling the pipeline and landowner liaison. The operator(s) would also issue permits for construction work inside the pipeline easement. This activity would include locating the pipeline and witnessing excavation work to ensure the pipeline is not damaged.

Activities associated with the operation of the pipeline would generally be undertaken by operations staff and specialist service companies. Descriptions for each of the components of the pipeline operational activities are provided below.

Patrolling / Inspections – Easement Access

Patrolling / Inspections of the pipeline would be undertaken to monitor and audit environmental conditions and for maintenance activities. Inspection of creek lines or run-off areas on the ROW would be undertaken after major rainfall events to assess soil erosion. Areas where significant erosion has occurred would be rehabilitated as soon as practicable after such an event. This would necessitate access on to private property and private tracks. The patrols also inspect for unauthorised activities near or over the pipeline, such as excavation, fencing, deep ploughing and the building of structures. The frequency of patrols / inspections would depend on whether a particular issue required monitoring and may range from weekly to monthly patrols / inspections.

Pipeline patrol frequency relates to the pipeline location class and therefore the risk to public safety. In built up areas (known as T1 or Town sections) or where the pipeline is in close proximity to towns, patrols would occur once a week. In isolated sections (known as R1 Rural) the pipeline would be patrolled less frequently.

Line of Sight Clearance

Clearance of the ROW to maintain line-of-sight may be required in the vicinity of pipe markers, where tall shrubs or trees regenerate. Trees retained on the easement during construction would not be removed, however it may be necessary to remove trees that regenerate within 5 m of the pipeline as they may pose a threat to pipeline integrity.

Weed Control

Weed control would be undertaken through the localised spraying of weeds, particularly within the first 12 months after construction.

Cathodic Protection and Coating Integrity Surveys

Surveys would be required annually to measure the CP point output at each of the above-ground posts and to assess the integrity of the coating conductivity to determine if there are defects in the external protective coating of the pipe. Excavation and repair of the external coating would be required to parts of the pipeline where defects were detected that could not be protected by the cathodic protection system.

Supervisory Control and Data Acquisition System (SCADA)

A SCADA system would be utilised to continually monitor pipeline operating conditions such as pressure, temperature, gas flows, valve status, cathodic protection, and gas quality. Such information would be relayed via a radio signal to the Control Room. The SCADA system would allow the pipeline operator to remotely control the pipeline operating system such as operating pressure, open and close valves, and gas flow rates.

Pigging

The integrity of the pipeline would be assessed periodically through the use of a pipeline inspection gauge (pig), referred to as an 'intelligent pig', in a process known as 'pigging'. Pigging would also be required periodically to assess the integrity of the pipeline. The process involves inserting the intelligent pig into the pipeline via a 'pig launcher' at one end of the pipeline. This process can be undertaken while the pipeline is operating. The intelligent pig collects data which is then interpreted to provide information such as the thickness of the pipe, location and size of defects, and may be fitted with a camera to allow internal inspection of the pipe. The pig is removed at the other end of the pipeline at the pig receiver site. Launching intelligent pigs normally occurs at 5-10 year intervals following commencement of operation with regular pigging occurring depending on operational requirements

Main Line Valve

It is anticipated that a Main Line Valve (MLV) would be required along the pipeline. The MLV would be situated approximately half way along the pipeline, and would act as an isolation point for the pipeline in the event of an emergency. In the event of an emergency, upstream gas in the pipeline could be vented at the MLV if venting of the pipeline was required. The final location of the MLV would be determined based on further engineering and design, and would be subject to a hazard and risk assessment.

5.6.11 Pipeline Decommissioning

When the infrastructure is no longer required, the pipeline may be suspended or abandoned in accordance with AS 2885 requirements and accepted industry and environmental practice of the day.

At present, abandonment procedures require the removal of all above ground infrastructure and the restoration of associated disturbed areas. If the pipeline was decommissioned / suspended for future benefits, it would be filled with an inert material and the cathodic protection system maintained to prevent corrosion and operated as per AS 2885. During suspension, a decision would be made regarding the opportunities for future use of the pipeline. If no longer required, the pipeline would be abandoned by being purged of gas and below ground facilities allowed to gradually degrade in-situ. All above ground facilities including signage would be removed.

5.7 Project Area - Hexham Delivery Station

The HDS would be the custody transfer point for CSG extracted from the Project, and would be located within land zoned for industrial use on Old Maitland Road, Hexham. High pressure CSG would be transported from the CPF via the transmission pipeline to the HDS. The site location at Hexham and conceptual site layout are shown on **Figure 5.11.**

There is an existing facility on the Sydney Newcastle trunk pipeline located at Hexham, known as a Gate Station (refer **Figure 5.11**). The pipeline would feed into the Gate Station facility adjacent to the HDS, for distribution to the gas market.

Machinery and equipment required for the construction of the HDS would include:

- Concrete delivery (4-5 per day during civil construction);
- 1 x Light crane
- Equipment transport including:
  - 2 x Water bath heaters;
  - 2 x Filters;
  - 2 x Control buildings;
  - 1 x Pig receiver;

    - 1 x Attenuator;
- 3 x Pipework skids;
- 6 - 8 x miscellaneous pipe / valve trucks;
- Site preparation vehicles including:
    - Bobcat;
    - Grader;
    - Dozer;
    - Piling Truck;
    - Roller;
    - 5 x Water and Dump truck

The delivery of these items to the HDS site would via Old Maitland Road. The site preparation equipment would be delivered to the site at the start of construction to establish the hardstand areas.

Once gas production and transport and commences via the gas transmission pipeline, the HDS would operate continuously.

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6.0 Statutory Planning

This chapter outlines the statutory framework applicable to the Project, including the key approvals and licenses required for the Project as well as environmental planning instruments which apply to the Project and how they relate to the various project components and activities.

6.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the approval of the Commonwealth Minister for the Environment, Water, Heritage and the Arts 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. However, a bilateral agreement between the NSW and Commonwealth governments provides for the accreditation of the NSW assessment and approvals process by the Commonwealth such that one approval may be granted covering both State and Commonwealth requirements. This is discussed further in **Section 6.1.10** of this EA.

The EPBC Act also provides for the identification, conservation and protection of places of National Heritage significance and provides for the management of Commonwealth Heritage places.

The EPBC Act lists seven matters of NES which must be addressed when assessing the impacts of a proposal which are:

- World Heritage properties;
- National Heritage places;
- Wetlands of International Importance;
- Listed threatened species and ecological communities;
- Listed migratory species;
- Commonwealth Marine Areas; and
- Nuclear action.

A Protected Matters search under the EPBC Act was undertaken by GHD on 6 February 2008 and 17 March 2008 for the purposes of the Preliminary Environmental Assessment (PEA) Report. This search covered the Initial Study Area as defined in the PEA, roughly comprising the area of PEL 285 and a pipeline corridor of some 10 km in width. The search returned no records of World Heritage Properties, National Heritage Places, Commonwealth Marine Areas or Nuclear Actions. The following matters of NES were identified:

- One threatened ecological community;
- 19 threatened species previously recorded within PEL 285 and 25 threatened species previously recorded within the pipeline corridor; and
- 15 migratory species previously recorded within PEL 285 and 27 migratory species previously recorded within the pipeline corridor (GHD, 2008).

A broader search of the EPBC Protected Matters database was undertaken for each of the LGAs affected by the Project. A summary of the findings is presented in the following sections.

6.1.1 World Heritage Properties

World heritage properties found within each of the LGAs are shown in the table below.

Table 6-1: World Heritage Properties

Gloucester LGA	Dungog LGA	Great Lakes LGA	Maitland LGA	Newcastle LGA	Port Stephens LGA
Gondwana Rainforests of Australia NSW – Barrington Tops Area	Gondwana Rainforests of Australia NSW – Barrington Tops Area	Gondwana Rainforests of Australia NSW – Barrington Tops Area	None	None	None

The Gondwana Rainforests of Australia are a string of rainforest reserves located on the Great Escarpment of eastern New South Wales which were inscribed on the World Heritage list for their outstanding natural universal values. The Barrington Tops Area is located 20 km north of Dungog, and approximately 17 km from the nearest area affected by the proposed Project. Therefore the Project is not anticipated to affect world heritage properties.

6.1.2 National Heritage Places

National Heritage places found within each of the LGAs are shown in the table below.

Table 6-2: National Heritage Places

Gloucester LGA	Dungog LGA	Great Lakes LGA	Maitland LGA	Newcastle LGA	Port Stephens LGA
Gondwana Rainforests of Australia NSW – Barrington Tops Area	Gondwana Rainforests of Australia NSW – Barrington Tops Area	Gondwana Rainforests of Australia NSW – Barrington Tops Area	None	None	None

The Gondwana Rainforests of Australia are discussed in **Section 6.1.1** above, and are not expected to be impacted by the Project.

6.1.3 Wetlands of international importance (declared Ramsar wetlands)

Wetlands of International Importance found within each of the LGAs, or within the catchment of the LGA are shown in the table below.

Table 6-3: Wetlands of International Importance

Gloucester LGA	Dungog LGA	Great Lakes LGA	Maitland LGA	Newcastle LGA	Port Stephens LGA
Hunter Estuary Wetlands Myall lakes	Hunter Estuary Wetlands Myall lakes	Hunter Estuary Wetlands Myall lakes	Hunter Estuary Wetlands	Hunter Estuary Wetlands	Hunter Estuary Wetlands Myall lakes

The proposed action would not directly affect wetlands of international importance, however parts of the Project are located within the catchment of two wetlands of international importance; Hunter Estuary Wetlands and Myall Lakes. Hunter Estuary Wetlands are located approximately 1.5 km from the southern most point of the gas pipeline. Myall Lakes National Park is located a minimum distance of some 30 km from areas affected by the Project, and the Project is not anticipated to have a direct or indirect effect on ecological values in this area.

Potential direct and indirect impacts on areas potentially affected by the Project have been investigated as part of the Ecological Assessment and Ecological Addendum undertaken in respect of the Project (detailed in **Chapter 10** and **Appendix G** to this EA) and no significant impacts upon these wetlands are anticipated.

6.1.4 Listed threatened species and ecological communities

The number of threatened species and endangered ecological communities (EECs) found within each of the LGAs are shown in the table below.

Table 6-4: Listed threatened species and ecological communities

Gloucester LGA	Dungog LGA	Great Lakes LGA	Maitland LGA	Newcastle LGA	Port Stephens LGA
No EECs Threatened species – 23	One EEC – White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Threatened species – 26	One EEC – White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Threatened species – 53	One EEC – White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Threatened species – 17	One EEC – White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Threatened species – 36	One EEC – White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Threatened species – 46

The Project would require some clearing of vegetation along the gas pipeline route and in the Stage 1 GFDA. An Ecological Assessment and Ecological Addendum has been undertaken as part of the EA and is detailed in **Chapter 10** and **Appendix G**. This assessment was used to inform and refine the location of well sites, gas gathering and water lines and the gas pipeline such that significant areas of vegetation would be avoided where possible. The assessment concludes that provided appropriate management and mitigation measures are implemented, the Project is not expected to have a significant adverse impact upon listed threatened species and ecological communities.

6.1.5 Listed migratory species

The number of listed migratory species potentially occurring within each of the LGAs is shown in the table below.

Table 6-5: Listed migratory species

Gloucester LGA	Dungog LGA	Great Lakes LGA	Maitland LGA	Newcastle LGA	Port Stephens LGA
15 migratory species	15 migratory species	46 migratory species	15 migratory species	46 migratory species	56 migratory species

As discussed in **Section 6.1.4** above, the Project would require some clearing of vegetation along the gas pipeline route and in the Stage 1 GFDA, which may have the potential to affect the habitat of migratory species potentially occurring within the areas affected by the Project. The ecological assessment undertaken as part of the EA addresses potential impacts associated with the clearing of vegetation, including the potential to impact migratory species and finds that, subject to the implementation of recommended mitigation measures, there is not expected to be a significant impact upon migratory species. Areas of identified potential habitat for such species would be avoided in the final placement of wells and associated infrastructure wherever possible.

6.1.6 Commonwealth marine area

The Project would not affect a Commonwealth marine area.

6.1.7 Nuclear action

The Project would not involve nuclear action as defined under the *EPBC Act 1999*.

6.1.8 Commonwealth land

The Project would not affect Commonwealth land.

6.1.9 Register of the National Estate

Whilst changes to the *Australian Heritage Commission Act 1975* mean that no further places can be added to the Register of the National Estate (RNE), the RNE would continue its function as a statutory register until February 2012, beyond which it would be maintained as a non-statutory register and listed heritage places would be transferred as appropriate to relevant State and Territory heritage lists. Until this time, the Minister for the Environment, Water, Heritage and the Arts is required, under Section 391A of the EPBC Act to have regard to the information in the RNE when making a decision under the EPBC Act to which the RNE is relevant.

A search of the RNE was undertaken online for each of the LGAs affected by the Project. There is one item listed on the RNE which is in the vicinity of the proposed Concept Area and Project Area which could potentially be affected by the proposed works, being Barrington Tops World Heritage Area. The potential impacts of the Project on this listed item are considered in detail in the heritage assessment undertaken for the Project included as **Appendix K** and summarised in **Chapter 19**, and are not considered to be significant.

6.1.10 Referral

A referral was lodged with the DEWHA to ensure that due consideration was given to the potential impacts upon matters of NES and that the requirements of the EPBC Act were adequately met. A response from the DEWHA was received via email on 30th September 2008 and deemed that the proposed project was a 'controlled action' as it was considered likely to have a significant impact on:

- Wetlands of international importance; and
- Listed threatened species and communities.

More specifically, the DEWHA determined that, based upon the information submitted with the referral that the Project:

- Involved disturbance of acid sulfate soils which have the potential to change the physio-chemical status of the Hunter Estuary Wetlands; and
- Involved the potential disturbance of breeding populations of nationally threatened frog species including the Booroolong frog (*Litoria booroolongensis*) and the Giant Barred frog (*Mixophyes iteratus*).

The management of acid sulfate soils in relation to the Project is discussed in detail in **Chapter 17** of this EA which concludes that, with the implementation of the recommended mitigation measures, there should be no significant adverse impacts in relation to acid sulfate soils as a result of the Project. Potential impacts upon threatened species, including the abovementioned frog species are discussed in **Chapter 10** and **Appendix G** of this EA and are not expected to be significant with the implementation of appropriate management measures and safeguards as detailed in this EA.

As the Project has been deemed to be a 'controlled action' under the EPBC Act, approval is required from the Commonwealth Minister for the Environmental, Water, Heritage and Arts as discussed in **Section 6.1** of this EA. The '*Agreement between the Commonwealth of Australia and the New South Wales Government under section 45 of the Environment Protection and Biodiversity Conservation Act 1999 relating to environmental assessment'* (The Agreement) provides for the accreditation of the NSW environmental impact assessment process (including assessment under Part 3A of the EP&A Act), enabling the Commonwealth to rely primarily on the NSW assessment process in assessing actions under the EPBC Act. Clause 9.1 of The Agreement states that:

> *Pursuant to subsection 47(1) of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999, it is declared that a controlled action does not require assessment under Part 8 of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 if:*
>
> - *the action is assessed in accordance with the requirements set out in Part A of Schedule 1 to this agreement*, (i.e. Assessment under Part 3A of the NSW EP&A Act 1979)

Clause 13 of The Agreement requires that, where the NSW Minister for Planning receives a written notice from the Commonwealth Minister for the Environment, Water, Heritage and Arts that an action proposed to take place in NSW is a controlled action, that:

> *The State of New South Wales undertakes that as soon as practicable, the New South Wales Minister will indicate in a written notice given to the Commonwealth Environment Minister whether the action will be assessed in the manner specified in Schedule 1 to this agreement.*

The State of New South Wales is then required, under Clause 14.1 of The Agreement to:

> *Provide a copy of the Assessment Report, or the part of the relevant report that addresses the relevant impacts of a controlled action, and recommended approval conditions to the Commonwealth Environment Minister as soon as possible.*

Based upon this assessment report and any other relevant information, the Commonwealth Minister for the Environment, Water, Heritage and the Arts will decide whether to approve the proposed action and may impose conditions on any approval issued.

In addition to the above, the DEWHA was formally requested by the DoP to provide notification of any additional requirements to be addressed in the preparation of the EA. DEWHA's response via email dated 15th October 2008 confirmed the addition of the following points to the EARs for the Project:

- In Surface and Groundwater:
  - reference to the ecological character of the Ramsar listed Hunter Estuary Wetlands, including a discussion of any potential impacts on the ecological character from the proposed action

- where Potential Acid Sulfate Soils (PASS) are encountered, include information on the elevation of the affected area, the depth and extent of drilling and proposed methods for soil management; and identify risks and provide details of mitigation measures in relation to impacts from PASS, including impacts on the Hunter Estuary Wetlands.

- In Consultation Requirements add in a point:
  - Commonwealth Department of the Environment, Water, Heritage and the Arts.

A letter was subsequently issued by the DoP (dated 19th October 2008 and included as **Appendix C** to this EA) amending the EARs to reflect DEWHA's response above.

DEWHA also requires that matters outlined in Schedule 4 of the EPBC Regulation 2000 are addressed in the EA. These matters and the relevant reference in this EA are provided in the table below.

Table 6-6: EPBC Regulation 2000 Schedule 4 Matters to be addressed

Matters in Schedule 4	Reference in EA
1. General Information	
The background of the action including: (a) the title of the action;	**Chapter 1**
(b) the full name and postal address of the designated proponent;	**Certification Page**
(c) a clear outline of the objective of the action;	**Chapter 2**
(d) the location of the action;	**Chapter 3** and **11**
(e) the background to the development of the action;	**Chapter 1** and **2**
(f) how the action relates to any other actions (of which the proponent should reasonably be aware) that have been, or are being, taken or that have been approved in the region affected by the action;	**Chapter 24**
(g) the current status of the action;	**Chapter 1**
(h) the consequences of not proceeding with the action.	**Chapter 4**
2. Description	
A description of the action, including: (a) all the components of the action;	**Chapter 5**
(b) the precise location of any works to be undertaken, structures to be built or elements of the action that may have relevant impacts;	**Chapter 5**
(c) how the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts;	**Chapters 5, 10, 12, 13**
(d) relevant impacts of the action;	**Chapters 10, 12, 13**
(e) proposed safeguards and mitigation measures to deal with relevant impacts of the action;	**Chapters 10, 12, 13**
(f) any other requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action;	**Chapter 6**

Matters in Schedule 4	Reference in EA
(g) to the extent reasonably practicable, any feasible alternatives to the action, including: (i) if relevant, the alternative of taking no action; (ii) a comparative description of the impacts of each alternative on the matters protected by the controlling provisions for the action; (iii) sufficient detail to make clear why any alternative is preferred to another;	**Chapter 4**
(h) any consultation about the action, including: (i) any consultation that has already taken place; (ii) proposed consultation about relevant impacts of the action; (iii) if there has been consultation about the proposed action — any documented response to, or result of, the consultation;	**Chapter 7**
(i) identification of affected parties, including a statement mentioning any communities that may be affected and describing their views.	**Chapters 7 and 20**
3. Relevant Impacts	
Information given under paragraph 2.01 (d) must include: (a) a description of the relevant impacts of the action;	**Chapters 10, 12, 13**
(b) a detailed assessment of the nature and extent of the likely short term and long term relevant impacts;	**Chapters 10, 12, 13**
(c) a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;	**Chapters 10, 12, 13**
(d) analysis of the significance of the relevant impacts;	**Chapters 10, 12, 13**
(e) any technical data and other information used or needed to make a detailed assessment of the relevant impacts.	**Chapters 10, 12, 13** and **Appendix G**
4. Proposed Safeguards and Mitigation Measures	
Information given under paragraph 2.01 (e) must include: (a) a description, and an assessment of the expected or predicted effectiveness of, the mitigation measures;	**Chapters 10, 12, 13** and **Appendix G**
(b) any statutory or policy basis for the mitigation measures;	**Chapters 10, 12, 13** and **Appendix G**
(c) the cost of the mitigation measures;	**Unknown**
(d) an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action, including any provisions for independent environmental auditing;	**Chapters 10, 12, 13** and **Appendix G**

Matters in Schedule 4	Reference in EA
(e) the name of the agency responsible for endorsing or approving each mitigation measure or monitoring program;	**Chapters 10, 12, 13** and **Appendix G**
(f) a consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including mitigation measures proposed to be taken by State governments, local governments or the proponent.	**Chapter 25**
5. Other Approvals and Conditions	
Information given under paragraph 2.01 (f) must include: (a) details of any local or State government planning scheme, or plan or policy under any local or State government planning system that deals with the proposed action, including: (i) what environmental assessment of the proposed action has been, or is being, carried out under the scheme, plan or policy; (ii) how the scheme provides for the prevention, minimisation and management of any relevant impacts;	**Chapter 6**
(b) a description of any approval that has been obtained from a State, Territory or Commonwealth agency or authority (other than an approval under the Act), including any conditions that apply to the action;	**Chapter 6**
(c) a statement identifying any additional approval that is required;	**Chapter 6**
(d) a description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.	**Chapter 25** and **Chapter 26**

6.1.11 Ecologically Sustainable Development

The term 'ecologically sustainable development' was introduced by the Commonwealth Government in June 1990 and is defined as:

> *'Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased. (ref: Ecologically Sustainable Development: A Commonwealth Discussion Paper)'*

One of the objects of the EPBC Act is:

> *to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources;*

Clause 3A of the EPBC Act sets out the principles of ESD, being:

- decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
- if there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent degradation;

- the principle of inter-generational equity--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;
- the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;
- improved valuation, pricing and incentive mechanisms should be promoted.

These five principles are interrelated and need to be considered both individually and collectively as part of determining whether or not a project would be consistent with the principles of ESD in Australia.

Decision Making Processes

The decision making processes principle states that these processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations. This EA has been prepared in respect of the Project to allow for the full consideration of relevant economic, environmental and social issues in the decision-making process. Statutory processes have been followed in relation to the preparation of the EA and both the short-term and long-term impacts of the Project have been considered.

Precautionary Principle

The precautionary principle states that if 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. A comprehensive assessment of the potential environmental impacts of the Project has been undertaken in this EA including ecological, air quality, ground and surface water impacts. The EA concludes that, provided the recommended mitigation measures are implemented the environmental impacts of the Project are not expected to be significant. The project is therefore not anticipated to result in a threat of serious or irreversible environmental harm and is considered to be generally consistent with the precautionary principle.

Intergenerational Equity

The principle of intergenerational equity implies 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. As discussed above, the potential environmental impacts of the Project have been considered in this EA and are not expected to result in significant impacts upon the long term health, diversity and productivity of the environment in line with this principle.

Biological Diversity and Ecological Integrity

The fourth principle states that conservation of biological diversity and ecological integrity should be a fundamental consideration. The potential impacts of the Project on biological diversity and ecological integrity are considered in **Chapters 10** and **27** and **Appendix G** of this EA. It is concluded that, subject to the implementation of recommended mitigation measures, the Project would not result in significant adverse impacts upon biological diversity or ecological integrity and is considered to be generally consistent with this principle.

Valuation and Pricing of Environmental Resources

The principle of valuation and pricing provides 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. Environmental controls and safeguards have been built into the design of the Project and the full cost of recommended mitigation measures, including rehabilitation upon project completion has been incorporated into the Project budget in line with the intention of this principle.

6.2 NSW Environmental Planning and Assessment Act 1979

6.2.1 Approvals Overview

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.

The objects of the EP&A Act, and how the Project meets these objects are listed in **Table 6-7** below.

Table 6-7: Objects of the EP&A Act

Objects of the EP&A Act	Comment
(a) to encourage:	
(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,	The proposed Concept Plan and Project involve the extraction of an important natural resource required for the security of the NSW energy supply in the medium to long term. The Project has been planned and designed in consideration of the surrounding environment including natural features, land use, built form and social and economic factors with the aim of minimising potential impacts in accordance with the objects of the EP&A Act. The Project avoids, wherever possible, environmentally sensitive lands and incorporates safeguards and management measures to ensure the protection and conservation of these areas into the future.
(ii) the promotion and co-ordination of the orderly and economic use and development of land,	The Project utilises an existing, valuable natural resource which stands to provide significant public benefit. The project proposes appropriate and efficient use of the affected land in accordance with the objects of the EP&A Act.
(iii) the protection, provision and co-ordination of communication and utility services,	The primary purpose of the Project is the provision of energy to the NSW market, thus representing an important utility service for the State.
(iv) the provision of land for public purposes,	The Project does not impact upon the provision of land for public purposes.
(v) the provision and co-ordination of community services and facilities, and	The Project does not impact upon the provision and coordination of community services and facilities.
(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and	The planning and design of the proposed Concept Plan and Project were undertaken in consideration of the surrounding natural environment and feasible measures were taken during this phase to minimise impacts upon the environment. Where potential impacts upon native species, populations and ecological communities and their habitats have been identified, safeguards and management measures would be implemented as recommended by this EA in order to minimise these impacts.

Objects of the EP&A Act	Comment
(vii) ecologically sustainable development, and	**Chapter 28** of this EA discusses the Concept Plan and Project in relation to the principles of ESD.
(viii) the provision and maintenance of affordable housing, and	Not relevant to the Project.
(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and	Not relevant to the Project.
(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.	The Concept Plan and Project are subject to assessment under Part 3A of the EP&A Act and the public consultation and participation requirements set out therein. In addition to statutory requirements, the Proponent has undertaken an extensive community consultation process as detailed in **Chapter 7** of this EA.

As outlined in **Chapter 1** of this EA, the Project has been declared by the Minister to be a 'major project', eligible for assessment under Part 3A of the EP&A Act.

Under Part 3A, a proponent can seek a Project approval or a Concept Plan approval (where the Minister authorises a concept plan to be lodged). Concept Plan approval allows the Project to be assessed by focusing on the broader strategic issues. The proponent is able to obtain approval for the Concept Plan prior to undertaking detailed studies of the various components of the Project. Further details, assessments and approvals would subsequently be required before works could commence on the Project.

In accordance with the provisions of Part 3A of the EP&A Act, the Proponent is seeking Concept Plan approval for the broader Project and concurrent Project approval for defined components of the Project for which more detailed planning and development have been undertaken as summarised in the table below:

Table 6-8: Part 3A Approvals Sought

Project Component	Concept Plan Approval	Project Approval
Concept Area – PEL 285	✓	✓ Stage 1 GFDA between Gloucester and Craven for 110 wells
CPF		✓ Capacity of approximately 30 PJ per year (average 80 TJ/day) and associated ancillary infrastructure
Pipeline		✓ 100 m wide pipeline corridor
HDS		✓

The area the subject of the Concept Plan and Project approvals is shown in **Figure 1.1, Figure 5.1** and **Figure 5.2**.

The Minister for Planning is the consent authority for the Concept Plan and Project applications.

In addition to the above approvals sought under the EP&A Act, the Project requires approval under the EPBC Act as it has been deemed to be a 'controlled action'. In accordance with the bilateral agreement existing between the Commonwealth and the State of NSW, approval under the EPBC Act will be assessed concurrently with approval under the EP&A Act and will be reliant upon the NSW environmental assessment process, as discussed in detail in **Chapter 1** of this EA.

6.2.2 Environmental Planning and Assessment Regulation 2000

Part 1A of the *Environmental Planning and Assessment Regulation 2000* (EP&A Reg) relates to Major Projects.

Clause 8F of the EP&A Reg addresses owner's consent or notification in relation to Major Projects and states that:

> *The consent of the owner of land on which a project is to be carried out is required for a project application unless:*
>
> *the application relates to a mining or petroleum production project, or*
>
> *the application relates to a linear infrastructure project.*

Mining or petroleum production is deemed to include:

> *any activity that is related to mining or petroleum production, but does not include a project on land that is a state conservation area reserved under the National Parks and Wildlife Act 1974.*

Clause 8F defines 'linear infrastructure' project as:

> *development for the purposes of linear transport or public utility infrastructure*.

The Project comprises petroleum production (the Concept Area, Stage 1 GFDA and CPF and linear infrastructure (the pipeline), therefore the consent of the owner of land on which the Project is to be carried out is not required under the EP&A Regs. However, Clause 8F states that, if consent is not required, the proponent is required to give notice of the application as follows:

- in the case of the pipeline notice is to be given to the public by advertisement published in a newspaper circulating in the area of the Project before the start of the public consultation period for the Project; and
- in the case of the Concept Area, Stage 1 GFDA, CPF and HDS notice is to be given to the public by advertisement published in a newspaper circulating in the area of the Project before the end of the period of 14 days after the application is made.

Notice of the component parts of the Project was given in accordance with the provisions of Clause 8F through advertisements published on the 20th August 2008 in the Gloucester Advocate, Dungog Chronicle and the Maitland Mercury.

6.2.3 Environmental Planning Instruments

A range of environmental planning instruments (EPIs) created under the EP&A Act provide further detailed guidance and regulation for development at a State, regional and local level.

In accordance with Clauses 75J and 75O of the EP&A Act, in deciding whether or not to approve a Concept Plan or the carrying out of a Project, the Minister may (but is not required to) take into account the provisions any EPI that would not apply if the Project were approved. As this is a discretionary matter for the Minister, a range of EPIs have been considered in relation to the Concept Plan/Project.

The following SEPPs are of relevance to the Project:

- *State Environmental Planning Policy (Major Development) 2005;*
- *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007;*
- *State Environmental Planning Policy (Infrastructure) 2007;*
- *State Environmental Planning Policy No. 14 – Coastal Wetlands;*
- *State Environmental Planning Policy No. 33 – Hazardous and Offensive Industries;*
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection;*
- *State Environmental Planning Policy No. 55 – Remediation of Land; and*
- *State Environmental Planning Policy No. 71 – Coastal Protection.*

These policies are discussed in relation to the Project in **Section 6.5** of this EA.

The following Local Environmental Plans (LEPs) apply to land subject of the Concept Plan and Project applications:

- *Gloucester Local Environmental Plan 2000;*
- *Draft Gloucester Local Environmental Plan 2009;*
- *Great Lakes Local Environmental Plan 1996;*
- *Dungog Local Environmental Plan 2006;*
- *Port Stephens Local Environmental Plan 2000;*
- *Maitland Local Environmental Plan 1993; and*
- *Newcastle Local Environmental Plan 2003.*

The application of these plans to the Project is discussed in **Section 6.7** of this EA.

6.3 NSW Petroleum (Onshore) Act 1991

The *NSW Petroleum (Onshore) Act 1991* (PO Act) regulates the exploration and production of petroleum primarily through the issue of certain licences and/or leases such as Petroleum Exploration Licences (PELs) and Petroleum Production Leases (PPLs).

A PEL allows the holder exclusive rights to prospect for petroleum on the land covered by the licence. Should petroleum be discovered, the holder of the PEL is required to apply for a PPL if they wish to recover the petroleum through mining operations. A PPL allows the holder to undertake petroleum mining operations on the subject land. Clause 41 of the PO Act addresses the scope of PPLs and states that, with respect to the rights of PPL 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.

The Concept Area (refer to **Figure 5.1**) is subject to a PEL issued under the PO Act, known as PEL 285. Future operations within the Concept Area would require the issue of a PPL. Application for specific PPLs would be made once relevant approvals are issued under the EP&A Act.

A PPL would be required prior to the commencement of the proposed petroleum production operations within the Stage 1 GFDA. Should approval be granted for the Project under Part 3A of the EP&A Act, a PPL cannot be refused and must be generally consistent with the Part 3A Approval. An application would be made for a PPL to cover the proposed petroleum production activities to take place within the Stage 1 GFDA following the issue of Project approval.

6.4 NSW Pipelines Act 1967

The *Pipelines Act 1967* (Pipelines Act)regulates the construction and operation of pipelines within the State, with certain exemptions such as those operated for the purposes of supply of water or those to be constructed by a public authority.

Clause 11 of the Pipelines Act provides that a pipeline (other than those identified as exempt) cannot be constructed or operated without a licence. The Act also addresses the ongoing maintenance and management of pipelines.

The requirement for a licence in relation to a petroleum pipeline (one which conveys naturally occurring hydrocarbons) generally relates to high pressure trunk lines and does not extend to gathering lines within the Stage 1 GFDA and broader Concept Area

Construction and operation of the proposed pipeline (as described in **Chapter 5** of this EA) would require a licence under Part 3 of the Pipelines Act. Should Project approval be granted for the pipeline, an application for a Pipeline Licence would be made in accordance with clause 13 of the Pipelines Act. Should Project approval be granted under Part 3A of the EP&A Act, the Pipelines Licence cannot be refused and must be generally consistent with the Project approval.

6.5 State Environmental Planning Policies

6.5.1 State Environmental Planning Policy (Major Development) 2005

State Environmental Planning Policy (Major Development) 2005 (Major Development SEPP) is the primary instrument which identifies 'major projects', being those eligible for assessment under Part 3A of the EP&A Act. The primary aim of the Major Development SEPP 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 2, clause 6 of Schedule 1 of Major Development 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:

a) *has a capital investment value of more than $30 million or employs 100 or more people, or*

b) *is in an environmentally sensitive area of State significance, or*

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, Hawkesbury, Port Stephens, Upper Hunter or Muswellbrook, but only if the principal resource sought is coal seam methane.*

- Development for the purpose of petroleum related works (including processing plants) that:

  a) *is ancillary to or an extension of another Part 3A project, or*

  b) *has a capital investment value of more than $30 million or employs 100 or more people.*

The proposed Project involves the drilling and operation of petroleum wells and associated gas and water gathering lines which has a capital investment value of greater than $30 million. The Project also involves the development of central processing facilities including a gas compression plant and water treatment plant, also with a capital investment value of greater than $30 million.

Group 8, clause 26A of Schedule 1 of the Major Development SEPP 2005 addresses pipeline projects, being:

Development for the purposes of a pipeline in respect of which:

- *a licence is required under the Pipelines Act 1967 or*
- *an application for a licence is made under that Act on or after the commencement of this clause, or*
- *a licence was granted under that Act before the commencement of this clause.*

The proposed gas transmission pipeline would require a licence under the Pipelines Act as discussed in **Section 6.4** earlier in this EA.

The proposed Project falls within the relevant criteria specified under Schedule 1 of the Major Development SEPP 2005 and is therefore classified as a 'major project', eligible for assessment under Part 3A. The Minister for Planning has formally declared the Project to be a 'major project' and has authorised the lodgement of a Concept Plan (refer to **Appendix B** to this EA).

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

State Environmental Planning Policy (Mining. Petroleum Production and Extractive Industries) 2007 (MPPEI SEPP) recognises the importance of mining, petroleum production and extractive industries within the State and has the following aims:

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

To facilitate the orderly and economic use and development of land containing mineral, petroleum and extractive material resources, and

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.

Under the MPPEI SEPP, petroleum is defined as:

> *(a) any naturally occurring hydrocarbon, whether in a gaseous, liquid or solid state, or*
>
> *(b) any naturally occurring mixture of hydrocarbons, whether in a gaseous, liquid or solid state, or*
>
> *(c) any naturally occurring mixture of one or more hydrocarbons, whether in a gaseous, liquid or solid state, and one or more of the following, that is to say, hydrogen sulphide, nitrogen, helium, carbon dioxide and water.*

The definition of petroleum also includes any substance referred to above that has been returned to a natural reservoir, but does not include coal or oil shale or any substance prescribed to be a mineral for the purposes of the *Mining Act 1992*.

The MPPEI SEPP also provides definitions for 'petroleum production' and 'petroleum related works', as follows:

> ***Petroleum production*** *means the recovery, obtaining or removal of petroleum pursuant to a production lease under the Petroleum (Onshore) Act 1991 or a production licence under the Petroleum (Submerged Lands) Act 1982 and includes:*
>
> *(a) the construction, operation and decommissioning of associated petroleum related works, and*
>
> *(b) the drilling and operation of wells, and*
>
> *(c) the rehabilitation of land affected by petroleum production.*
>
> ***Petroleum related works*** *means any works, structures or equipment that are ancillary or incidental to petroleum production and includes all works, structures and equipment that a production lease under the Petroleum (Onshore) Act 1991, or a production licence under the Petroleum (Submerged Lands) Act 1982 entitles the lease or licence holder to construct, maintain or execute.*

The Project would involve the drilling and operation of gas wells and the construction and operation of associated infrastructure and ancillary plant for the recovery of CSG (a naturally occurring hydrocarbon) subject to the issue of a PPL under the PO Act. The Project therefore fits within the definition of 'petroleum production' and 'petroleum related works'.

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

> *(a) petroleum production on land on 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,*
>
> *(c) petroleum production in any part of a waterway, an estuary in the coastal zone or coastal waters of the State that is not in an environmental conservation zone,*
>
> *(d) facilities for the processing or transportation of petroleum on land on 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 land or adjoining land,*

(e) petroleum production on land that is reserved as a state conservation area under the National Parks and Wildlife Act 1974.

Clause 7(2)(a) allows development for the purposes of petroleum production provided it is to be carried out on land upon which agriculture or industry can be carried out with or without consent. As such, where the relevant LEP allows development for the purposes of agriculture or industry, the Project including drilling and operation of gas wells and the construction and operation of associated infrastructure and ancillary plant for the recovery of CSG may be carried out with consent.

Clause 7(2)(d) also allows for development facilities for the processing or transportation of petroleum. The proposed CPF and HDS fit within the definition of processing and transportation facilities and are therefore permissible.

Clause 8(1) of the MPPEI 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.

Clause 8 further provides that:

if a local environmental plan provides that development for the purposes of mining, petroleum production or extractive industry may be carried out on land with development consent if the consent authority is satisfied as to certain matters specified in the plan, development for that purpose may be carried out on that land with development consent without the consent authority having to be satisfied as to those specified matters.

This clause therefore allows for the Project, being 'petroleum production', to be carried out with consent without the need to satisfy certain provisions which may be included in relevant LEPs.

Part 3 of the MPPEI SEPP sets out the matters for consideration for development applications for relevant development. Clause 12 specifically sets out the matters which must be considered prior to granting consent for the purposes of mining, petroleum production or extractive industry. These matters have been assessed as part of this EA and are addressed in the document as summarised in the **Table 6-9**.

Table 6-9: Matters for Consideration – Clause 12, the MPPEI SEPP

Matter	Reference in EA
The existing uses and approved uses of land in the vicinity of the development:	**Chapters 6 and 11**
- whether or not the development is likely to have a significant impact on the uses that, in the opinion of the consent authority having regard to land use trends, are likely to be the preferred uses of land in the vicinity of the development, and	**Chapter 11**
- any ways in which the development may be incompatible with any of those existing, approved or likely preferred uses.	**Chapter 11**
Evaluate and compare the respective public benefits of the development and the land uses referred to in paragraph (a) (i) and (ii).	**Chapter 11**

Matter	Reference in EA
Evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	**Chapter 11**

Clause 13 of the MPPEI SEPP relates to development on land that is in the vicinity of an existing mine, petroleum production facility or extractive industry and requires that certain matters be considered prior to granting consent for such development.

The Project, in particular the proposed CPF and Stage 1 GFDA are located in the vicinity of existing mining activities at the Stratford Colliery. The relevant matters specified in clause 13 are considered in the EA and the appropriate reference in the EA is provided in the table below.

Table 6-10: Matters for Consideration, Clause 13, the MPPEI SEPP

Matter for Consideration	Reference in EA
(a) the existing uses and approved uses of land in the vicinity of the development, and	**Chapters 6 and 11**
(i) whether or not the development is likely to have a significant impact on current or future extraction or recovery of minerals, petroleum or extractive materials (including by limiting access to, or impeding assessment of, those resources), and	**Section 11.2.2 and Section 11.3.1**
(ii) any ways in which the development may be incompatible with any of those existing or approved uses or that current or future extraction or recovery, and	**Chapter 11**
(b) evaluate and compare the respective public benefits of the development and the uses, extraction and recovery referred to in paragraph (a) (i) and (ii), and	**Chapter 11**
(c) evaluate any measures proposed by the applicant to avoid or minimise any incompatibility, as referred to in paragraph (a) (iii).	**Chapter 11**

Part 3 of the MPPEI SEPP also requires that consideration be given to natural resource and environmental management, resource recovery and rehabilitation when assessing proposals for mining, petroleum production or extractive industry. The EA assesses these issues and the relevant reference is provided in the table below.

Table 6-11: Matters for Consideration - Clauses 14, 15 & 17, the MPPEI SEPP

Matter for Consideration	Reference in EA
Natural Resource and Environmental Management	
(1) (a) that impacts on significant water resources, including surface and groundwater resources, are avoided, or are minimised to the greatest extent practicable,	**Chapters 12 and 13**
(b) that impacts on threatened species and biodiversity, are avoided, or are minimised to the greatest extent practicable,	**Chapter 10**
(c) that greenhouse gas emissions are minimised to the greatest extent practicable.	**Chapter 21**

Matter for Consideration	Reference in EA
(2) The consent authority must consider an assessment of the greenhouse gas emissions (including downstream emissions) of the development, and must do so having regard to any applicable State or national policies, programs or guidelines concerning greenhouse gas emissions.	**Chapter 21 and Appendix F**
Resource Recovery	
(a) whether or not the consent should be issued subject to conditions aimed at optimising the efficiency of resource recovery and the reuse or recycling of material.	**Chapters 5 and 23**
(b) may refuse to grant consent to development if it is not satisfied that the development would be carried out in such a way as to optimise the efficiency of recovery of minerals, petroleum or extractive materials and to minimise the creation of waste in association with the extraction, recovery or processing of minerals, petroleum or extractive materials.	**Chapters 5 and 23**
Rehabilitation	
(a) require the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated	**Chapters 22 and 26**
(b) require waste generated by the development or the rehabilitation to be dealt with appropriately	**Chapters 22 and 23**
(c) require any soil contaminated as a result of the development to be remediated in accordance with relevant guidelines (including guidelines under section 145C of the Act and the *Contaminated Land Management Act 1997*), or	**Chapters 17 and 23**
(d) require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of the rehabilitation, does not jeopardize public safety.	**Chapter 22**

6.5.3 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (Infrastructure SEPP) aims to facilitate the effective delivery of infrastructure across the State by:

> *(a) improving regulatory certainty and efficiency through a consistent planning regime for infrastructure and the provision of services, and*
>
> *(b) providing greater flexibility in the location of infrastructure and service facilities, and*
>
> *(c) allowing for the efficient development, redevelopment or disposal of surplus government owned land, and*
>
> *(d) identifying the environmental assessment category into which different types of infrastructure and services development fall (including identifying certain development of minimal environmental impact as exempt development), and*
>
> *(e) identifying matters to be considered in the assessment of development adjacent to particular types of infrastructure development, and*
>
> *(f) providing for consultation with relevant public authorities about certain development during the assessment process or prior to development commencing.*

Clause 53 of the Infrastructure SEPP details development permitted without consent in relation to gas pipelines. Clause 53 states the following development as permissible without consent:

> *(1) Development for the purpose of a gas pipeline may be carried out by any person without consent on any land if the pipeline is subject to a licence under the Pipelines Act 1967 or a licence or authorisation under the Gas Supply Act 1996.*

Clause 53 further states that:

> *(2) Development for the purpose of a gas pipeline may be carried out by or on behalf of a public authority without consent on any land.*
>
> *(3) However, subclauses (1) and (2) apply with respect to land in Zone E1 National Parks and Nature Reserves or an equivalent land use zone only if the development:*
>
> *(a) is authorised by or under the National Parks and Wildlife Act 1974, or*
>
> *(b) is, or is the subject of, an existing interest within the meaning of section 39 of that Act, or*
>
> *(c) is carried out on land to which that Act applies over which an easement has been granted and is not contrary to the terms or nature of the easement.*
>
> *(4) In this clause, a reference to development for the purpose of a gas pipeline includes a reference to development for any of the following purposes if the development is in connection with a gas pipeline:*
>
> *(a) construction works,*
>
> *(b) emergency works or routine maintenance works*

The proposed pipeline constitutes development for the purpose of a gas pipeline that would be carried out subject to a licence under the *Pipelines Act 1967*. Accordingly, while under clause 53(1) of the Infrastructure SEPP, should project approval be granted for the pipeline and a pipeline licence is issued in respect of this component of the Project , further development in relation to the pipeline would be permissible without consent.

While the pipeline does affect land designated as a National Park under the *National Parks and Wildlife Act 1974*, the pipeline does not affect land zoned E1 National Parks and Nature Reserves or equivalent, therefore Clause 53(3) is not relevant to the proposed pipeline.

Clause 104 of the Infrastructure SEPP relates to traffic generating development and requires that certain development with the potential to generate a substantial level of traffic be referred to the RTA for comment. Development to which the clause applies is set out in Schedule 3 of the SEPP and includes development for any purpose not specifically identified in the schedule with the potential to generate traffic of more than 200 vehicles.

The Project would generate traffic of greater than 200 vehicles during the construction period and is therefore subject to clause 104.

In relation to such traffic generating development, Clause 104 requires the consent authority to take into consideration:

> *(i) any submission that the RTA provides in response to that notice within 21 days after the notice was given (unless, before the 21 days have passed, the RTA advises that it will not be making a submission), and*
>
> *(ii) the accessibility of the site concerned, including:*
>
> > *(A) the efficiency of movement of people and freight to and from the site and the extent of multi-purpose trips, and*
> >
> > *(B) the potential to minimise the need for travel by car and to maximise movement of freight in containers or bulk freight by rail, and*
>
> *(iii) any potential traffic safety, road congestion or parking implications of the development.*

The RTA has been consulted with respect to the Project (as detailed in **Chapter 7**) and would be further consulted prior to commencement of the Project. Comments provided so far have been taken into consideration in the preparation of the EA and further comments would be considered by the DoP as appropriate through the approvals process. The traffic and access arrangements and potential impacts of the Project are considered in detail in **Chapter 16** of this EA. A range of mitigation measures have been recommended to ensure that these impacts are minimised.

6.5.4 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

State Environmental Planning Policy No.33 – Hazardous and Offensive Development (SEPP 33) applies to industry that has the potential to create an off-site risk or offence to people, property or the environment. SEPP 33 applies to two categories of industry - hazardous industry and offensive industry.

SEPP 33 defines a 'potentially hazardous industry' as:

> *'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:*
>
> - to human health, life or property, or
> - to the biophysical environment,
>
> *and includes a hazardous industry and a hazardous storage establishment'.*

A 'potentially offensive industry' is defined under SEPP 33 as:

> *'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.*

If the development is found to be 'potentially hazardous', a Preliminary Hazard Analysis (PHA) is required to be prepared in accordance with current circulars or guidelines published by the Department of Planning and submitted with any development application.

The document, "*Applying SEPP 33 – Hazardous and Offensive Development Application Guidelines*" was prepared by the Department of Urban Affairs and Planning (DUAP, now DoP) 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 waste 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 matter for consideration is whether the proposal is identified as an industry as defined under the principle planning instrument which applies. The subject proposal is defined as 'petroleum production', 'petroleum related works' and 'utility installation' under the relevant environmental planning instruments (EPIs) (see **Sections 6.7.7 and 6.5).**

As the proposed development is not defined as an industry, SEPP 33 does not strictly apply to the Project. However, in order to satisfy community and stakeholder concerns regarding risk issues, a PHA has been prepared in respect of the Project and is included as **Appendix I** of the EA. The PHA concludes that the Project does not pose a significant risk to humans or the biophysical environment subject to recommended mitigation measures (see **Chapter 15**).

6.5.5 State Environmental Planning Policy No. 14 – Coastal Wetlands

State Environmental Planning Policy No. 14 (SEPP 14) aims to preserve and protect coastal wetlands in the State and requires the consent of the council and the concurrence of the Director-General for certain development including clearing, constructing a levee, draining or filling of land to which the policy applies. Clause 6(b) of SEPP 14, however states that the concurrence of the Director-General is not required where the Project is one which Part 3A applies. **Figure 6.1** indicates SEPP 14 wetlands located within the Concept and Project Areas.

In considering whether consent should be granted for such development, the consent authority is required to consider a range of matters as specified and referenced in the table below.

Table 6-12: SEPP 14 - Matters for Consideration

Matter	Reference in EA
The environmental effects of the proposed development, including the effect of the proposed development on: ▪ the survival of native wildlife populations, ▪ the growth of native plant communities; ▪ the provision and quality of habitats for both indigenous and migratory species, ▪ the surface and groundwater characteristics of the site on which the development is proposed to be carried out and of the surrounding area, including salinity and water quality.	**Chapters 10, 12 and 13 and Appendix G**
Whether adequate safeguards and rehabilitation measures have been, or will be, made to protect the environment.	**Chapter 25 and 26**
Whether carrying out the development would be consistent with the aim of this policy.	**Chapter 10 and Appendix G**

Matter	Reference in EA
The objectives and major goals of the *"National Conservation Strategy for Australia"* in so far as they relate to wetlands and the conservation of "living resources" generally, copies of which are deposited in the office of the Department.	Generally addressed by the ecological assessment in **Appendix G** and summarised in **Chapter 10.**
Whether consideration has been given to establish whether any feasible alternatives exist to the carrying out of the proposed development (either on other land or by other methods) and if so, the reasons given for choosing the proposed development.	**Chapter 4**
Any representations made by the Director of National Parks and Wildlife in relation to the development application.	Consultation has been undertaken with NPWS. Refer to **Chapter 7**.
Any wetlands surrounding the land to which the development application relates and appropriateness of imposing conditions requiring the carrying out of works to preserve or enhance the value of those surrounding wetlands.	**Chapter 10 and Appendix G**

6.5.6 State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 (SEPP 44) applies to a range of LGAs including Dungog, Gloucester, Maitland, Port Stephens, Newcastle and Great Lakes within which the Concept and Project Areas are located. The policy aims to:

> *encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline:*
>
> - *by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and*
> - *by encouraging the identification of areas of core koala habitat, and*
> - *by encouraging the inclusion of areas of core koala habitat in environment protection zones.*

The policy applies to land which is the subject of a development application (DA) and which is greater than 1 hectare in area. Whilst the Project is not the subject of a DA, but of a Concept Plan/Project Application, it is assumed that the policy is intended to apply to Part 3A projects and the provisions of the SEPP are therefore considered in relation to the proposal.

SEPP 44 requires that prior to granting consent to a development on land subject to the policy, the Council must consider whether the land constitutes 'potential' or 'core' koala habitat. Core koala habitat is defined as areas which contain a resident koala population and potential koala habitat is defined as areas in which the tree species listed in Schedule 2 comprise at least 15 % of the total number of trees in the upper or lower strata of the tree component. Should core koala habitat be identified, a Plan of Management is required to be prepared in respect of the habitat and any consent granted in respect of the land must be consistent with the Plan of Management.

Part 3 of SEPP 44 sets the requirements for the preparation and approval of Plans of Management.

A targeted flora and fauna survey was undertaken within the Concept and Project Areas with full details provided in **Chapter 10** and **Appendix G** to this EA.

A KoalaPlan of Management has been prepared in respect of the Port Stephens Local Government Area and is discussed below. Compliance with this plan of management implies compliance with the requirements of SEPP 44.

Port Stephens Comprehensive Koala Plan of Management

The Port Stephens Comprehensive Koala Plan of Management (CKPoM) was prepared by Port Stephens Council and the Australian Koala Foundation pursuant to the provisions of SEPP 44. The CKPoM aims to conserve koalas in their existing habitat through identifying and protecting koala habitat and incorporating koala conservation into local government planning processes. The CKPoM supersedes the requirements of SEPP 44 for the investigation of potential and core koala habitat and the requirement for the preparation of individual Koala Plans of Management. The provisions of the CKPoM were taken into consideration in the ecological assessment for the Project and included as **Appendix G** and summarised in **Chapter 10.**

6.5.7 State Environmental Planning Policy No. 55 – Remediation of Land

State Environmental Planning Policy 55 (SEPP 55) aims to provide a State wide approach to the remediation of contaminated land, and in particular, promotes the remediation of contaminated land for the purpose of reducing risk of harm to human health or any other aspect of the environment.

Clause 7 provides for consideration of contamination and remediation in determining development applications. It states:

> *(1) A consent authority must not consent to the carrying out of any development on land unless:*
>
> *(a) it has considered whether the land is contaminated, and*
>
> *(b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and*
>
> *(c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.*
>
> *(2) Before determining an application for consent to carry out development that would involve a change of use on any of the land specified in subclause (4), the consent authority must consider a report specifying the findings of a preliminary investigation of the land concerned carried out in accordance with the contaminated land planning guidelines.*
>
> *(3) The applicant for development consent must carry out the investigation required by subclause (2) and must provide a report on it to the consent authority. The consent authority may require the applicant to carry out, and provide a report on, a detailed investigation (as referred to in the contaminated land planning guidelines) if it considers that the findings of the preliminary investigation warrant such an investigation.*
>
> *(4) The land concerned is:*
>
> *(a) land that is within an investigation area,*

(b) land on which development for a purpose referred to in Table 1 to the contaminated land planning guidelines is being, or is known to have been, carried out,

(c) to the extent to which it is proposed to carry out development on it for residential, educational, recreational or child care purposes, or for the purposes of a hospital—land:

(i) in relation to which there is no knowledge (or incomplete knowledge) as to whether development for a purpose referred to in Table 1 to the contaminated land planning guidelines has been carried out, and

(ii) on which it would have been lawful to carry out such development during any period in respect of which there is no knowledge (or incomplete knowledge).

The Project does not involve a change of use of any of the land specified in subclause (4) of SEPP 55 and therefore a preliminary investigation of the subject land is not required. .

As part of the EA an investigation of DECCW Contaminated Land records was undertaken for the six affected LGAs. The results are summarised in the table below.

Table 6-13: DECCW Contaminated Land Records

Gloucester LGA	Dungog LGA	Great Lakes LGA	Maitland LGA	Port Stephens LGA	Newcastle LGA
No records registered	No records registered	No records registered	4 records registered	1 record registered	38 records registered to 17 sites.

Details of specific sites are provided in **Chapter 17** of this EA.

The Project does not traverse any of the registered sites, therefore it is unlikely that the works would disturb identified contaminated lands. The proposed Stage 1 GFDA and pipeline route do not encroach upon existing industrial lands, which are considered to be the most likely source of land contamination.

There is the potential for historical land uses, such as livestock intensive industries, to result in soil contamination. The proposed Stage 1 GFDA and the pipeline route, would cross large areas of agricultural and grazing lands that may have involved activities with the potential to result in contaminated materials. The Project involves the development of this land for a gas well field and associated plant and a gas transmission pipeline, none of which are land uses which are particularly sensitive in relation to contamination. Further, in relation to the pipeline, once construction was complete, the land would be rehabilitated to its former state and returned to its existing use. With regard to the proposed GFDA and CPF, this component of the Project has would be rehabilitated and returned to either agricultural or industrial use. The subject land is considered to be suitable for the proposed development and it is not anticipated that remediation of land would be required in order for the Project to take place.

6.5.8 State Environmental Planning Policy No. 71 – Coastal Protection

State Environmental Planning Policy 71 – Coastal Protection (SEPP 71) aims to ensure that development in the NSW coastal zone is appropriate and suitably located, so that there is a consistent and strategic approach to coastal planning and management, and to ensure a clear development assessment framework for the coastal zone.

lause 4 stipulates land to which SEPP 71 applies, being land which is within the coastal zone. **Figure 6.1** illustrates the areas within the Concept and Project Areas to which SEPP 71 applies.

Clause 8 of SEPP 71 states matters that are to be taken into consideration by a consent authority when determining a development application to carry out development on land to which SEPP 71 applies. These are addressed in relation to the Project in **Table 6-14** below.

Table 6-14: Matters for Consideration – SEPP 71

Clause 8 Matters for Consideration	Comment or Reference in EA
a) aims of this Policy set out in clause 2:	
(a) to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast, and	The portion of the Project Area affected by SEPP 71 is limited to the southern half of the pipeline route. Whilst some clearing of vegetation would be required as part of the Project, this has been minimised wherever possible and appropriate offsets are proposed to compensate for the loss of vegetation. The Project stands to provide economic benefits to the State without impacting significantly upon the cultural or recreational values of the area. A detailed assessment of the potential environmental impacts of the proposal is provided in **Chapters 9** to **24** of this report.
(b) to protect and improve existing public access to and along coastal foreshores to the extent that this is compatible with the natural attributes of the coastal foreshore, and	The proposed works are not in proximity to the coastal foreshore therefore access to these areas would not be affected by the Project.
(c) to ensure that new opportunities for public access to and along coastal foreshores are identified and realised to the extent that this is compatible with the natural attributes of the coastal foreshore, and	Not applicable to the Project.
(d) to protect and preserve Aboriginal cultural heritage, and Aboriginal places, values, customs, beliefs and traditional knowledge, and	The potential impacts of the proposal upon Aboriginal cultural heritage are discussed in **Chapter 19** and **Appendix K** of this EA.
(e) to ensure that the visual amenity of the coast is protected, and	The proposed pipeline would be underground with affected land being rehabilitated upon completion of construction. The proposed works would therefore not impact upon the visual quality of the NSW coastal area. Visual impacts are considered in **Chapter 18**.
(f) to protect and preserve beach environments and beach amenity, and	The Project does not impact upon beach environments.

Clause 8 Matters for Consideration	Comment or Reference in EA
(g) to protect and preserve native coastal vegetation, and	Whilst some clearing of vegetation would be required as part of the Project, this has been minimised wherever possible and appropriate offsets are proposed to compensate for the loss of vegetation. The potential ecological impacts of the proposal are discussed in detail in **Chapter 10** and **Appendix G** of this report.
(h) to protect and preserve the marine environment of New South Wales, and	The proposed works are not in proximity to marine areas and therefore are not expected to have any direct impact upon the marine environment. The potential impacts of the proposal in terms of surface water and ground water are discussed in **Chapters 12** and **13** of this EA.
(i) to protect and preserve rock platforms, and	The proposed works would not impact upon rock platforms.
(j) to manage the coastal zone in accordance with the principles of ecologically sustainable development (within the meaning of section 6 (2) of the Protection of the Environment Administration Act 1991), and	The Project has been considered against the principles of ESD (refer to **Section 6.1)** and has been found to be generally consistent with these principles.
(k) to ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding area, and	The potential visual impacts of the Project are discussed in **Chapter 18** of this EA. In general, the nature and scale of the structures comprising the various components of the development are such that visual impacts would not be significant.
(l) to encourage a strategic approach to coastal management	The strategic context of the Project is considered in **Chapter 2** of this EA.
b) existing public access to and along the coastal foreshore for pedestrians or persons with a disability should be retained and, where possible, public access to and along the coastal foreshore for pedestrians or persons with a disability should be improved	The proposed works are not in proximity to the coastal foreshore therefore access to these areas would not be affected by the Project.
c) opportunities to provide new public access to and along the coastal foreshore for pedestrians or persons with a disability	Not applicable to the Project.
d) the suitability of development given its type, location and design and its relationship with the surrounding area	**Chapter 11** of this EA addresses the relationship of the Project with surrounding land uses including its suitability for the proposed location.
e) any detrimental impact that development may have on the amenity of the coastal foreshore, including any significant overshadowing of the coastal foreshore and any significant loss of views from a public place to the coastal foreshore	The proposed works are not in proximity to the coastal foreshore and the nature of the components of the Project affected by SEPP 71 (being the underground pipeline) are such that amenity of the coastal foreshore would not be affected.

Clause 8 Matters for Consideration	Comment or Reference in EA
f) the scenic qualities of the New South Wales coast, and means to protect and improve these qualities	The potential impacts of the Project upon the scenic quality of the landscape are discussed in **Chapter 18** of this EA. In general, the nature and scale of the structures comprising the various components of the Project are such that visual/scenic impacts would not be significant.
g) measures to conserve animals (within the meaning of the Threatened Species Conservation Act 1995) and plants (within the meaning of that Act), and their habitats	An assessment of the potential impacts of the Project upon native fauna was undertaken as part of the EA and is detailed in **Chapter 10** and **Appendix G**.
h) measures to conserve fish (within the meaning of Part 7A of the Fisheries Management Act 1994) and marine vegetation (within the meaning of that Part), and their habitats	Consideration of fish and fish habitat has been given through the preparation of the EA and the design and siting of the proposed works. **Chapter 12** discusses the methods of waterway crossings and how these were developed in relation to the potential for impact upon fish.
i) existing wildlife corridors and the impact of development on these corridors	**Chapter 10** and **Appendix G** address the potential ecological impacts of the Project including the impact of the proposed works upon wildlife corridors.
j) the likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and coastal hazards	The proposed works are not located on the coast and therefore would not be impacted by coastal processes or coastal hazards.
k) measures to reduce the potential for conflict between land-based and water-based coastal activities	Not applicable to the Project.
l) measures to protect the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals	The potential impacts of the Project upon Aboriginal cultural heritage are discussed in **Chapter 19** and **Appendix K** of this EA.
m) likely impacts of development on the water quality of coastal waterbodies	The potential impacts of the Project upon surface water and ground water are discussed in **Chapters 12** and **13** of this EA.
n) the conservation and preservation of items of heritage, archaeological or historic significance	The potential impacts of the Project upon items of heritage, archaeological or historic significance are discussed in **Chapter 19** and **Appendix K** of this EA.
o) only in cases in which a development application in relation to proposed development is determined: (i) the cumulative impacts of the proposed development on the environment, and (ii) measures to ensure that water and energy usage by the proposed development is efficient.	The cumulative impacts of the Project are discussed in **Chapter 24** of this EA. The use of water and energy by the Project is detailed in **Chapter 5** of the EA.

The Project is considered to be generally consistent with the matters for consideration set out in clause 8 of SEPP 71.

6.6 Local Planning Instruments

The proposed works comprising the Project cover six different LGAs. These are listed below in relation to their EPIs:

- Gloucester - *Gloucester Local Environmental Plan 2000* and *Draft Gloucester Local Environmental Plan 2009*;
- Dungog - *Dungog Local Environmental Plan 2006*;
- Great Lakes - *Great Lakes Local Environmental Plan 1996*;
- Port Stephens - *Port Stephens Local Environmental Plan 2000* ;
- Maitland - *Maitland Local Environmental Plan 1993*; and
- Newcastle - *Newcastle Local Environmental Plan 2003*.

6.6.1 Overview of Permissibility

There are a number of land use zones within the Concept and Project Areas. The permissibility of the proposed works within each of the land use zones affected by the Concept Plan application is summarised in **Table 6-15** below.

Table 6-15: Permissibility of Project

Relevant Instrument	Land Use Zone	Permissible?	Comment*
Gloucester LEP 2000	Rural 1(a)	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
	Environmental Protection 7(d)	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
Draft Gloucester LEP 2009	RU1 Primary Production	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
	IN3 Heavy Industrial	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
Great Lakes LEP 1996	Rural 1(a)	✓	In accordance with Clause 7(2) of the MPPEI SEPP.
Dungog LEP 2006	Rural 1(a)	✓	In accordance with Clause 53 of the Infrastructure SEPP.
	Rural Lifestyle 1(l)	✓	In accordance with Clause 53 of the Infrastructure SEPP.
	Environment 7(a)	✓	In accordance with Clause 53 of the Infrastructure SEPP.
	Transition 9(a)	✓	In accordance with Clause 53 of the Infrastructure SEPP.
Port Stephens LEP 2000	1(a) Rural Agriculture “A”	✓	In accordance with Clause 53 of the Infrastructure SEPP.

Relevant Instrument	Land Use Zone	Permissible?	Comment*
Maitland LEP 1993	1(a) Prime Rural Land	✓	In accordance with Clause 53 of the Infrastructure SEPP.
Newcastle LEP 2003	4(b) Port and Industry	✓	In accordance with Clause 53 of the Infrastructure SEPPand Clause 7(2) of the MPPEI SEPP.
	5(a) Special Uses	✓	In accordance with Clause 53 of the Infrastructure SEPP and Clause 7(2) of the MPPEI SEPP.
	7(a) Conservation Zone	✓	In accordance with Clause 53 of the Infrastructure SEPP.
	7(b) Environmental Protection	✓	In accordance with Clause 53 of the Infrastructure SEPP.

Refer to following sections for further detail.

6.6.2 Gloucester Local Environmental Plan 2000

Gloucester Local Environmental Plan 2000 (GLEP 2000) is the relevant EPI applying to the Gloucester LGA, incorporating the Stage 1 GFDA, both CPF Site 1 and Site 7, and the gas transmission pipeline. The aims of GLEP 2000 are:

- to manage the resources of the Gloucester area,
- to protect prime crop and pasture land and places of natural and cultural significance,
- to manage development to benefit the community,
- to embrace and promote the principles of ecologically sustainable development.

Definition of the Development

Clause 6 of the LEP adopts the *Environmental Planning and Assessment Model Provisions 1980* (Model Provisions) with the exception of:

- the definition of agriculture and rural worker's dwelling, and
- clauses 15 and 29, and
- Schedule 1, clause 9 as it relates to land in Zone 7 (d) (Environment Protection (Scenic) Zone),

The *Environmental Planning and Assessment Model Provisions 1980* (Model Provisions) provide the following definition for a public utility undertaking:

> *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 definition of each of the Stage 1 GFDA, CPF and pipeline are discussed in respect of the Model Provisions definition of a ‘public utility undertaking’, as well as the definition of the proposed Project under the MPPEI SEPP.

Stage 1 GFDA

The Stage 1 GFDA is situated on land predominantly zoned Rural 1(a). The Proponent for the Project is the holder of a PEL issued under the PO Act which covers the Project and Concept Areas for the Stage 1 GFDA and CPF locations. This PEL allows the Proponent exclusive rights to undertake petroleum exploration as discussed in **Section 6.3** of this EA. Subject to the granting of Project Approval for the Stage 1 GFDA and CPF Project Areas, the Proponent would apply for a PPL pursuant to the PO Act allowing it exclusive rights to undertake petroleum production within the Stage 1 GFDA. As discussed in **Section 6.3**, if Project Approval is granted for the Project, a PPL cannot be refused and must be consistent with the terms of Project Approval.

Therefore, in relation to the proposed Project, AGL comprises a corporation or firm carrying out an undertaking in pursuance of a State Act. The Stage 1 GFDA is therefore defined as a ‘public utility undertaking’ under the Model Provisions, being an undertaking for the supply of gas, carried on under the authority of the PO Act and the Pipelines Act by a corporation, being AGL.

Under the MPPEI SEPP, the Stage 1 GFDA comprising the drilling and operation of gas wells and the construction and operation of associated infrastructure and ancillary plant for the recovery of CSG is defined as ‘petroleum production’ and ‘petroleum related works’, as discussed in **Section 6.5.2**.

CPF Site 1 and Site 7

Both CPF locations at Site 1 and Site 7 are situated on land zoned Rural 1(a). The buildings associated with the CPF are defined as ‘utility installations’ under the Model Provisions, being:

> *a building or work used by a public utility undertaking, but does not include a building designed wholly or principally as administrative or business premises or as a show-room.*

Under the MPPEI SEPP, the CPF is defined as the construction and operation of infrastructure and ancillary plant for the recovery of coal seam gas which constitutes works defined as ‘petroleum production’ and ‘petroleum related works’, as discussed in **Section 6.5.2** and above.

Pipeline

With respect to the construction and operation of the pipeline, subject to the granting of Project Approval for the pipeline, a Pipeline Licence would be sought in accordance with the provisions of the *Pipelines Act 1967*. If Project Approval is issued for the pipeline, a Pipeline Licence cannot be refused and must be generally consistent with the terms of Project Approval. AGL comprises a corporation or firm carrying out an undertaking in pursuance of a State Act. The pipeline is therefore defined as a ‘public utility undertaking’ under the Model Provisions, being an undertaking for the supply of gas, carried on under the authority of the PO Act and the Pipelines Act by a corporation.

Under the MPPEI SEPP, the pipeline is defined as the construction and operation of infrastructure and ancillary plant for the recovery of CSG which constitutes works defined as ‘petroleum production’ and ‘petroleum related works’, as discussed in **Section 6.5.2** and above.

Permissibility

Concept Area

The land comprising the Concept Area is primarily zoned Rural 1(a) and partially Environment Protection (Scenic) 7(d) under GLEP 2000.

Stage 1 GFDA

The Stage 1 GFDA is situated on land zoned Rural 1(a) under GLEP 2000. The GLEP adopts the Model Provisions, pursuant to which the proposed Stage 1 GFDA is defined as a ‘public utility undertaking’. Part 2 of GLEP 2000 specifies development which can be carried out without consent and development which can be carried out with consent with all other development not listed under these categories being prohibited.

> *Public utility undertakings are not permissible with or without consent within the Rural 1(a) or Environment Protection 7(d) zones and are therefore deemed to be prohibited under the GLEP 2000.*

However, Clause 5(3) of the MPPEI SEPP states that:

> *(3) Subject to subclause (4), if this Policy is inconsistent with any other environmental planning instrument, whether made before or after this Policy, this Policy prevails to the extent of the inconsistency.*

Clause 7(2)(a) and 7(2)(d) of the MPPEI SEPP allow for certain development defined as petroleum production to be carried out with consent including:

> *(a) petroleum production on land on which development for the purposes of agriculture or industry may be carried out (with or without development consent),*
>
> *(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.*

Accordingly, as Stage 1 GFDA is defined as petroleum production under the MPPEI SEPP, and is to take place upon land zoned Rural 1(a) upon which agriculture is a permissible use, the Stage 1 GFDA is permissible with consent in accordance with Clause 7(2)(a) of the MPPEI SEPP.

CPF Site 1 and Site 7

Both the proposed CPF locations, Site 1 and Site 7, are situated on land zoned Rural 1(a) under GLEP 2000 and the CPF is prohibited under the GLEP 2000.

However under the MPPEI SEPP, the CPF is defined as ‘petroleum production’ and ‘petroleum related works’, and is to take place upon land zoned Rural 1(a) upon which agriculture is permissible without consent. Under Clause 7(2) of the MPPEI SEPP the proposed CPF comprises facilities for the processing and transportation of petroleum on land which petroleum production may be carried out (GLEP 2000, Rural 1(a)) with consent under the MPPEI SEPP as the petroleum would be recovered from that, or adjoining land. Therefore the CPF is permissible with consent in accordance with Clauses 7(2)(a) and 7(2)(d) of the MPPEI SEPP.

Pipeline

The proposed pipeline is situated on land zoned Rural 1(a) under the GLEP 2000.

As stated above, the GLEP 2000 adopts the Model Provisions. clause 35 of the Model Provisions (adopted for the purposes of GLEP 2000) states that:

> *Nothing in the local environmental plan shall be construed as restricting or prohibiting or enabling the consent authority to restrict or prohibit:*
>
> *(a) the carrying out of development of any description specified in Schedule 1,*

Schedule 1(2) to the Model Provisions includes:

> *The carrying out by persons carrying on public utility undertakings, being water, sewerage, drainage, electricity or gas undertakings, of any of the following development, being development required for the purpose of their undertakings, that is to say:*
>
> *(a) development of any description at or below the surface of the ground,*

Accordingly, as the proposed gas pipeline is development below the surface of the ground, it is permissible use under the GLEP 2000.

Additionally, under the MPPEI SEPP, the proposed pipeline is defined as ‘petroleum production’ and ‘petroleum related works’. Under Clause 7(2)(a), petroleum production development is permissible on land which development for the purposes of agriculture or industry may be carried out. Agriculture is permissible on land Rural 1(a) upon which agriculture is permissible without consent, therefore the pipeline is permissible with consent under the MPPEI SEPP.

Relevant Special Provisions

Table 6-16: Special Provisions GLEP2000

Clause	Description	Relevance	Reference in EA
34	Requires that the consent of Council be obtained for development proposed on environmentally sensitive land and states that Council shall not consent to such development unless: *‘it is satisfied that the carrying out of the development in accordance with the consent will not harm the scientific, natural, aesthetic, archaeological or ecological significance of the land.’*	The Concept Area may encroach within land zoned for environmental protection.	**Chapters 10** and **11**
35	Requires that Council consider certain matters in relation to the proposed development of flood liable land such as community safety, impact upon flood regime and local hydrology and the impact upon the water table. Also requires that Council has regard to its Floodplain Management Plan and the NSW Government *Floodplain Management Manual.*	The Project encroaches within flood liable land.	**Chapter 12.**

Clause	Description	Relevance	Reference in EA
45	Relates to development of known or potential archaeological sites and requires that Council consider an assessment of how the proposed development would affect the conservation of the site/relic and that the relevant State Government authorities are notified of the proposed development.	The Project has the potential to impact upon known or potential archaeological sites and/or heritage items.	**Chapter 19** and **Appendix K**
46	Addresses development in the vicinity of heritage items, heritage conservation areas, archaeological sites or potential archaeological sites and requires that Council consider the likely effect of the proposed development on the heritage significance of the item, conservation area or site.	The Project passes in the vicinity of archaeological sites and/or heritage items.	**Chapter 19** and **Appendix K**

6.6.3 Draft Gloucester Local Environmental Plan 2009

Draft Gloucester Local Environmental Plan 2009 (Draft GLEP 2009) has been publicly exhibited by DoP and as such the EPI has been considered in respect of the Project. The aims of Draft GLEP 2009 are:

> *(a) to manage the resources of the Gloucester area,*
>
> *(b) to protect rural lands, natural resources and assets of heritage significance,*
>
> *(c) to manage development to benefit the community,*
>
> *(d) to embrace and promote the principles of ecologically sustainable development, conservation of biological diversity and sustainable water management, and to recognise the cumulative impacts of climate change,*
>
> *(e) to protect, enhance and provide for biological diversity, including native threatened species, populations and ecological communities, by long term management and by identifying and protecting habitat corridors and links throughout the Gloucester area.*

Definition

The Draft GLEP 2009 does not provide a specific definition for petroleum production and related activities. The most fitting definition for the proposal under Draft GLEP 2009 is that of a *public utility undertaking*, being:

> *any of the following undertakings carried on or permitted 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 includes a reference to a council, electricity supply authority, Government Department, corporation, firm or authority carrying on the undertaking.

The relevance of this definition to the proposal is established previously in **Section 6.7.2** of this EA.

Permissibility

The Stage 1 GFDA and CPF sites are located on land zoned RU1 Primary Production and IN3 Heavy Industrial under Draft GLEP 2009. The section of the proposed pipeline within the Gloucester LGA is also situated on land zoned RU1 Primary Production.

Public utility undertakings are prohibited in both the RU1 and IN3 zones under Draft LEP 2009. However, Clause 5(3) of the MPPEI SEPP states that:

(3) Subject to subclause (4), if this Policy is inconsistent with any other environmental planning instrument, whether made before or after this Policy, this Policy prevails to the extent of the inconsistency.

Accordingly, as discussed in section 6.6.2 above, the proposed gas production wells, CPF and pipeline are permissible under clause 7(2) of the MPPEI SEPP and the Infrastructure SEPP.

6.6.4 Great Lakes Local Environmental Plan 1996

Great Lakes Local Environmental Plan 1996 (GLLEP 1996) is the relevant EPI applying to the Great Lakes LGA within which part of the proposed pipeline runs. The aims of GLLEP 1996 are:

- to provide an updated and simplified plan for the area of Great Lakes, and
- to protect and enhance the environmental qualities of the area, and
- to facilitate the orderly and economic development of land within the area, and
- to promote the well-being of the area’s population.

The proposed pipeline is situated on land zoned Rural 1(a) within the Great Lakes LGA.

Definition of the Development

The proposed pipeline does not fall within the definitions set out in GLLEP 1996 and is therefore undefined under the LEP.

As discussed in **Section 6.5.2** and in the sections above, under SEPP 2007 the proposed pipeline is defined as ‘petroleum production’ and ‘petroleum related works’.

Permissibility

Clause 15 of GLLEP 1996 addresses particular activities which are deemed to be unaffected by the provisions of the LEP. The clause states that:

Nothing in this plan restricts, prohibits or requires development consent for:

(a) the use of existing buildings under the control of the Crown by the Crown, or

(b) any activity listed in Schedule 1.

Schedule 1 to the GLLEP 1996 includes the following forms of development:

Public utility water, sewerage, drainage, electricity or gas undertakings comprising:

(a) development of any description at or below the surface of the ground,

The proposed pipeline comprises a gas undertaking which is below the surface of the ground and is therefore permissible without consent.

Under the MPPEI SEPP, the proposed pipeline is defined as 'petroleum production' and 'petroleum related works'. Under Clause 7(2)(a), petroleum production development is permissible on land which development for the purposes of agriculture or industry may be carried out. Agriculture is permissible on land zoned Rural 1(a). Therefore the pipeline is permissible with consent under the MPPEI SEPP.

Relevant Special Provisions

Table 6-17: Special Provisions – GLLEP1996

Clause	Description	Relevance	Reference in EA
11 – Modification to Landform	Requires the consent of Council for the filling or excavation of land and requires that Council consider the impact of the development upon the existing natural and built environment.	The Project would require some excavation and backfilling for the laying of the pipeline.	**Chapters 5** and **17.**
21 – Heritage	Addresses heritage issues including proposed development of heritage items and within conservation areas, development in the vicinity of heritage items, conservation areas, archaeological sites and potential archaeological sites and development of archaeological sites and potential archaeological sites.	The proposed pipeline may be located in the vicinity of certain heritage items and/or archaeological sites and has the potential to impact upon archaeological sites and/or potential archaeological sites.	**Chapter 19** and **Appendix K**
25 – Waterways	Addresses waterways issues including development below the mean high water mark and development on flood-liable land.	The Project would include some development below the mean high water mark in the form of creek/river crossings. The Project would affect certain flood-liable land.	**Chapters 5** and **12**

6.6.5 Dungog Local Environmental Plan 2006

Dungog Local Environmental Plan 2006 (DLEP 2006) is the primary EPI applying to land within the Dungog LGA, including that affected by the proposed gas pipeline. The aims of the plan are to:

> *…promote the Council's vision for Dungog by providing opportunities for, and constraints on, development that will achieve the following objectives set out in Part 2:*
>
> *(a) the objectives for a country atmosphere, productive agriculture, diverse communities, distinctive settlements and a sustainable environment,*
>
> *(b) the objectives of the zones into which land in the area of Dungog is divided by this plan.*

The proposed pipeline is situated on land zoned Rural 1(a), Rural Lifestyle 1(l), Environment 7(a) and Transition 9(a) under LEP 2006. It is noted that the pipeline affects land declared to be a National Park under the *National Parks and Wildlife Act 1974* within Dungog LGA, however this land is not zoned National Parks 8(a) zone under DLEP 2006.

Definition of the Development

DLEP 2006 provides the following definition for a 'utility installation':

> *(a) a building, structure or work used by a public or private utility undertaking or by a public or private communication undertaking (excluding buildings designed wholly or principally as administrative or business premises or as a showroom), or*
>
> *(b) an accessway, road, conveyor or work for the drainage of water or the damming or filling of a watercourse, or*
>
> *(c) a pipeline.*

The component of the Project within the Dungog LGA is the proposed pipeline which fits within the above definition of a 'utility installation' under DLEP 2006.

As discussed in **Section 6.5.2** and in the sections above, under the MPPEI SEPP the proposed pipeline is defined as 'petroleum production' and 'petroleum related works'.

Permissibility

'Utility installations' are permissible with consent in all zones within the Dungog LGA with the exception of the Special Uses 5(a) zone where 'utility installations' are permissible without consent. The proposed pipeline is therefore permissible in the Rural 1(a), Rural Lifestyle 1(l), Environment 7(a) and Transition 9(a) zones within Dungog LGA.

Under the MPPEI SEPP, the proposed pipeline is defined as 'petroleum production' and 'petroleum related works'. Under Clause 7(2)(a), petroleum production development is permissible on land which development for the purposes of agriculture or industry may be carried out. Agriculture is permissible on Rural 1(a), Rural Lifestyle 1(l), Environment 7(a) and Transition 9(a) zones under DLEP 2006. Therefore the pipeline is permissible with consent under the MPPEI SEPP.

Relevant Special Provisions

Table 6-18: Special Provisions DLEP 2006

Clause	Description	Relevance	Reference in EA
25 - Heritage	Requires the consent of Council for certain development with the potential to impact upon a heritage item or place of Aboriginal heritage significance. The clause also sets out a number of considerations which must be taken into account by the Council when considering whether to grant consent for such development.	The proposed pipeline may be located in the vicinity of certain heritage items and has the potential to impact upon places of Aboriginal heritage significance.	**Chapter 19** and **Appendix K**
26 – Environmental protection	Sets out matters for consideration in relation to development proposed in the 1(a), 1(l), 1(e), 7(a) or 9(a) zones including landscape character and rural amenity, clearing of vegetation, vehicular access, services, flood conditions, slope, heritage and threatened ecological communities, noise and vibration, stormwater, groundwater, acid sulfate soils, biodiversity and bushfire.	The proposed pipeline would encroach upon land zoned 1(a), 1(l) and 9(a).	**Chapters 10, 11, 12, 13, 14, 15, 17,** and **18.**

6.6.6 Port Stephens Local Environmental Plan 2000

Port Stephens Local Environmental Plan 2000 (PSLEP 2000) is the principle EPI applying to the Port Stephens LGA within which part of the proposed gas transmission pipeline runs. The aims of the LEP are to:

> *(a) provide for appropriate planning and environmental control over the use and development of land within the area of Port Stephens, in order to uphold and promote the objectives of the Environmental Planning and Assessment Act 1979, and*
>
> *(b) provide an updated and simplified plan for the area of Port Stephens, and*
>
> *(c) achieve the objectives of each zone referred to in clause 10, and*
>
> *(d) promote community involvement and participation in environmental planning and development assessment, and*
>
> *(e) ensure that existing and future residents enjoy a range of attractive living environments, have safe and secure communities and have access to a wide range of services and amenities, and*
>
> *(f) allow flexibility in the planning framework so as to encourage orderly, economic and equitable development while safeguarding the community's interests, and*

> *(g) ensure that development has regard to the principles of ecologically sustainable development.*

The proposed pipeline is situated on land zoned 1(a) Rural Agriculture within the Port Stephens LGA.

Definition of the Development

PSLEP 2000 adopts the following definition for a ‘utility undertaking’:

> *any undertaking carried on by or under the authority of any government department, or in pursuance of any Commonwealth or State Act, for the purpose of:*
>
> *(c) the supply of water, hydraulic power, electricity or gas*

The proposed pipeline falls within the above definition of a ‘utility undertaking’ as an undertaking for the supply of gas, carried on in pursuance to the NSW *Pipelines Act 1967.*

As discussed in **Section 6.5.2** and in the sections above, under the MPPEI SEPP the proposed pipeline is defined as ‘petroleum production’ and ‘petroleum related works’.

Permissibility

‘Utility installations’ are permissible in all zones within the Port Stephens LGA with the exception of the Special Uses 5(a) – Defence Purposes Zone, where ‘utility installations’ are prohibited. The proposed gas pipeline does not encroach within the Special Uses 5(a) – Defence Purposes Zone and is therefore permissible.

Under the MPPEI SEPP, the proposed pipeline is defined as ‘petroleum production’ and ‘petroleum related works’. Under Clause 7(2)(a), petroleum production development is permissible on land which development for the purposes of agriculture or industry may be carried out. Agriculture is permissible on 1(a) Rural Agriculture under PSLEP 2000. Therefore the pipeline is permissible with consent under SEPP 2007.

Relevant Special Provisions

The special provisions of relevance to the Project, along with a reference to where these matters are addressed in the EA are summarised in the table below:

Table 6-19: Special Provisions – PSLEP 2000

Clause	Description	Relevance	Reference in EA
38 – Development on flood prone land	Requires consent of Council for development on flood prone land and sets out matters for consideration in relation to a DA for development on flood prone land.	Proposed pipeline would encroach upon flood prone land.	**Chapter 12**
39 – Development near the Williams River	Requires the consent of Council for certain development within 30 m of a bank of the Williams River and within the Williams River catchment. Also provides matters for consideration for the consent authority when considering a DA for such development.	Proposed pipeline would cross Williams River requiring works within 30m of the bank.	**Chapter 12**
51A – Development on land identified on Acid Sulfate Soils Planning Maps	Requires consent for certain specified development on land identified on the Acid Sulfate Soils Planning Maps. Requires preparation and consideration of an Acid Sulfate Soils Management Plan for such development.	The proposed pipeline would encroach upon land identified as having potential for Acid Sulfate Soils.	**Chapter 17**
59 – Development of known or potential archaeological sites	Requires consideration of an assessment of the potential impacts of a proposed development upon the conservation of known sites or relics prior to granting consent for such development.	The proposed pipeline has the potential to impact upon archaeological sites or relics, although measures have been taken to avoid known sites or relics in the determination of the pipeline route.	**Chapter 19** and **Appendix K**
60 – Development in the vicinity of heritage items, heritage conservation areas, archaeological sites or potential archaeological sites.	Requires the consent authority to consider the likely effect of a development proposal on the heritage significance of a heritage item, heritage conservation area, archaeological site or potential archaeological site located in the vicinity of the proposed development.	The proposed pipeline may be located in the vicinity of certain heritage items, conservation area, archaeological sites and potential archaeological sites.	**Chapter 19** and **Appendix K**

6.6.7 Maitland Local Environmental Plan 1993

Maitland Local Environmental Plan 1993 (MLEP1993) is the primary EPI applying to the Maitland LGA. The proposed gas transmission pipeline runs through the Maitland LGA. The objectives of MLEP 1993 are:

> *(a) To ensure the natural environment remains safe from detrimental impacts of development.*
>
> *(b) To minimise adverse environmental, social and economic impacts resulting from urban development and to encourage building designs which are aesthetic and energy efficient.*
>
> *(c) To provide appropriate land in area, location and quality for living, working and recreational activities and agricultural production.*
>
> *(d) To provide a diversity of housing available throughout the City.*
>
> *(e) To ensure the retail hierarchy of regional, district and neighbourhood shopping centres is maintained.*
>
> *(f) To encourage functional and economically viable industrial development, which does not adversely affect the environment or the amenity of nearby residents.*
>
> *(g) To provide a range of community facilities to serve the population.*
>
> *(h) To conserve and enhance buildings, structures and sites of recognised significance which are part of the heritage of the City for future generations.*
>
> *(i) To ensure an efficient and safe road network is maintained with minimum intrusion on business centres, open space and residential areas.*
>
> *(j) To provide open space and a range of recreational facilities to meet the needs of the population.*
>
> *(k) To protect attractive landscapes and preserve places of natural beauty, including wetlands, waterways and the floodplain.*
>
> *(l) To ensure residents are not put at risk in the event of flooding.*

The proposed pipeline is situated on land zoned 1(a) Prime Rural Land under MLEP 1993.

Definition of the Development

The proposed gas pipeline is defined as a 'utility undertaking' under MLEP 1993, being:

> *any undertaking carried on by or by authority of any Government department, or in pursuance of any Commonwealth or State Act, for the purpose of:*
>
> *(c) the supply of water, hydraulic power, electricity or gas,*

The proposed pipeline falls within the above definition of a 'utility undertaking' as an undertaking for the supply of gas pursuant to the NSW *Pipelines Act 1967.*

As discussed in **Section 6.5.2** and in the sections above, under the MPPEI SEPP the proposed pipeline is defined as 'petroleum production' and 'petroleum related works'.

Permissibility

'Utility installations' are permissible in all zones within the Maitland LGA with the exception of the Special Uses 5(a) Railways Zone and the Proposed Recreation 6(c) zone, where 'utility installations' are prohibited. The proposed gas pipeline does not encroach into either of these zones and is therefore permissible.

Under the MPPEI SEPP, the proposed pipeline is defined as 'petroleum production' and 'petroleum related works'. Under Clause 7(2)(a), petroleum production development is permissible on land which development for the purposes of agriculture or industry may be carried out. Agriculture or industry is permissible with or without consent on land zoned 1(a) Prime Rural Land under MLEP 1993. Therefore the pipeline is permissible with consent in these zones under the MPPEI SEPP.

Relevant Special Provisions

Table 6-20: Special Provisions MLEP 1993

Clause	Description	Relevance	Reference in EA
29 – How are trees preserved?	Requires the consent of Council for the removal of trees with a height of 3 m or more or having a branch spread of 3 m or more in diameter. Sets out matters for consideration in this regard including soil stability and land degradation, scenic or environmental amenity and vegetation systems and natural wildlife habitats.	The proposed Project would require some removal of trees, however the clearing of trees with a height or branch spread of 3 m or more have been avoided wherever possible.	**Chapter 10** and **Appendix G**
38 – What controls apply with respect to development in the vicinity of heritage items?	Requires the consent of Council to carry out development on land in the vicinity of a heritage item and requires Council to consider an assessment of the effect of the proposed development on the heritage significance of the item and its setting.	The proposed Project may pass in the vicinity of certain heritage items.	**Chapter 19** and **Appendix K**
41 – What restrictions apply to development of land within floodways?	Requires that Council consider certain matters in relation to development proposed in floodways including potential for detrimental changes to the flow of floodwater or possible harm to human life, animal welfare or property.	The proposed pipeline encroaches within the floodway in certain locations.	**Chapter 12**

6.6.8 Newcastle Local Environmental Plan 2003

Newcastle Local Environmental Plan 2003 (NLEP 2003) is the principle EPI applying to land within the Newcastle LGA with the exception of land subject to *Newcastle City Centre Local Environmental Plan 2008*. The aims of NLEP 2003 are:

> *To respect, protect and complement the natural and cultural heritage, the identity and image, and the sense of place of the City of Newcastle.*
>
> *To conserve and manage the natural and built resources of the City of Newcastle for present and future generations, and to apply the principles of ecologically sustainable development (ESD) in the City of Newcastle.*
>
> *To contribute to the economic well being of the community in a socially and environmentally responsible manner.*
>
> *To improve the quality of life and well being of the people of the City of Newcastle.*
>
> *To facilitate a diverse and compatible mix of land uses in and adjacent to the urban centres of the City of Newcastle, to support increased patronage of public transport and help reduce travel demand and private motor-vehicle dependency.*
>
> *To encourage a diversity of housing types in locations that improve access to employment opportunities, public transport, community facilities and services, retail and commercial services, and the like.*

The proposed pipeline is located on land zoned 4(b) Port and Industry, 5(a) Special Uses, 7(a) Conservation Zone and 7(b) Environmental Protection. The proposed HDS is situated on land zoned 4(b) Port and Industry.

Definition of the Development

Pipeline

NLEP 2003 provides the following definition for a 'utility undertaking':

> *any undertaking carried on by or by authority of any Government department, or in pursuance of any Commonwealth or State Act, for the purpose of:*
>
> *(a) railway, road, water or air transport, or wharf or river undertakings,*
>
> *(b) the provision of sewerage or drainage services,*
>
> *(c) the supply of water, hydraulic power, electricity or gas,*
>
> *(d) telecommunications facilities,*
>
> *(e) firefighting facilities, or*
>
> *(f) paramedical facilities.*

The proposed pipeline comprises undertakings for the supply of gas, carried on by a corporation in pursuance of the NSW *Pipelines Act 1967* and therefore falls within the definition of a 'utility undertaking' under NLEP 2003.

As discussed in **Section 6.5.2** and in the sections above, under the MPPEI SEPP the proposed pipeline is defined as ‘petroleum production’ and ‘petroleum related works’.

Hexham Delivery Station

The proposed HDS comprises undertakings for the supply of gas, carried on by a corporation in pursuance of the NSW *Pipelines Act 1967* and therefore falls within the definition of a ‘utility undertaking’ under NLEP 2003.

Under the MPPEI SEPP, the proposed HDS constitutes works and structures ancillary to petroleum production. As such, the HDS fits within the definition of ‘petroleum related works’ described in **Section 6.5.2** under the MPPEI SEPP.

Permissibility

Pipeline

Utility undertakings are permissible with consent in each of the land use zones, 4(b) Port and Industry, 5(a) Special Uses, 7(a) Conservation Zone and 7(b) Environmental Protection. Therefore the pipeline is permissible with consent under NLEP 2003.

Under the MPPEI SEPP, the proposed pipeline is defined as ‘petroleum production’ and ‘petroleum related works’. Under Clause 7(2)(a), petroleum production development is permissible on land which development for the purposes of agriculture or industry may be carried out. Agriculture is permissible on land zoned 5(a) Special Uses, 7(a) Conservation Zone and 7(b) Environmental Protection under NLEP 2003. Industry is permissible on land zoned 4(b) Port and Industry under NLEP 2003. Therefore the pipeline is permissible with consent under the MPPEI SEPP.

Hexham Delivery Station

Utility undertakings are permissible with consent in the 4(b) Port and Industry zone. Therefore the HDS is permissible with consent under NLEP 2003.

Under the MPPEI SEPP, the HDS is defined as ‘petroleum related works’, which are works ancillary or incidental to development defined as ‘petroleum production’. Under Clause 7(2)(a), petroleum production development is permissible on land which development for the purposes of agriculture or industry may be carried out. Industry is permissible on land zoned 4(b) Port and Industry under NLEP 2003. Therefore the HDS is permissible with consent under the MPPEI SEPP.

Relevant Special Provisions

Table 6-21: Special Provisions - NLEP 2003

Clause	Description	Relevance	Reference in EA
25 – Acid Sulfate Soils	Requires consent to carry out certain works on land identified as Class 1, 2, 3, 4 or 5 on Potential Acid Sulfate Soils Planning Map. Requires that the consent authority consider an acid sulfate soils management plan (ASSMP), the likelihood of the proposal resulting in the discharge of acid into the ground or surface water and any comments from the DoP on the ASSMP.	The proposed gas transmission pipeline affects certain land which is potentially subject to acid sulfate soils.	**Chapter 17.**
26 – Bushfire prone land	Requires that the consent authority consider the measures taken with respect to the proposed development to protect persons, property and the environment from bushfire.	The proposed gas pipeline encroaches within bushfire prone land.	**Chapter 16**
31 – Development affecting places or sites of Aboriginal heritage significance.	Requires that Council consider a heritage impact statement and notify local Aboriginal communities and the Director-General of the NPWS prior to granting consent to development that is likely to impact upon a place of Aboriginal heritage significance.	The proposed gas pipeline has the potential to impact upon places or sites of Aboriginal heritage significance.	**Chapter 19** and **Appendix K**
32 – Development affecting archaeological sites or relics of non-Aboriginal heritage significance.	Requires that Council consider a heritage impact statement prior to granting consent to development that is likely to impact upon an archaeological site or relic of non-Aboriginal heritage significance.	The proposed gas pipeline has the potential to impact upon archaeological sites or relics of non-Aboriginal heritage significance.	**Chapter 19** and **Appendix K**
33 – Development in the vicinity of a heritage item.	Requires that the consent authority assess the impact of a proposed development in the vicinity of a heritage item or conservation area on the heritage significance of a heritage item or conservation area prior to granting consent.	The proposed gas pipeline may pass in the vicinity of certain items of heritage significance.	**Chapter 19** and **Appendix K**

6.6.9 Development Control Plans

Development Control Plans (DCPs) have been considered in relation to the Project, however, given the nature and scale of the proposal there are no provisions of direct relevance to the Part 3A assessment.

6.7 Other State Legislation

6.7.1 NSW Protection of the Environment Operations Act 1997

Under the *NSW Protection of the Environment Operations Act 1997* (POEO Act) it is an offence, for which there are penalties, to cause water, air or noise pollution without authorisation for such under an Environmental Protection Licence (EPL). Additionally, Schedule 1 of the POEO Act identifies certain activities as “scheduled activities” which are required to be licensed by the DECCW.

The production of more than 5 PJ of methane gas is a scheduled activity under clause 31 of Schedule 1 of the POEO Act and therefore requires an EPL.

If approval is granted for the Project, an application for an EPL for the Project cannot be refused and must be substantially consistent with the Part 3A approval.

6.7.2 Water Management Act 2000

The *Water Management Act 2000* (WM Act) aims to ensure the sustainable management of water resources in the State, primarily through the issue of licences and approvals for the extraction and use of water from rivers and groundwater aquifers. The WM Act applies to parts of the State which are subject to Water Sharing Plans. Those areas of the State not covered by such plans are managed in accordance with the *Water Act 1912.*

The northern section of the Concept and Project Areas is largely located within the Lower North Coast Water Management Area, within which two Water Sharing Plans currently exist – the Karuah River Water Sharing Plan (KRWSP) and the Lower North Coast Unregulated and Alluvial Water Sharing Plan (LNCUAWSP). The remainder of the Concept and Project Areas is generally located within the Hunter Water Management Area within which a number of Water Sharing Plans have been commenced. The WM Act is therefore relevant to the Project.

Section 75U of the EP&A Act exempts Part 3A projects from the need to obtain water use approvals under section 89, water management works approval under section 90 and activity approvals under section 91 of the WM Act. Therefore no such approvals are required for the Project. However, an access licence under section 56 of the WM Act may be required in respect of the proposed gas wells within the Stage 1 GFDA.

It is noted that clause 18 of the WM Act provides that any person lawfully engaged in the hydrostatic testing of gas pipelines is exempt from the need for an access licence in relation to water required for testing purposes.

7.0 Consultation and Issues Identification

This chapter provides a summary of the consultation undertaken as part of the EA process to date, including both formal consultation undertaken by the NSW DoP with relevant regulatory authorities and independent consultation undertaken by the Proponent with both regulatory authorities, the local community and other stakeholders. The chapter summarises the key issues raised by the consulted parties and references where these issues are addressed in the EA document.

7.1 NSW 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, the Director-General's EARs have been addressed as required by Clause 75F of the EP&A Act. The key matters raised by the Director-General for consideration in the EA are outlined in **Table 7-1** below, together with the relevant section of the EA which addresses that matter. Supplementary EARs were issued in October 2008 and August 2009, which are addressed in **Table 7-2** and **Table 7-3**. A full copy of the Director-General's EARs for the Project is provided in **Appendix C**.

Table 7-1: Director-General's EARs issued August 2008

Key Matters	Reference in EA
Strategic Planning and Justification	
Including the following: • A strategic assessment of the need, scale, scope and location of the concept plan as a whole and its component projects, considering the availability and location of gas reserves, areas of gas demand and expected demand growth, and pipeline network constraints; • Description of alternatives considered (ie. Location and/or design); • Justification for the preferred proposal demonstrating how it achieves the stated objectives of the concept plan and part projects; and • Demonstrate the benefits of the concept plan and the part projects at a strategic and local scale.	**Chapters 2, 4, 26** and **28**
Land Use and Infrastructure	
Including a justified and tiered assessment of impacts to land use and infrastructure including: • Identification of the likely post-activity land use and the rehabilitation/decommissioning measures to be implemented; • Identification of major infrastructure (including rail, road, electricity, gas and water supply infrastructure) that may be impacted by the proposed development including how the infrastructure would be traversed and options for mitigating and managing conflicts between the Project and infrastructure;	**Chapters 5, 11, 16** and **20**

Key Matters	Reference in EA
• An assessment of the impacts of the proposed development on directly affected land and on surrounding land use (including on mineral reserves, conservation areas, land or high agricultural value and land of significant scenic or visual value) considering: - Local and strategic land use objectives; - Impacts on future development potential; and - Any development pressures and/or economic opportunity that may be supported or generated as a result of the proposed development in the surrounding land use.	
Air Quality and Greenhouse Gases	
Including the following: • An assessment of the risk of fugitive dust, odour and flare impacts during the construction and operation phases, and identify mitigation measures to reduce impacts; and • A quantitative GHG assessment including emission levels expressed on basis of tonnes per unit of production, total annual emissions during the life of the Project, and as a percentage of total annual NSW and national emissions.	**Chapters 9** and **21** and **Appendix F**
Surface and Groundwater	
• Including a justified and tiered assessment of impacts on surface and groundwater such as: • Quantification of the coal seam groundwater volumes likely to require extraction as part of the Field Area (including future stages of the concept plan) and an assessment of the extraction impact on existing groundwater resources and users, including measures to monitor and mitigate impacts; • Identification of extracted water storage, use, disposal and/or resupply to other users at the Central Processing Facility; • Identification of watercourses to be traversed by the proposed development or otherwise impacted by activities within the riparian corridor; • An assessment of proposed measures to protect hydrology, water quality, aquatic habitat and riparian vegetation of the watercourses during construction and operation; and • An assessment of erosion and sedimentation risk associated with the proposed development, particularly in areas of acid sulfate soils and measures to contain and manage impacts.	**Chapters 12, 13** and **17**

Key Matters	Reference in EA
Hazards and Risk	
Including the following: • A screening of potential hazards likely to be associated with the proposed development to determine the potential for offsite impacts and any requirement for the PHA to satisfy the *HIPAP No. 3*, *HIPAP No.6* and *Multi-Level Risk Assessment.* Reference should also be made to applicable Australian Standards (including *AS2885 – Gas and Liquid Petroleum – Operation and Maintenance*). • An assessment of risk impacts associated with the transport of dangerous goods and hazardous materials to satisfy the requirements of the *Route Selection guideline*. • Assessment of on-going maintenance and safety management of the proposed development, including busk fire risk.	**Chapters 5, 15** and **Appendix I**
Traffic and Transport	
• Including a justified and tiered assessment of the construction and operational traffic impacts of the proposed development: • Identification of construction haulage routes; and • Assessment of any significant construction disruptions to road traffic or access, including associated control measures, alternative access arrangements, and road upgrade requirements for operational access and/or construction traffic (eg. over-size haulage).	**Chapter 16**
Flora and Fauna	
• Including a justified and tiered assessment of impacts on biodiversity including on aquatic and riparian habitat values and threatened species and communities listed under both State and Commonwealth legislation: • Review of bioregions potentially impacted by the proposed development across its length; • Assessment for each identified region, of a screening of species, populations, ecological communities and habitats based on ecological significance and the potential for impact as a consequence of the proposed development; • Provision of information to demonstrate the likely impacts and their acceptability, consistent with Guidelines for Threatened Species Assessment (DECC, July 2005) for species, populations, ecological communities and habitats with high ecological significance and significant potential for impact; • Outline of any proposed compensatory habitat or off-set strategy including scale, scope and timing of implementation, considering region-based ecological outcomes to incorporate habitat connectivity and distribution of species; and • Demonstration of a design philosophy of impact avoidance on ecological values, especially ecological values of high significance.	**Chapter 10** and **Appendix G**

Key Matters	Reference in EA
Noise and Vibration	
Including a justified and tiered assessment of the noise and vibration risks associated with the proposed development such as: • An operational noise impact assessment of the Central Processing Facility project consistent with *NSW Industrial Noise Policy* (EPA, 2000); and • An assessment of construction noise and vibration impacts (including of construction traffic noise and blasting impacts where relevant) considering measures to mitigate, manage and monitor impacts.	**Chapter 14** and **Appendix H**
Indigenous and Non- Indigenous Heritage	
Including a justified and tiered assessment of impacts to indigenous and non-indigenous heritage: • Demonstrate the likely impacts of the proposed development on indigenous values consistent with *Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation* (DEC, July 2005) including measures to avoid, minimise, manage and/or offset impacts; • Demonstrate effective consultation with indigenous stakeholders in determining impacts and developing mitigation options; and • Demonstrate the likely impacts of the proposed development on non-indigenous heritage values consistent with the guidelines in the *NSW Heritage Manual*. Note that where impacts to state or local non-indigenous heritage items are proposed, a statement of heritage significance is required incorporating measures to mitigate and manage impacts.	**Chapter 19** and **Appendix K**
Environmental Risk Analysis	
Include an environmental risk analysis to identify potential environmental impacts associated with the proposed development incorporating mitigation measures and potentially significant residual environmental impacts post mitigation measure application.	**Chapters 8** and **26**
Consultation	
Consult with the relevant Local, State or Commonwealth government authorities, service providers, community groups or affected landowners. The consultation process and the issues raised are to be described in the EA. In particular, consultation should be undertaken with the following parties: • Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA); • NSW Department of Environment and Climate Change (DECC); • NSW Department of Water and Energy (DWE) (now part of Industry and Investment NSW (I&I NSW)); • NSW Department of Primary Industries (DPI) (now part of I&I NSW); • NSW Roads and Traffic Authority (RTA);	**Chapter 7**

Key Matters	Reference in EA
• NSW Rural Fire Service; • Australian Rail Track Corporation; • Mine Subsidence Board; • Gloucester Shire Council; • Great Lakes Shire Council; • Dungog Shire Council; • Port Stephens Council; • Maitland City Council; • Newcastle City Council; and • The local community and land owners.	

Table 7-2: Supplementary EARs Issued 19 October 2008

Key Matter	Reference in EA
A description of the controlled action	**Chapter 5**
A description of the relevant impacts of the controlled action	**Chapters 9 to 22**
A description of feasible mitigation measures or compensatory measures, changes to the controlled action or procedures, which have been proposed by the proponent or suggested in public submissions, and which are intended to prevent or minimise relevant impacts	**Chapter 10** and **Appendix G**
To the extent practicable, a description of any feasible alternatives to the controlled action that have been identified through the assessment, and their likely impact	**Chapter 4**
All relevant impacts that the controlled action has, will have or is likely to have on the ecological character of the Hunter Estuary Wetlands, a wetland of international importance listed under sections 16 and 17B of the EPBC Act and on any species or ecological communities potentially present and listed under sections 18 and 18A of the EPBC Act	**Chapter 10** and **Appendix G**
Where Potential Acid Sulphate Soils (PASS) are encountered, include information on the elevation of the affected area, the depth and extent of drilling and proposed methods for soil management; and identify risks and provide details of mitigation measures in relation to impacts from PASS, including impacts on the Hunter Estuary Wetlands listed under sections 16 and 17B of the EPBC Act	**Chapter 17**
Sufficient information about the controlled action and its relevant impacts to allow an informed decision whether or not to approve the controlled action under the EPBC Act.	**Chapter 10** and **Appendix G**
Information to address the matters outlined in Schedule 4 of the Commonwealth Environment Protection and Biodiversity Conservation Regulation 2000	**Section 6.1.10, Chapter 10** and **Appendix G**

Key Matter	Reference in EA
Details of consultation undertaken with the Department of the Environment, Water, Heritage and the Arts during the preparation of the EA clearly indicating the issues raised and how the matters have been addressed in the EA.	**Section 7.2.2**
The description and assessment of these issues in the Environmental Assessment must be integrated as far as is practicable with the description and assessment of the other flora and fauna impacts of the Project. However, a separate stand alone chapter or summary specifically addressing impacts on the relevant protected matters controlling provisions under the EPBC Act, together with any commitments or proposed measures to mitigate such impacts, should also be included in the Environmental Assessment.	**Chapter 10**

Table 7-3: Supplementary Director-General's EARs issued August 2009

Key Matters	Reference in EA
A comprehensive air quality impact assessment prepared in accordance with the Approved Methods for Modelling and Assessment of Air Polutants in NSW (DEC, 2005), with particular focus on nitrogen oxides and particulates. The assessment must consider worst case operating scenarios and meteorological conditions and potential cumulative impacts from surrounding mining operations.	**Chapter 9** and **Appendix F**
An assessment of potential operational noise impacts consistent with NSW Industrial Noise Policy (EPA, 2000).	**Chapter 14** and **Appendix H**
Consideration of potential risks to aviation safety from stack emissions.	**Chapter 9** and **Appendix F**

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 7-4** below.

Table 7-4: 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	**Chapters 5**
Details of the location of the Project and environmental planning provisions applicable to the site and the Project	**Chapters 3** and **6**
Consideration of Alternatives	**Chapter 4**
An assessment of the environmental impacts of the Project, with particular focus on the key assessment requirements specified below	**Chapters 9 to 25**
Proposed mitigation/ management measures of residual environmental impacts	**Chapters 9 to 25**
Justification for undertaking the Project with consideration of the benefits/ impacts of the proposal, and proposed management/ mitigation	**Chapters 9 to 28**

Requirement	Reference in EA
A draft Statement of Commitments for environmental mitigation, management and monitoring for the Project	**Chapter 26**
Certification by the author of the Environmental Assessment that the information contained in the Assessment is neither false nor misleading	**Certification at front of EA**

The Heritage Assessment undertaken as part of this EA also involved consultation with local Aboriginal groups. Details of this consultation are summarised in the Aboriginal Cultural Heritage Assessment discussed in **Chapter 19** of this EA and included as **Appendix K.**

7.2 Consultation with Stakeholders and Other Relevant Authorities

7.2.1 Planning Focus Meeting

The DoP advised that a PFM would be required in order for the Proponent to formally seek the views of relevant statutory authorities in respect of potential impacts of the proposal and issues to be addressed during preparation of the EA.

A PFM was held on 23 July 2008. The PFM provided an opportunity for statutory authorities to establish the requirements for the form and content of the EA. The minutes from the PFM are provided in **Appendix D**. Issues raised by statutory authorities at the PFM are addressed in **Table 7-5**.

7.2.2 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 was 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, face to face meetings, where possible, were held with relevant statutory agencies and written comments sought from those parties identified in the EARs to assist with the preparation of the EA. **Table 7-5** below summarises the responses received together with the relevant section of the EA which addresses the matter.

Table 7-5: Agency Responses

Agency	Matters for Consideration	Comment / EA Reference
Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA)	Assessment of the proposed development under the *Environment Protection and Biodiversity Conservation Act 1999* has identified that the resultant proposed action is a controlled action and requires assessment and approval by the Minister for the Environment, Heritage and the Arts before it can proceed. The following matters were required to be considered as part of the EA process:	**Chapter 10** and **Appendix G**
	Reference to the ecological character of the Ramsar listed Hunter Estuary Wetlands, including a discussion of any potential impacts on the ecological character from the proposed action.	**Chapter 10** and **Appendix G**

Agency	Matters for Consideration	Comment / EA Reference
	Where Potential Acid Sulfate Soils (PASS) are encountered, include information on the elevation of the affected area, the depth and extent of drilling and proposed methods for soil management; and identify risks and provide details of mitigation measures in relation to impacts from PASS, including impacts on the Hunter Estuary Wetlands.	**Chapter 17**
Department of Environment Climate Change and Water (DECCW)	Impacts on threatened species and Aboriginal cultural heritage.	**Chapter 10** and **Chapter 19**
	Impacts on DECCW estate.	**Chapter 10**
	Impacts on air quality, such as burning of fuels and waste products, dust generation during construction and operation activities.	**Chapter 9**
	Waste management including the collection, storage, and disposal of waste (including sewerage) and solid waste.	**Chapter 23**
	Impacts of noise from the operation and construction of the proposed development including blasting.	**Chapter 14**
	Monitoring programs for management of noise, air quality, water quality and waste during construction and operational phases.	**Chapter 25**
	Greenhouse gas emissions.	**Chapter 21**
	Possible requirement for application of Environment Protection Licences.	**Chapter 6**
	Dangerous Goods and chemical transport, storage and handling.	**Chapter 15**
	Assessment of contaminated land potential and compliance with relevant guidelines if contaminated soils likely to be disturbed.	**Chapter 11** and **Chapter 17**
	Impact on water quality (during construction and operation) of the proposal, such as: • waste water management; • stormwater management; • potential impacts on groundwater; • surface water impacts and controls; • management of sewerage waste from the proposal; • fuel and chemical storage and management; and • spill management.	**Chapter 12** and **Chapter 13**

Agency	Matters for Consideration	Comment / EA Reference
Department of Water and Energy (DWE)	Licence required under Part 3 of the *Pipelines Act 1967* to construct and operate the pipeline.	**Chapter 6**
	Quantification of groundwater volumes requiring extraction, and management of groundwater extracted for the Project.	**Chapter 13**
	Stability and management of river crossings and maintenance associated with the pipeline.	**Chapters 5** and **12**
	Compliance with State Government technical and policy documents in relation to water management and groundwater.	**Chapters 12** and **13**
Department of Primary Industries (DPI) (now I&I NSW)	Title tenure and location of gas infrastructure.	**Chapters 3** and **5**
	Application for appropriate titles under the *Petroleum (Onshore) Act 1991*.	**Chapter 6**
	Include all existing and proposed production test wells as a component of the current Part 3A application.	
	Future requirement for the preparation of a Petroleum Production Operations Plan and Environmental Management Plan, and associated security bond.	Noted. Consultation would be undertaken with DPI in relation to Rehabilitation Security Deposits for Mining and Petroleum Titles (DPI, 2006).
	Project justification in regards to relevant planning policies and ESD.	**Chapter 28**
	Hydrology of impacted catchment areas.	**Chapter 12**
	Land capability, land use and agricultural values and any impacts on land values, farm production or transfer of property values.	**Chapter 11**
	Terrestrial and aquatic flora and fauna for the activity area and surrounds.	**Chapter 10** and **Appendix G**
	Ground cover and weed species along proposed pipeline route incorporating Council advice.	**Chapter 10** and **Appendix G**
	Potential impacted farm holdings and infrastructure from well field and pipeline construction.	**Chapters 3, 5** and **11**
	Management strategies and contingency plans for produced water.	**Chapter 5**
	Water treatment, use and disposal options.	**Chapter 5**
	Construction standards for any water management dams.	**Chapter 5** and **12**
	Control and management of run-off water.	**Chapter 5**
	Flood management strategies.	**Chapter 12**
	Monitoring of groundwater system.	**Chapter 13**

Agency	Matters for Consideration	Comment / EA Reference
	Alignment with existing infrastructure to help minimise impact on agricultural operations and for efficient access to gas collection facilities and pipeline monitoring.	**Chapters 3, 4** and **11**
	Placement of drill cuttings, drill holes and production wells located in consultation with affected landholders.	**Chapters 1** and **5**
	Erosion and sediment control and topsoil management.	**Chapter 17**
	Waste product management	**Chapter 23**
	Provide measures to minimise impacts on agricultural land use in consultation with affected land holders.	**Chapter 11**
	Weed management plan and monitoring program in consultation with local weed authorities.	**Chapter 10** and **Appendix G**
	Provide proposed process for relevant landholder compensation agreements.	Consultation has been undertaken with a majority of affected landowners regarding compensation agreements, and would continue throughout the detailed design phase.
	Plans for progressive final rehabilitation of pipeline route and well sites.	**Chapters 5** and **22**
	Final land use options and their justification including completion criteria.	**Chapter 11** and **Chapter 22.**
	Options for appropriate offsets within the Project Area.	**Chapter 10** and **Appendix G**
	Impact assessment upon any mineral resources.	**Chapter 11**
	Liaison with relevant minerals related stakeholders to discuss pipeline impact.	**Chapter 7** and **Section 11.2.2**
	Assessment of design constraints to identify possible impact of future mining and exploration on the Project.	**Chapter 11**
	Adopt strategies regarding mineral resources including: • protection of operating mines and quarries from stabilisation or incompatible adjacent development; • protection of known valued resources through inappropriate zoning and development; and • maintenance of access to land for mineral exploration and possible development.	**Chapter 11**
	Identify and assess any future exploration activities.	**Chapter 11**

Agency	Matters for Consideration	Comment / EA Reference
	Obtain necessary approvals prior to any exploration.	**Chapter 6**
	Design, construction and installation of wellhead devices and gas gathering lines to meet all appropriate Australian Standards.	**Chapter 5**
	Best practice techniques for design and operation of production test wells and gas gathering system.	**Chapter 5**
	Details of how issues of potential sterilisation will be managed, including consultation with the holders of coal mining and exploration titles affected by the Project.	**Chapter 11**
	Proposed impact on existing or potential farming operations.	**Chapter 11**
	Provide details of location of creeks and rivers including all water bodies and waterways, potentially directly or indirectly affected by the proposed development/activity.	**Chapter 12**
	Description of waterway/waterbody flora, fauna and general habitats, and stream hydrology and morphology; measures to minimise impact on marine vegetation including details of compensatory habitat development to replace lost vegetation.	**Chapters 10** and **12 and Appendix G**
	Details of proposed methodology for waterway crossings and mitigation measures for protection during construction.	**Chapter 12**
	Fish movement and potential impact.	**Chapter 12**
	Assessment of potential fishing and aquaculture impact.	**Chapter 12**
NSW RTA	Provision of concept plans of the pipeline highlighting the proposed location and likely crossings of the State roads.	**Volume 2**
	The proposed pipeline should be laid transverse across State roads, not constructed parallel, to reduce impact on road maintenance.	**Chapters 5** and **16**
	Ensure the proposed extension of the F3 Freeway to Heatherbrae is identified and addressed in relation to the proposed pipeline development as it is likely to cross the road extension.	**Chapters 11** and **16**
	The proposed widening of Raymond Terrace Road should be taken into account in relation the proposed pipeline crossing.	**Chapter 16**
	Proposed temporary or permanent access points connecting to State roads.	**Chapter 5** and **16**
Rural Fire Service	As the RFS is defined as a public authority in assessing developments under Part 3A, the RFS is able to provide comment only when the Department of Planning formerly refers the EA onto RFS.	**N/A**

Agency	Matters for Consideration	Comment / EA Reference
Australian Rail Track Corporation (ARTC)	No infrastructure or equipment to be located in the rail corridor without prior approval by ARTC and their associated and Australian standards.	**Noted**
	Use of cranes and other equipment capable of intruding into airspace above corridor should be strictly controlled.	**Chapter 5**
	Agreement with ARTC required for any encroachment for aerial operations onto the corridor.	**Noted**
	Access to the corridor during the planning or construction phase requires formal application to the ARTC.	**Noted**
	Any excavations or under bores of the rail corridor requires formal application to the ARTC, and Infrastructure licences agreed to between parties if appropriate.	**Noted**
Mine Subsidence Board	No particular assessment requirements identified for the EA, as the proposed development is not located within a Mine Subsidence District.	**Noted**
Gloucester Shire Council	Compliance with SEPP (Infrastructure) 2007.	**Chapter 6**
	Production well locations and potential impact on future development.	**Chapters 4** and **5**
	Councils section 94 and 94a contributions.	**Chapter 6**
	Existing road network and access for emergency events at CPF site via Fairbairns Road and Tiedemans Lane requires more consideration. Council preference is to close the Tiedemans Lane access.	Access to the CPF Site 1 at The Tiedeman Property would be via Wenham Cox Road.
	Bridge suitability and road flooding issues on Fairbairns Road.	Not applicable as access to The Tiedeman property would be via Wenham Cox Road
	Flora and fauna constraints along Tiedemans Lane.	Tiedemans Lane is not affected by the Project.
	Preferred access for the CPF site via Bowens Road, Stratford, to allow improved access in relation to flooding events.	Access to the CPF Site 1 at The Tiedeman Property would be via Wenham Cox Road.
	Fairbairns Road access will require a series of improvements including bridge replacement, increased road levels, road sealing, and intersection upgrades.	Access along Fairburns Road would now only be required for emergency situations **Chapter 16**

Agency	Matters for Consideration	Comment / EA Reference
	Provide advice on location of all gravel sources for use in construction of drilling pads.	**Chapter 5**
	Deterioration report to be provided pre and post gravelling activity for roads used utilised for gravel activity, including identification of substandard bridges.	**Noted**
	Repair of damaged roads post activity.	**Noted**
	Interaction of pipeline with Council roads requires compliance with requirements in regards to under boring and crossings for bitumen and gravel roads.	**Noted**
	Noise assessment to include assessment of: background levels, noise contouring, noise emitting equipment, vehicles entering and exiting site and drilling rigs.	**Chapter 14** and **Appendix H**
	Management onsite of water produced from each well and transfer pathway to other sites.	**Chapter 5**
	Water treatment processes and water quality monitoring programs including reuse.	**Chapter 5**
	Treatment of any salt removed from the RO process, if used.	**Chapters 5** and **23**
	Flora and fauna assessment of remnant vegetation stand on Tiedemans Lane, especially Babbler Bird species.	**Chapter 10** and **Appendix G**
	Overall benefit of the activity and other indirect benefits.	**Chapters 2** and **28**
	Assessment of potential to install a peaking power plant on the gas main and use of gas for adjacent coal wash and Gloucester township.	**Chapters 4** and **5**
	Construction information regarding identified camps, number of workers, training requirements, road access, water supply and waste management. An approval for any proposed construction camps will be required from Council.	**Chapter 5**
Great Lakes Shire Council	Appropriate assessment of flora, fauna, noise, vibration, odour, transport, water, soils and construction impacts	**Chapters 9, 10, 12, 14** and **17**
	Project justification and alternatives provided.	**Chapters 4** and **28**
	Maintain rural landscape character especially in the Wards River valley area	**Chapter 18**
	Provide studies on various issues including heritage, water, soils, flora and fauna, transport, operation and visual amenity.	**Chapters 5, 10, 12, 13, 16, 17, 18** and **19**
Dungog Shire Council	Detailed erosion and sediment control plan.	**Chapters 17** and **25**
	Assessment of bushfire risks and proposed mitigation measures.	**Chapters 10, 15** and **21**

Agency	Matters for Consideration	Comment / EA Reference
	Assessment of impacts at or close to creek crossings to satisfy requirements of the Water Management Act 2000.	**Chapter 12**
	Flora and fauna report.	**Appendix G**
	Assessment of potential weed spread and mitigation and control measures.	**Chapter 10** and **Appendix G**
	Post construction visual amenity issues.	**Chapter 18**
	Assessment of noise and general associated disturbances to nearby residents during construction.	**Chapter 14** and **Appendix H**
	Detailed Aboriginal Archaeological report.	**Appendix K**
	Environmental Management and Rehabilitation Plan.	**Chapters 22** and **25**
	Hazard and Risk Analysis Plan for all stages of the Project	**Appendix I**
	Land use review of the proposed pipeline location to include consultation with affected landholders and identify potential future impact on future development of site	**Chapter 11**
	Assessment against the Dungog Shire Council LEP to detail compliance with applicable zones and address Section 79C of the EP&A Act 1979	**Chapter 6**
	Details regarding staging/timing of works	**Chapters 4** and **5**
	Assessment report on the potential impact on public and private roads	**Chapter 16**
	Council approval for road crossings	**Noted**
	Assessment of road and bridge infrastructure for project vehicle materials transport	**Chapter 16**
	Road impact assessment for project	**Chapter 16**
	Details of community consultation with affected landholders and road users	**Chapter 7**
	Provide plan detailing replacement/rehabilitation on public and private land including access roads, fencing and drainage lines	**Chapters 5** and **22**
	Potential benefits to the local community and economy from the Project	**Chapters 2** and **20**
Port Stephens Shire Council	During the construction phase, road closures or interruptions may occur through the Hunter Water pipeline corridor which runs through Brandy Hill. Consultation of Council Asset Engineers in regards to these potential road impacts is required.	**Chapter 16**
	Community consultation of residents immediately impacted and the wider community surrounding the pipeline.	**Chapter 7**
	Risk assessment analysis of pipeline for the construction period and long term life of pipeline	**Chapter 15** and **Appendix I**

Agency	Matters for Consideration	Comment / EA Reference
	Define appropriate buffer around SEPP 14 Wetlands to ensure no adverse effects occur, especially in relation to hydrology	**Chapter 10** and **Appendix G**
	Clearing within or immediately adjacent to identified EECs should be avoided through the preparation of a Flora and Fauna Report which also identifies other threatened species through a 7 part test	**Chapter 10** and **Appendix G**
	Specification and location of any remediation activities to reduce the impact on threatened species	**Chapter 10** and **Appendix G**
	Acid sulfate soils testing and identification of how disturbance of these soils will be addressed	**Chapter 17** and **Chapter 25**
	Appropriate weed management of Alligator Weed in relation to earthmoving practice	**Chapter 10** and **Appendix G**
	The Comprehensive Koala Management Plan should be addressed to ensure koala habitat is protected. Note that offsets may be required for any proposed removal of koala habitat.	**Chapter 10** and **Appendix G**
	The Osterley gravestones should be avoided by the pipeline route due to local community significance.	**Chapter 19** and **Appendix K**
	Damage to vegetation on East Seaham Rd should be avoided by the pipeline route due to local community significance.	**Chapter 10** and **Appendix G**
	Council's planning policies including the Local Environmental Plan (LEP) 2000 and Development Control Plan (DCP) 2007 should be addressed including the requirements for Acid Sulfate Soils in the DCP.	**Chapters 6** and **17**
Maitland City Council	Impact on native vegetation, EECs and fauna.	**Chapter 10** and **Appendix G**
	Disturbance to and destruction of archaeological heritage sites.	**Chapter 19** and **Appendix K**
	Impact on local roads and interruption of traffic during construction and maintenance.	**Chapter 16**
	Impact on rail infrastructure.	**Chapter 16**
	Impact on utilities infrastructure.	**Chapter 5**
	Erosion and sedimentation management during and after construction.	**Chapter 17**
	Impact on agricultural improvements.	**Chapter 11**
	Effects of flooding and impacts on water quality, local hydrology and drainage lines.	**Chapters 12** and **13**
	Impacts on residential improvements and associated infrastructure.	**Chapters 5** and **11**
	Impacts and interaction with the F3 to Pacific Highway proposed route.	**Chapter 16**

Agency	Matters for Consideration	Comment / EA Reference
	Other environmental constraints including: PASS, Class 1 & 2 Agricultural land and SEPP 71 assessment.	**Chapters 6, 11** and **17**
Newcastle City Council	Protected areas, wetlands and watercourses. EA should address ecological and hydrological impacts upon Hunter Estuary Wetlands, Kooragang Nature Reserve and Hexham Swamp Nature Reserve.	**Chapter 10** and **Appendix G**
	Ecological impacts upon smaller watercourse.	**Chapter 10** and **Appendix G**
	Habitat and threatened species – potential ecological impacts upon threatened species and communities should be undertaken, in particular the Green and Golden Bell Frog.	**Chapter 10** and **Appendix G**
	Assessment of the potential impact of the Project on climate change, including both direct and indirect sources of greenhouse gases.	**Chapter 21** and **Appendix F**
	The potential for contamination should be assessed for the Project footprint.	**Chapter 17**
	Sampling within the pipeline corridor should be undertaken to ascertain the presence of acid sulfate soils. Where present, an Acid Sulfate Soils Management Plan should be prepared.	**Chapter 17**
	A hazard and risk analysis should be undertaken to address potential risks at the Hexham Delivery Station.	**Chapter 15** and **Appendix I**
	Potential impacts of flooding, specifically access roads and construction works that may alter existing ground levels and flooding regime.	**Chapter 16**
	Construction should be undertaken in a manner which has no or minimal impacts on the road network in the Newcastle LGA.	**Chapter 16**
	Council and/or RTA will have specific requirements with respect to works affecting their assets including under boring of roads.	**Chapter 16**
	Permissibility of the Project should be addressed in the context of Newcastle LEP 2003.	**Chapter 6**

During August and early September 2009, presentations were made to the Councils through which the Project passes to provide a project update since AGL has purchased the Project.

7.3 Consultation with Utility Providers

AGL has undertaken extensive consultation with utility providers, including Energy Australia, TransGrid, and Country Energy, regarding the engineering design requirements for co-locating the gas pipeline adjacent to existing infrastructure. AGL Energy is currently completing an Electrical Induction Report which would assist with design requirements to mitigate electrical induction through the pipeline.

Consultation with utility providers would be an ongoing process through the detailed design process of the Project which would include mitigation measures to address design concerns raised by utility providers.

7.4 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 open days and community information sessions and meetings. Details of this consultation program are provided in the following sections.

7.4.1 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.

7.4.2 Community Consultation Program

Extensive community consultation program has been undertaken since from February 2008 through July 2009, to ensure community views have been captured, and these have been incorporated into the EA.

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

The approach adopted to distribute information to and interact with the local community and landowners affected by the proposed development, and to obtain community feedback, involved the following:

- Meetings with community organisations within the Project Area, including the following:
  - Rotary Club;
  - Barrington, Gloucester, Stroud Preservation Alliance Management Group;
  - Chamber of Commerce presentation;
  - Gloucester Environment Group;
  - Gloucester Project;

  - Probus Group;
  - Lions Club;
  - NSW Farmers Association local branch;
  - Dairy farmers from Gloucester district;
  - Anglican Men's Dinner; and
  - Town Fire Brigade members.
- Information Nights at the Gloucester Country Club and Wards River Hall;
- Drop-In Sessions for the following locations:
  - Gloucester Country Club for the field, pipeline and processing facility;
  - Stratford Hall for the field, pipeline and processing facility;
  - Clarence Town Sport and Recreation Club to disseminate information predominantly for the pipeline part of the Project, but all other information was available.
- General discussions with landowners affected by the proposed development.
- An Open day was held in September 2008 at the Tiedemans Property where the Stratford Pilot Project is located, in order to enable the community to visit the field under operation. The open day was successful with approximately 300 to 400 community members attending to gain a better understanding of the Gloucester Gas Project.

7.4.3 Community Consultative Committee

A Community Consultative Committee (CCC) was formed in September 2008 to provide a forum for discussion and exchange of information between the community, Government agencies and AGL. The Committee assists AGL in identifying project related local issues for consideration during the development, environmental, construction and operational phases of the Project. It also acts as a communication link between AGL, the community and other stakeholders.

The aim of the CCC is to:

- Create a forum for discussion and exchange of information on topics related to the Project;
- Assist AGL in identifying project related local issues that would need to be taken into consideration in the development, approval (including environmental assessment), construction and operational phases of the Project; and
- Act as a communication link between AGL, the community and other stakeholders.

Nominations were advertised in the Gloucester Advocate, Dungog Chronicle and the Maitland Mercury, and membership was by application. The Committee is to meet at least four times in the first six months from commencement (September 2008) and would meet at least four times per year for the remainder of the planning, construction and operation for the life of the Project. Membership would be reviewed every two years. Community Consultative Committee membership is currently made up of:

- Local Community, including residents and community groups;
  - Two individual community representatives;
  - Barrington – Gloucester – Stroud Preservation Alliance Inc.;
  - Avon Valley Landcare;

  - The Gloucester Project;
  - Lower Waukivory Residents Group;
- State Government agencies;
  - Department of Primary Industries and Department of Water and Energy were invited, however have not responded at this stage;
- Local Government;
  - Port Stephens Council;
  - Gloucester Shire Council;
  - Dungog Shire Council;
  - Great Lakes Council; and
- Representatives from the AGL project team.

The first meeting was held on Friday 26 September 2008 at the Gloucester Country Club. The meeting covered the roles and responsibilities of the Committee and the ground rules. The Committee also received an update on project activities, an overview of planned consultation activities and were provided with preliminary reports and plans for review.

Subsequent meetings have been held regularly with the CCC providing ongoing updates of the Project status, and outcomes of ongoing environmental investigations. Meetings were held on 14 November 2008, 13 February 2009, 9 April 2009 and 27 July 2009. Refer to **Table 7-6** for where issues raised are addressed in this document.

7.4.4 Landowner Consultation

Extensive consultation has been undertaken with landowners potentially affected by both the proposed Stage 1 GFDA and the preferred corridor for the Stratford to Hexham Pipeline. Landowner consultation for the Field Development and the Stratford to Hexham Pipeline is outlined below.

Stage 1 GFDA

All landowners within the Stage 1 GFDA were initially identified by undertaking title searches based upon the Lot and Plan of each property within the proposed area. AGL staff conducted initial meetings with each landowner to discuss the Project requirements and review the potential to locate gas wells within their property.

An overview map of the Stage 1 GFDA and a detailed map of each landowner's property were prepared, which included the following information:

- the 600m x 600m grid;
- the physical constraints;
- property boundaries; and
- aerial photography.

The locational principles as described in **Section 5.2** were explained to the landowner. The maps were left with the landowner to mark up possible well locations which they would be agreeable to. Follow up meetings were held with each landowner to discuss the potential well locations and associated infrastructure.

Prior to undertaking the environmental surveys across the Stage 1 GFDA, consent to survey was obtained from each landowner to allow investigation surveys to be undertaken for the proposed well locations and associated gathering pipelines.

Pipeline

After establishing the preferred pipeline corridor for the Stratford to Hexham Pipeline as part of the route selection process, title searches were completed for all the affected properties in order to identify property ownership. Landowner liaison officers (Land Agents) acting on behalf of AGL are being utilised to carry out the landowner negotiation along the pipeline corridor.

The Land Agents initially met with landowners along the proposed corridor and advised that the pipeline route investigations were currently being undertaken to deliver gas from Stratford to Hexham and that initial desktop investigations had identified a corridor which affects their property. The landowners were given an introduction letter along with an information brochure to provide an overview of the Project.

Follow up meetings were held with each landowner to discuss obtaining permission to access their property to undertake investigation surveys. Landowners granting permission to access signed a Consent to Survey form. During this meeting, the Land Agent discussed with the landowner the potential location of the pipeline and whether they had any concerns prior to ground truthing surveys commencing. On completion of the surveys, plans of each property were prepared and hand delivered to each landowner for discussion.

AGL aims to seek formal agreement with each landowner. Prior to presenting formal documentation, a valuation to determine the compensation package for the purchase of the easement would be undertaken by an independent valuer. The compensation assessment would be subsequently incorporated into an Easement Agreement and presented to the landowner for their consideration.

Easement Agreements have commenced being presented to landowners along the proposed alignment since June 2009.

CPF Sites and Coal Mining

AGL has developed a close working relationship with Gloucester Coal, who own and operate both the Stratford and Duralie mines within the Gloucester Basin. CPF Site 7 is proposed to be located on land currently owned by Gloucester Coal, adjacent to the Stratford Mine. Extensive negotiations with Gloucester Coal are in progress regarding the potential for acquiring this land for the CPF if site 7 is chosen, CPF site 1 would be located on land currently owned by the proponent. General discussions with Gloucester Coal about the Project have not raised any specific concerns, other than a general requirement to minimise any impact upon their current operations. A Cooperation Agreement is in the process of being developed between both parties which would include details for development requirements and planning considerations. The purpose of this agreement is to optimise the development of coal and gas resources within overlapping mineral and petroleum tenure.

General discussions have also been undertaken with Gloucester Resources, who are conducting coal exploration activities in the Gloucester region.

7.4.5 Issues Raised

A summary of issues raised during the information sessions, drop-in meetings and community group meetings is provided at **Table 7-6** together with reference to relevant section of the EA in which the issue is addressed.

Table 7-6: Summary of Issues Raised - Community Consultation Sessions

Matters for Consideration	Comment / EA Reference
General	
Compensation of landholders affected by the proposed development.	Consultation has been undertaken with a majority of affected landowners regarding compensation agreements, and would continue throughout the detailed design phase.
The location of the CPF with attendant concerns regarding noise, lighting, visual effects and traffic movements.	**Chapters 14**, **18** and **16,** respectively
Disruption caused by pipeline construction.	**Chapters 11** and **20**
Property valuations decreasing due to project location.	**Chapter 11**.
Duplication of effects if the CPF is located on Stratford Coal land.	**Chapter 24**
Local employment will be improved; potential to assist local business and economy.	**Chapter 20**
Impact on tourism.	**Chapters 11** and **18**
Pipeline marking and signage.	**Chapter 5**
Local mining company and current impacts (actual and perceived by community) in relation to noise and dust.	**Chapters 14** and **9**
Coal mining potential post gas reserves depleted. Concerns mainly relate to Gloucester resources.	**Chapter 1**
Cumulative Impact - long term impact of ongoing development in area.	**Chapters 5, 18, 20** and **24**
Land Use	
Impact on future sub-division.	**Chapter 11**
Impact on prime agricultural land.	**Chapter 11**
Hazard and Risk/Safety	
Uncontrolled escape of gas.	**Chapter 15** and **Appendix I**
Fears of gas pipeline explosion.	**Chapter 15**
Concerns about CPF.	**Chapter 15**
Potential size of the CPF causing the area to become heavily industrialized.	**Chapters 11** and **18**

Matters for Consideration	Comment / EA Reference
Noise	
Construction 'extraction' method.	**Chapter 14**
Noise emitted from the wells and rill rigs.	**Chapter 14**
Gas flare and drilling noise.	**Chapters 5** and **14**
Construction phase machinery.	**Chapter 14**
General impact of noise on neighbours.	**Chapter 14**
Noise and light from flares.	**Chapter 14**
Flora and Fauna and Bushfire	
Local drill sites and clearing. Unsightliness of drill pads in their full form.	**Chapter 18**
Concerns largely relate to the crossing of watercourses with the high pressure pipeline.	**Chapters 5** and **12**
Concerns regarding impact of bushfire on infrastructure and potential safety issue with gas flares/wells.	**Chapter 15** and **Appendix I**
Soils and Water	
Number of creeks that will need to be crossed; River crossings / creek crossings.	**Chapters 5** and **12**
Timing in wet areas (flooding).	**Chapter 12**
Wells impacting aquifers.	**Chapter 13**
Rock cracking.	**Chapters 10,12** and **13**
Request for wells kept off the floodplain areas.	**Chapter 12**
Loss of surface water and close to surface aquifers supplying bore water for stock and domestic usage. Concerns the process was similar to pulling the plug from a bathtub.	**Chapter 13**
Impact on groundwater flows from gas extraction. Concern drilling would be similar to pulling out a bathplug. Water supply breakdown and overall usage.	**Chapter 12** and **Chapter 13**
Sediment and erosion control during construction.	**Chapter 17**
Concern regarding reducing impact on surface water/waterways.	**Chapter 12**
Concerns over Avon River drying up.	**Chapter 12**
Impact on groundwater flows from gas extraction.	**Chapter 13**
Landscape and Visual	
Selection of well type/design and compatibility with rural areas.	**Chapter 18**
Additional mining in the area.	**Chapter 11**
Width of clearing right of way proposed and proposed rehabilitation post construction of pipeline and CPF.	**Chapter 5** and **22**
The well heads and their effect on loss of visual amenity.	**Chapter 18**
Impact on rural views - Loss of visual amenity.	**Chapter 18**

Matters for Consideration	Comment / EA Reference
Lighting associated with 24 hour drilling.	**Chapter 18**
Road network to wells causing mosaic effect.	**Chapters 16** and **18**
Above ground power to well sites.	**Chapter 5**
Powerlines crisscrossing properties and preference for underground power.	**Noted**
Greenhouse Gases	
Green house effect of Methane.	**Chapter 21**
Traffic	
Truck movements, timing and speed.	**Chapter 16**
Traffic movements, especially on Fairbairns Road.	**Chapter 16**
Indigenous and European Heritage	
Damage to heritage sites.	**Chapter 19** and **Appendix K**
Air Quality	
Dust impacts during construction period.	**Section 10**

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8.0 Issues Prioritisation

This chapter draws upon the Preliminary Assessment prepared in respect of the Project by GHD as well as feedback received from the relevant government authorities, the community and other stakeholders during the consultation undertaken on the Project, as summarised in Chapter 7. The chapter identifies the key issues of importance to the Project and applies a prioritisation matrix to rank issues in terms of their relevance and importance to the assessment of the potential impacts of the Project. The results of the prioritisation exercise are then used to establish the most appropriate level of assessment within the EA – high, medium or low.

8.1 Issues Identification

A preliminary assessment of environmental issues associated with the Project was undertaken as part of the *Concept Plan and Preliminary Assessment Report* (GHD, 2008) (Preliminary Assessment) prepared in respect of the Project. Key environmental issues identified in the Preliminary Assessment included:

- Hazard and Risk;
- Water management;
- Geology and Soils;
- Waste Management;
- Air Quality;
- Noise;
- Resource Implications;
- Traffic and Transport;
- Social and Economic;
- Heritage;
- Ecological;
- Land Use; and
- Visual.

8.2 Prioritisation of Issues

8.2.1 Approach

The prioritisation of issues for the Project undertaken by GHD (2008), and submitted with the Project application, was based on the need to recognise that a higher degree of assessment is required for the issues with the highest severity and greatest consequences. This prioritisation of issues has been based on the Preliminary Assessment, with a ranking system applied by AECOM for consistency with the EA and Residual Risk approach (refer to **Chapter 27**) so that a comparison may be drawn with the level of risk remaining after mitigation has been applied.

Table 8-1 shows the issues prioritisation matrix used to identify priorities. Each issue was given a ranking between one and three for the severity of effects and the perceived consequences of those effects if left unmanaged. These two numbers were added together to provide a numerical ranking for the issue that was used to categorise each issue into high, medium or low priority.

Table 8-1: 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)

8.2.2 Assessment

The prioritisation of environmental issues related to the Project is shown in **Table 8-2**. This assessment aims to allow the prioritisation of issues for assessment and does not consider the application of mitigation measures to manage environmental effects. In all cases, appropriate and proven mitigation measures, chosen based upon the experience of regulators and other similar projects would be used to minimise potential impacts. These measures are described in detail in the EA prepared for the Project. The prioritisation of issues presented below is based on the Preliminary Assessment undertaken by GHD (2008).

The allocation of risk is based upon the following considerations:

Severity of Risk

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 readily available.

Medium: moderate adverse environmental change; offsets available.

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

Table 8-2: 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.	1	2	**3 (Low)**
Exposure of employees to risks and hazards.	2	2	**4 (Medium)**
Aspect: Land Use			
Inappropriate use of land	1	1	**2 (Low)**
Incompatibility of land use with surrounding environment	2	2	**4 (Medium)**
Incompatibility of land use with new land uses proposed for area	1	2	**3 (Low)**
Aspect: Noise			
Temporary noise nuisance to local residents during construction.	2	2	**4 (Medium)**
Noise nuisance to local residents during operation/maintenance.	1	2	**3 (Low)**
Aspect: Air Quality			
Construction related impacts on air quality.	1	2	**3 (Low)**
Potential emissions to the atmosphere (from CPF) with the potential to result in degradation of air quality in the local area.	2	3	**5 (High)**
Odour emissions as a result of drilling activities.	1	2	**3 (Low)**
Community concern regarding degradation of air quality.	2	2	**4 (Medium)**
Regional and inter-regional impacts upon air quality.	1	1	**2 (Low)**
Aspect: Water Management			
Impacts related to the flooding of the river / creek systems.	1	2	**3 (Low)**
Potential impacts upon groundwater.	1	2	**3 (Low)**
Potential for degradation of water quality in the local area during construction.	2	2	**4 (Medium)**

Issue	Severity	Consequence	Priority
Potential for degradation of water quality in the local area during operation.	1	2	**3 (Low)**
Impacts on local water resources due to water use during construction/operation.	1	2	**3 (Low)**
Aspect: Visual			
Visual impacts during construction.	2	2	**4 (Medium)**
Visual impacts during operation.	2	2	**4 (Medium)**
Aspect: Soils and Geology			
Erosion and sedimentation during construction.	2	2	**4 (Medium)**
Acid Sulfate Soils	2	2	**4 (Medium)**
Potential geotechnical impacts as a result of drilling and fraccing operations.	1	2	**3 (Low)**
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.	2	3	**5 (High)**
Reduction in biodiversity due to loss of habitat for native species.	2	2	**4 (Medium)**
Spread of weeds and feral animals.	2	2	**4 (Medium)**
Impact upon threatened species.	2	2	**4 (Medium)**
Aspect: 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.	2	2	**4 (Medium)**
Increase in traffic on local road network during operation.	1	1	**2 (Low)**
Aspect: Socio-Economic			
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)**

Issue	Severity	Consequence	Priority
Job creation during construction	2	1	3 (Low)
Job creation during operation	1	1	2 (Low)
Aspect: Resource Implications			
Demand upon community resources.	1	1	2 (Low)
Demand upon natural resources.	1	1	2 (Low)
Demand upon transport resources.	2	1	3 (Low)
Aspect: Waste Management			
Generation of significant quantities of waste.	2	1	3 (Low)
Generation of toxic or hazardous waste.	2	1	3 (Low)

Table 8-3 identifies that the prioritisation of environmental issues, and therefore the focus of assessment for the proposed project should be as follows:

Table 8-3: Prioritisation of Issues

Low	Medium	High
Heritage Socio Economic Resource Implications Waste management	Water management Hazard and Risk Land Use Noise Visual Geology and Soils Traffic and Transport	Air Quality Ecology

As per the above table, the most detailed assessment for the EA would be focussed on air quality and ecology, followed by those issues classified as medium priority which would also be subject to a detailed assessment. Whilst heritage has been ranked as a low priority issue due to the relative ease with which impacts in this regard can be avoided, a detailed heritage survey of the Project Area has been undertaken in order to identify potential impacts and ensure appropriate mitigation measures are implemented as part of the Project. Resource implications are addressed in other chapters of the EA as relevant such as socio economic, traffic and transport and water management.

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9.0 Air Quality

Potential air quality impacts from the Project have been assessed by means of an air quality impact assessment (AQIA). The AQIA was prepared in accordance with NSW DECCW Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DECC, 2005) and includes a Plume Rise assessment as per the DGR's. The AQIA is presented in full in ***Appendix F****.*

This chapter of the EA summarises the AQIA in terms of the pollutants emitted by the Project, the assessment methodology, the modelling input data, background air quality, modelling results and the mitigation requirements to ensure compliance with DECCW ambient air quality criteria.

9.1 Concept Area

As described in **Chapter 5** of the EA, development of the Concept Area involves the construction and operation of additional wells and associated infrastructure as part of future stages of the GFDA and the development and operation of the proposed CPF and associated plant infrastructure with a capcity of approximately 30 PJ per year with an average of 80 TJ per day. Concept Plan and concurrent Project Approval is sought for development of the CPF on one of two sites, both of which have been included in the AQIA, however only one CPF would ultimately be constructed.

The potential air quality impacts of the development of the Concept Area would be similar to those predicted for the development of the Stage 1 GFDA and CPF. The full capacity of the CPF (assessed as part of the Project Application) would be sufficient to accommodate development of future stages of the GFDA, therefore the air quality impacts of the future development of the Concept Area would be related to additional wells and gathering lines only. The nature and extent of these impacts would be assessed at a later stage through the assessment of future project applications to be lodged for the Concept Area, when the location, scale and intensity of the future stages is known with greater certainty. A further AQIA would be prepared and submitted in respect of future stages of the GFDA and any future upgrades of associated plant and infrastructure to accurately assess potential air quality impacts and recommend safeguards as appropriate.

9.2 Project Area

9.2.1 Overview of Gloucester Basin

Air quality in the Gloucester basin is predominantly agricultural emissions with lesser contributions from coal mining operations and vehicular traffic moving along The Bucketts Way.

The pollutants of prime concern in NSW are listed in **Table 7.1** to **Table 7.5** of the Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales (DECC, 2005). The pollutants of potential concern of relevance to this project are as follows:

- Nitrogen Dioxide (NO_2);
- Carbon Monoxide (CO);
- Particulate Matter (as PM_{10});
- Volatile organic compounds (VOCs);
- Formaldehyde; and
- Odour.

Existing levels of these pollutants in NSW predominantly fall below the assessment criteria, only approaching or exceeding the national standards prescribed in the National Environment Protection Measure (NEPM) for Ambient Air Quality on occasion. Pollutant levels in the area around the proposed project have not been studied in detail due to a lack of acceptable short or long term monitoring data, however, given the population of the Stratford postcode area (which includes Gloucester), generally low vehicular traffic levels and distance from any large population centre or industrial development, the air quality is expected to be acceptable.

To ensure the assessment is conservative however, monitoring data has been sourced from DECCW for the Newcastle area (Wallsend data selected as closest relevant data, as discussed in **Section 9.2.2**). This monitoring data is expected to show higher values for particulates than the Stratford area due to the proximity to the Pacific Highway, relative population and regional characteristics and ensures any comparisons made for impact assessment purposes are conservative.

9.2.2 Regional Air Quality

The NSW DECCW operates air quality monitoring stations at various locations around the state. The closest monitoring stations to the Project Area are the Beresfield and Wallsend monitoring stations, both of which monitor a range of air pollutants including NOx and PM_{10} particulates (pollutants relevant to this study). For the purposes of the assessment, the Beresfield station was not considered representative of the Project site as it is located close to ongoing significant road works (Weakley's Drive overpass) and a major arterial road (Pacific Highway).

The Wallsend location is situated in a more residential setting, where the most significant contributors are likely to be residential vehicles and general regional air flows. On this basis, the Wallsend data was used in this study to allow an estimation of worst case cumulative impacts.

A summary of the key statistics for the monthly PM_{10} data monitored at the Wallsend site is shown in **Table 9-1**.

Table 9-1: Wallsend Ambient Monitoring Data Summaries

Year	NO_2 ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$)	
	Max. 1 Hr Average	Annual Average	Max. 24 Hr Average[1]	Annual Average
2001	82.7	34.8	34.0	17.2
2002	80.8	34.7	39.0	20.6
2003	94.0	33.1	34.0	16.4
2004	77.1	33.4	43.0	17.1
2005	71.4	33.1	36.0	18.3
2006	69.6	34.3	44.0	18.6
Maxima	94.0	34.8	44.0	20.6

[1] Data removed for Bushfire periods near Newcastle

Based on the data presented in **Table 9-1**, the background pollutant concentrations considered by the AQIA are as follows:

- NO_2 1 Hour Average – 94.0 $\mu g/m^3$
- NO_2 Annual Average – 34.8 $\mu g/m^3$
- PM_{10} 24 Hour Average – 44.0 $\mu g/m^3$
- PM_{10} Annual Average – 20.6 $\mu g/m^3$

9.2.3 Construction Pollution Sources

During the construction phase of the Project, air emissions such as dust and products from fuel combustion have the potential to occur. Sources of pollution as a result of the construction phase include:

- Grading machinery;
- Excavators;
- Tip trucks for transporting imported fill and base course material;
- Welding machinery;
- Electric generators;
- Cranes;
- Franners for pipe spool placement; and
- Forklifts.

9.2.4 Operation Pollution Sources

The operation of the CPF and flaring of the wells for up to one month during commissioning would result in air emissions. Sources of pollution as a result of the operational phase of the CPF include:

- 5 x 3 MW power generators (G1 – G5);
- 8 compressors (C1 – C8);
- Alternator (ALT);
- Triethylene glycol re-boiler (TEG1); and
- Triethylene regeneration skid (TEG2).

HDS is not expected to significantly contribute to air quality in the Hexham area, however as there is a small natural gas fired water bath heater that would operate at the site, this source has been included in the AQIA.

9.3 Overview of Receptors

Receptors typically include locations where people congregate and reside, such as dwellings, schools, sports fields, hospitals, nursing homes, child care facilities and some recreational facilities. Aged, infant and young populations are particularly sensitive to air pollutants. The model predicted ground level concentrations for modelled pollutants at these locations. These predictions were evaluated in terms of the impact of the Project on nearby sensitive receptors.

Receptors for the area surrounding the CPF sites, Stage 1 GFDA and pipeline corridor are best categorised as very low density rural receptors. The majority of the receptors included in the model and others close to the Stage 1 GFDA and pipeline corridor are single rural receptors with significant separation distances between them. Sensitive receptors in the vicinity of the potential CPF sites which have been considered in the AQIA are shown in **Figure 9.1**. Well site locations are determined based on the locational principles (refer to **Section 5.2**) and as such, sensitive receptors would typically be located at a distance greater than 200 m distance from a well site.

9.4 Potential Impacts

9.4.1 Stage 1 GFDA

Construction

Some construction emissions would be expected during the construction of the gas wells including dust emissions from soil excavation and handling activities and associated construction. Other emissions include exhaust emissions (products of combustion) from construction equipment. The location of the Stage 1 GFDA and low number and density of surrounding receptors means that there is little potential for dust and exhaust emissions to give rise to nuisance impacts off-site, provided the works are undertaken with appropriate dust mitigation and management measures.

In addition to the typical construction emissions expected as part of the construction of the Stage 1 GFDA, drilling of the wells is another expected source of particulate emissions. These emissions can be controlled using standard dust mitigation measures typically employed by drilling companies within the mining industry. Due to the short term nature of the drilling, the variable locations of the wells and the controllable emissions from the drilling activities, well drilling emissions have not been included in the AQIA modelling.

In order to ensure that construction emissions are adequately managed, a CEMP would be prepared for the Project, subject to the issue of project approval. The CEMP would contain, procedures to minimise dust emissions during construction and management practices to address air quality issues during construction. Responsibilities for the implementation, management, monitoring, reporting and enforcement of control measures would be clearly distinguished in the CEMP.

Emissions from the commissioning of the gas wells have been identified as intermittent, non continuous emissions that would occur at the commissioning of each gas well on average for a period of up to one month, with the likelihood that between 5 and 8 wells would be flared simultaneously. The flare emissions have been modelled using AUSPLUME assuming a volume source with emission source details obtained from literature. As these activities are only likely for a short period of time, only short term averaging periods have been considered and as the flare locations would vary as the gas field is expanded, the modelling domain has been modelled independently of other emission sources associated with the CPF. The tabulated results of the modelling are shown in **Table 10** of the AQIA (**Appendix F**).

The DECCW's ozone limiting method was utilised for the assessment using the assumption that the maximum background ozone and NO_2 concentrations to be the same as those recorded at the Wallsend monitoring station. This is deemed to be a conservative estimate as the background pollutant concentrations at the site are expected to be lower than those recorded at Wallsend due to the site's relative isolation from pollution sources compared to Wallsend.

All predicted ground level pollutant concentrations (GLC's) were below the impact assessment criteria with the exception of cumulative concentrations of PM_{10}. It should be noted, however, that the background concentrations from Wallsend are considered to be overestimates of actual background pollutant concentrations within the stage 1 GDFA. Appropriate separation distances for GLC's would be identified as part of future assessments.

It should be noted that the modelling showed that maximum concentration of PM_{10} decreases rapidly with distance from the well. At 150m from the wells, the PM_{10} concentration would be expected to reach a level below the assessment criteria.

The cumulative impacts of flaring were also examined using AUSPLUME to determine acceptable separation distances between simultaneously flaring wells without exceeding the air quality criteria (refer to **Appendix F**). The modelling results showed that the well separation distances to ensure compliance are:

- 500 m for wells positioned in a straight line (maximum of five wells simultaneously flaring); and
- 800 m for wells positioned in a triangular grid.

It needs to be noted that the modelling undertaken above was performed assuming a gas consumption rate of 0.1639 m^3/s (500,000 standard cubic feet per day, scfd). This gas flow rate is expected to comprise the upper limit of the expected flow rate and to ensure the modelling is conservative the upper limit of the gas consumption has been used in the modelling predictions. However, advice from AGL has indicated that the flow rate is expected to be lower than the upper limit and is expected to be closer to 0.0983m^3/s (300,000 scfd) to 0.0328 m^3/s (100,000 scfd), which would result in 40% - 80% reduction in NO_X emissions and a decrease in both the well minimum separation distances and the cluster spacing.

Based on modelling assumptions and assuming the minimum gas emission rate of 100,000 scfd, the well separation distance could be reduced from 800m (at 500,000scfd gas usage) to a 300m well spacing for wells in a triangular grid formation and from a spacing of 500m to 100m for wells configured in a straight line. In addition the well cluster spacing would be expected to be able to be reduced significantly (estimated value of 1km would be expected to provide a significant degree of protection to prevent cumulative impacts from flaring well clusters.

Due to the short term nature of flaring activities, the conservative nature of the Wallsend data and the conservative values adopted for flaring emissions, exceedances are considered unlikely to occur.

Operation

The small diesel generators potentially utilised at each well site during the operation of the Stage 1 GFDA and other potential operational activities such as well work overs or re-completion have the potential to result in impacts to air quality. However, these activities are not expected to constitute a significant pollutant source. The OEMP to be prepared for the Project, would outline the procedures to be adopted to minimise dust and air emissions during operational activities.

9.4.2 CPF

The AQIA modelled emissions from the operation of the CPF at both Site 1 and Site 7. The results of the assessment are discussed in the following sections. The AQIA is provided in full in **Appendix F**.

Construction

Potential emissions to air associated with the construction phase of the CPF include typical construction emissions such as dust from soil excavation and handling activities and associated construction. Other emissions include exhaust emissions (products of combustion) from construction equipment. As with the Stage 1 GFDA, the location of the CPF and low number and density of surrounding receptors means that there is little potential for dust and exhaust emissions to give rise to nuisance impacts off-site, provided the works are undertaken with appropriate dust mitigation and management measures.

The CEMP to be prepared for the Project, would outline the procedures to be adopted to minimise dust emissions during construction as described in **Chapter 9.5.1** above.

Operation

During the operation of the CPF, pollutants emitted from the facilities would primarily be combustion products formed during the compression, cleaning, and flaring of the gas, and burning of CSG by the proposed 15MW power plant to generate electricity.

Maximum GLCs of all pollutants predicted by the dispersion modelling are shown for each of the sensitive receptor locations surrounding each potential CPF site (refer to **Table 8** and **Table 9** in **Appendix F**), in addition to the maximum predicted concentrations at any point within the modelling domain.

The dispersion modelling predicted that there would be essentially no increase in background pollutant levels for annual NO_2 and annual and 24 hour PM_{10}. All pollutant concentrations were predicted to be well below the guideline criteria at all locations assessed.

9.4.3 Pipeline

Construction

As with the construction of the Stage 1 GFDA and CPF, some constructions emissions would be expected during the construction of the pipeline corridor. The issues and responses related to the pipeline corridor construction are similar to those expected for the Stage 1 GFDA and CPF i.e. development and implementation of a CEMP.

Operation

Potential emissions of CSG from the pipeline have been addressed by the Greenhouse Gas assessment discussed in **Chapter 21**. The HDS is not expected to constitute a source of emissions as it is a transfer station without any emission sources identified.

9.5 Environmental Safeguards

9.5.1 Stage 1 GFDA

Construction

The construction safeguards recommended for the Stage 1 GFDA consist of the development and implementation of an Air Quality Management Plan (AQMP) as part of the broader CEMP for the Project which would outline activities required to minimise dust and vehicle emissions during the construction phase of the Project including:

- Control of access via gravelled roadways.
- Vehicle speed limits on site.
- Monitoring of wind speed and direction to manage dust-generating activities during undesirable conditions.
- Minimisation of areas of disturbed soils during construction.
- Dust suppression with water sprays or other media during windy periods (as required).
- Stockpiling of soils on site kept to a minimum.
- Conducting excavation works with limited soil free fall.
- Progressive rehabilitation of disturbed areas wherever feasible.
- Construction equipment idling time and engine tuning to minimise exhaust emissions.

- Visual assessment of air emissions on a routine basis.
- Procedures to address any complaints received.
- Use of wet drilling methods or emission capture devices (e.g. baghouses) to reduce dust emissions during well drilling.
- Contingency measures.

The safeguards to minimise potential impacts to air quality from the flaring of wells when commissioning wells are as follows:

- Minimising the time that flares are to be active i.e. minimise the time taken to cap the wells;
- Assuming a conservative gas emission rate of 500,000scfd, ensure a separation distance of at least 500 m for wells positioned in a straight line (maximum of five wells simultaneously flaring), to prevent cumulative impacts from flaring emissions; and
- Assuming a conservative gas emission rate of 500,000scfd, ensure a separation distance of at least 800 m for wells positioned in a triangular grid;
- Lesser separation distances could be adopted depending on the gas emission rate.

If additional wells are to be flared simultaneously within the Stage 1 GFDA, a spacing of 4 km would be maintained. Provided the 4km spacing is implemented, the same separation distances as detailed above would be applied to ensure compliance.

Chapter 25 provides further detail on the CEMP to be prepared for the Project.

Operation

Operation of the Stage 1 GFDA would require the development and implementation of an OEMP, with specific features of the plan aimed at monitoring, assessing and, if required, rectifying any air quality issues associated with the operation of the Stage 1 GFDA. **Chapter 25** provides further detail on the OEMP to be prepared for the Project.

9.5.2 CPF

Construction

The construction safeguards recommended for the CPF consist of the development and implementation of an AQMP as part of the broader CEMP for the Project which would outline activities required to minimise dust and vehicle emissions during the construction of the CPF as described in more detail in **Section 9.5.1** above.

Operation

There are no predicted exceedences of the impact assessment criteria for pollutants of concern in relation to the operation of the CPF at either Site 1 or Site 7, provided that catalytic converters are installed on the generators and compressors with at least a 90% reduction efficiency for formaldehyde emissions.

The operational safeguards recommended for the CPF would require the development and implementation of an OEMP (refer to **Chapter 25**), with specific measures to monitor, assess and, if required, rectify any air quality issues associated with the operation of the CPF. These measures may include:

- Emissions testing to confirm post commissioning emissions for generator units and compressors;
- Regular emissions monitoring to ensure efficient operation of generator units and compressors;
- Provision for ambient monitoring of pollutants for a period of time post commissioning to demonstrate that impacts are not occurring; and
- Provision of a contact number for local residents to report environmental concerns.

The OEMP would have an air emissions monitoring regime comprising the following:

- Level 1: Year 1 to 2: air emissions testing conducted quarterly;
- Level 2: Year 3 to 4: air emissions testing conducted semi-annually;
- Level 3: Year 5 onwards: air emissions testing conducted annually, if required;
- If there are any deviations on air emissions the testing regime would regress to a former level for two periods; and
- If additional units are installed that are identical to ones previously installed then these new units would adhere to the older unit testing regime.

9.5.3 Pipeline

Construction

The construction safeguards recommended for the pipeline consist of the development and implementation of an AQMP as part of the broader CEMP for the Project which would outline activities required to minimise dust and vehicle emissions during the construction of the pipeline as detailed in **Chapter 9.6.1** above.

Operation

Operation of the pipeline would require the development and implementation of an OEMP with specific features of the plan aimed at monitoring, assessing and if required rectifying any air quality issues associated with the operation of the pipeline.

9.6 Plume Rise Assessment

9.6.1 Overview

Plume emitting stacks within 15 km of an airport require the authorisation of the Civil Aviation Safety Authority (CASA) to assess compliance with civil aviation requirements for air space safety. CPF Site 1 is located approximately 4.5 km from an active airfield. An air Plume Rise Assessment has therefore been prepared which provides data upon which CASA can base a hazard assessment, and determine whether the plume should be classified as a ‘hazardous object’ under Civil Aviation Safety Regulation (CASR) Part 139.

The Air Plume Rise Assessment was prepared in accordance with the Guidelines for Conducting Plume Rise Assessments (June 2004) issued by CASA, with data generated using The Air Pollution Model (TAPM). The full report is provided in the AQIA in **Appendix F**.

9.6.2 CASA Requirements

Guidelines for conducting plume rise assessments are recommended in the Advisory Circular (AC) 139-05(0). The purpose of the AC is to provide guidance to aerodrome operators and persons involved in the design, construction and operation of the facilities with exhaust plumes about the information required to assess the potential hazard from a plume rise to aircraft operations. CASA has identified that there is a need to assess the potential hazards to aviation because the vertical velocity from gas efflux may cause airframe damage and/or affect the handling characteristics of an aircraft in flight.

Aviation authorities have established that an exhaust plume with a vertical gust in excess of 4.3 m/s may cause damage to an aircraft airframe, or upset an aircraft when flying at low levels. As a result, CASA requires the proponent of a facility with an exhaust plume, which has an average vertical velocity exceeding the limiting value (4.3 m/s at the aerodrome Obstacle Limiting Surface (OLS) or at 110 m above ground level anywhere else) to be assessed for the potential hazard to aircraft operations.

9.6.3 Methodology

CASA considers that TAPM provides the ability for realistic plume modelling where there is no reliable meteorological data available from measurements/observations. The plume rise assessment for the Gloucester Gas Project has utilised the TAPM model. In the plume rise mode, TAPM analyses plume behaviour in the meteorological conditions which are likely to be experienced at the site.

Prediction of the plume rise statistics as required by the CASA AC has been undertaken using the TAPM prognostic dispersion model. Stack parameters along with expected plume merging parameters were used to predict the plume velocity and plume extent for every hour over a 5 year time period. The vertical velocity targeted by this investigation was 4.3 m/s. The modelling parameters used included:

- Modelling period;
- Grid centre coordinates;
- Local values;
- Grid points;
- Outer grid spacing;
- Vertical levels;
- Domains; and
- Terrain.

Modelling data used in the plume rise assessment incorporated the same time period as used in the AQIA for the Project (**Appendix F**) to ensure consistency.

The source parameters for each of the proposed stacks are shown in **Table 9-2.** The plumes from the three groups of stacks (i.e. G1 to G5, C1 to C8, and ALT, TEG1 and TEG2) would be expected to merge due to their proximity to each other, which may increase the buoyancy of the plume. This was accounted for in the dispersion modelling through the application of a buoyancy enhancement factors to the emissions from each gas stack. The value for the buoyancy enhancement factors was obtained from Manins, Carras and Williams (1992) and entered into the TAPM model.

Table 9-2: Summary of Stack Parameters

Source Name	Stack Height (m)	Stack Temperature (°C)	Diameter (m)	Stack Tip Velocity (m/s)	Buoyancy Emission Factor
G1 – G5	10	375.0	0.60	32.4	2.91
C1 – C8	12	447.8	0.98	15.0	3.34

Source Name	Stack Height (m)	Stack Temperature (°C)	Diameter (m)	Stack Tip Velocity (m/s)	Buoyancy Emission Factor
ALT	12	447.8	0.69	15.0	2.34
TEG1	8	250.0	0.20	15.0	2.34
TEG2	12	250.0	0.20	15.0	2.34

As both CPF Site 1 and CPF Site 7 are to be constructed to a similar footprint, modelling was taken to be indicative of the two locations with the results for the plume rise also applied to both locations and the impacts assessed in this context.

9.6.4 Results

The objective of the analysis of the data obtained from the TAPM model is to establish the critical height at which the plume vertical velocity is below the 4.3 m/s threshold. Data analysis was performed to calculate the critical vertical velocity profile in accordance with CASA (2004). A summary of the plume characteristics for the CPF for all five years is provided in **Table 9-3** , which shows the maximum, minimum and average heights below which the plume vertical velocity exceeded 4.3 m/s (critical height). Plume characteristics shown in addition to the plume height include the maximum, minimum and average spreads of the plume in the horizontal and vertical directions.

Table 9-3: Critical Plume Extents

Statistic	Critical Height (m)	Horizontal Plume Spread (m)	Vertical Plume Spread (m)	Horizontal Plume Displacement (m)[1]	
				X	Y
Maximum	48	5	3	9	7
Minimum	16	2	1	0	0
Average	18	3	2	1.3	1.3

[1] Note that the plume displacement value does not indicate direction, merely the degree to which the plume moved away from the source.

The results of the TAPM modelling found the plume height where the plume velocity was 4.3 m/s was 48 m. The maximum horizontal displacement away from the source location is estimated to be 9 m. As the closest proposed CPF (CPF Site 1) is located approximately 4.5 km from the airfield, impacts from the plume on the airfield are not expected to occur (and by inference the more distant CPF Site 7 to the south would also not result in impacts on the airfield). Furthermore, it was decided no further analysis was necessary as the plume height where the maximum plume vertical velocity occurred was well below 110 m.

9.7 Residual Impacts

The potential air quality impacts of the Project during the construction phase would be temporary and would cease upon completion of construction works with no significant residual air quality impacts.

The operation of the Stage 1 GFDA and pipeline would result in minimal residual air quality impacts related to emissions from plant and equipment required for the ongoing maintenance and operation of this infrastructure.

The operation of the proposed CPF (including 15MW power generation plant) would result in minimal residual air quality impacts. Provided the OEMP and safeguards are implemented, emissions would remain within acceptable levels.

Provided the mitigation measures are implemented to an appropriate standard, the Project would be able to operate within the standards required by NSW DECCW.

9.8 Conclusion

Air quality emissions from the proposed CPF at both Site 1 and Site 7 and Stage 1 GFDA well sites have been assessed during both construction and operation. Construction emissions, due to their temporary nature and variability, were not assessed quantitatively and would be addressed through the development and implementation of an AQMP as part of the broader CEMP for the Project. The results of the AQIA in respect of the Stage 1 GFDA and CPF indicated that:

- All ground level pollutant concentrations resulting from operation of the proposed facilities would be below the relevant DECCW criteria for both proposed CPF sites at all modelled locations within the modelling domain (including both gridded and sensitive receptors).
- Emissions resulting from the flaring of the wells during commissioning were predicted to be below the DECCW criteria, provided the recommended distance between simultaneously flaring wells is adhered to.

In relation to the pipeline component of the Project, the AQIA concluded that:

- Some emissions would be expected during the construction of the pipeline corridor and would be managed through the development and implementation of the CEMP for the Project. Operational emissions resulting from the pipeline would be limited to the potential for escape of CSG which is addressed in the Greenhouse Gas Assessment in Chapter 21 of this EA.
- The HDS is not expected to constitute a source of emissions as it is a transfer station without any emission sources identified.

Investigations into plume rise dynamics of the two potential CPF locations were conducted in accordance with CASA (2004). TAPM results were analysed to assess the height at which a vertical plume velocity of 4.3 m/s was exceeded and whether the subsequent plume height exceeded 110 m (CASA criteria). The results indicate that the plume characteristics from the proposed CFP are predicted to be comfortably in compliance with CASA (2004) requirements.

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10.0 Ecology

An Ecological Assessment was undertaken by AECOM which considered threatened species, populations and communities listed under both State and Commonwealth legislation that have been recorded within the Concept and Project Areas. This assessment identifies potential impacts on threatened species and details measures to avoid or mitigate impacts identified. Residual ecological risks associated with the construction and operation of the proposed infrastructure are identified and discussed. The Ecological Assessment (AECOM, 2009) is provided in full in ***Appendix G*** *and discussed in the sections below.*

Subsequent to the Ecological Assessment being undertaken, amendments to the pipeline route and location of the CPF were made by AGL. A further ecological survey was undertaken by AHA Ecology as an addendum to the original Ecological Assessment. The Ecological Addendum is also provided in ***Appendix G.***

An explanatory note is provided with ***Appendix G*** *which provides further clarification of the changes made since the original Ecological Assessment, as changes in the pipeline route changed the "KP" markers which run from north to south along the route. As the original Ecological Assessment utilised the original KP markers, and the Ecological Addendum utilised the revised KPs, a conversion table has been provided in the explanatory note to illustrate the KP changes in order that both reports may be understood. Also included is a map showing the original and revised pipeline route to clearly indicate where amendments have been made.*

Where specific elements of the Project have been amended, the results and mitigation measures of the Ecological Addendum supersede those of the original Ecological Assessment. The results of the Ecological Assessment and Ecological Addendum are summarised in this chapter.

10.1 Existing Environment – Concept Area

The Concept Area is situated within Gloucester Basin within a gently undulating valley surrounded to the east and west by linear ridges oriented approximately north-south. The majority of the Concept Area is cleared for agricultural and pastoral land uses, with scattered areas of remnant vegetation. The Concept Area is dissected by a number of watercourses which generally support riparian vegetation communities.

Several protected areas are located proximate to the Concept Area, including the western boundary of the Glen Nature Reserve, Running Creek Nature Reserve, and Avon River State Forest. The Concept Area has been located to avoid protected areas, and these areas would not be affected by the proposed development of the Concept Area.

Potential impacts of the future development of the Concept Area upon local ecology may occur as a result of the construction of additional well sites, water and gas gathering lines, and access tracks. The nature and extent of impacts would be similar to the potential impacts identified in relation to the development of the Stage 1 GFDA, which are described in **Section 10.3**.

The locational principles discussed in **Section 5.2** have been designed specifically to minimise potential impacts resulting from the future development of the Concept Area by guiding the placement of infrastructure so as to avoid sensitive ecological features. Generally, infrastructure would be placed to avoid potential impacts upon vegetation through the targeting and utilisation of existing cleared areas. Further detailed ecological assessment would be undertaken as part of future Project Applications, however it is anticipated that significant impacts would be avoided or minimised through the implementation of the locational principles described in **Section 5.2**.

10.2 Existing Environment – Project Area

Desktop searches for significant flora and fauna species and ecological communities were conducted for the areas incorporating and adjacent to the proposed Stage 1 GFDA, CPF, pipeline and HDS. Field surveys were subsequently undertaken at selected areas throughout the Project Area as detailed in **Appendix G**.

10.2.1 Stage 1 GFDA and CPF

The Stage 1 GFDA is approximately 50 km^2 and lies in a flat to gently sloping plain within the NSW North Coast biogeographic region. The majority of the Stage 1 GFDA is used for cattle pastures and the southern section is further disturbed by an active coal mining operation, Stratford Colliery. The majority of the Stage 1 GFDA is cleared, with a dense ground cover of exotic pasture grasses and very few trees, although regrowth of native tree species was observed in some areas.

Some remnant vegetation occurs within the Stage 1 GFDA, mostly contained within several blocks in the central and southern portions of the Stage 1 GFDA. Narrow strips of remnant vegetation also occur along the Avon River and tributaries, although these are often heavily disturbed by weeds, such as willows (*Salix* species), wandering jew (*Tradescantia fluminensis*), privet (*Ligustrum* species) and peach (*Prunus persica*).

CPF Site 1 (The Tiedeman Property) is currently vacant, consisting of mainly grassland on relatively flat terrain.

CPF Site 7 (adjacent to the rail loop) is located on vacant land and consists predominantly of grassland with some scattered sparse vegetation. A large stand of vegetation is located in the south eastern portion of the parcel of land, however this would not be affected by the Project.

10.2.2 Pipeline

The proposed pipeline corridor is some 95 km in length and traverses a variety of landforms, including flat plains, gently to moderately sloping hills, streams of varying sizes, swamps and minor tidal channels. The major rivers transected include the Karuah River, Williams River and the Hunter River. The majority of the proposed pipeline would pass through cleared pastures with a dense ground cover of exotic pasture grasses. Most cleared areas contain few trees, but regrowth of native tree species was observed in some areas. The proposed pipeline would transect or lie adjacent to a number of blocks of remnant vegetation, including the eucalypt forests associated with hilly terrain along Black Camp Road and in Wallaroo National Park. **Figures 10.2 – 10.20** show flora and fauna assessment sites and DECCW Wildlife Atlas Threatened Species records and Forestry ecosystems along the pipeline corridor.

The majority of the proposed pipeline lies within the NSW North Coast biogeographic region. The southern portion of the proposed pipeline lies in the Sydney Basin biogeographic region. **Figures 10.17 – 10.20** show the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) mapping for the pipeline corridor.

The provisions of SEPP 44 – Koala Habitat Protection, apply to the six LGAs through which the Project passes. The pipeline intermittently transects two Koala Management Units between KP 60.5 to KP 79.7 as defined in the *Port Stephens Council Comprehensive Koala Plan of Management Management* (Port Stephens Council 2002; CKPoM*).* These include the:

- Balickera Management Unit.
- Western Management Unit.

A summary of the key listed species and communities is provided in **Table 10-1** below.

Table 10-1: Summary Baseline Environment in the Stage 1 GFDA, CPF and Pipeline Corridor

Stage 1 GFDA and CPF	Pipeline
Protected Areas	
No protected tenures were identified within the Stage 1 GFDA or at both CPF site. The western boundary of the Glen Nature Reserve lies approximately 2.5 km east of the Stage 1 GFDA.	The proposed pipeline transects Wallaroo National Park for approximately 3.5 km from KP 60.7 to 64.2. The proposed pipeline follows an existing powerline easement that contains a clearing of approximately 25 m width. The proposed pipeline traverses on or passes adjacent to two landholdings which have a Voluntary Conservation Agreement (VCA) or are currently negotiating a VCA (refer to AECOM, 2009). SEPP 14 Wetlands 830 and 831 occur at the southern end of the amended route at Tomago. The southern end of the proposed pipeline lies about 0.8 km east of the northern end of the Hexham Swamp section of the Hunter Estuary National Park and 1 km northwest of the Kooragang section of the Hunter Estuary National Park. The southern end of the proposed pipeline lies about 1 km upstream of the Hunter Estuary Wetlands, which is listed as a RAMSAR wetland.
Critical Habitat	
No areas or habitats within the Project Area have been declared as critical habitat for threatened species or ecological communities under either the EPBC or TSC Acts.	
Threatened Ecological Communities under the EPBC Act	
The EPBC Act Protected Matters Report identified one critically endangered ecological community that may potentially occur within the study site including the Stage 1 GFDA, CPF locations and pipeline corridor (*White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*). Targeted searches were made for this ecological community during the field surveys but it was not observed in the areas inspected. Furthermore, the tree species that are recognised as dominant and characteristic of this ecological community were not recorded within the areas inspected.	
Threatened Ecological Communities under the TSC Act	
No threatened ecological communities have been identified within the Stage 1 GFDA or CPF locations.	Five Endangered Ecological Communities (EECs) occur within or adjacent to the pipeline.
Ecological Communities Protected under the FM Act	
Not applicable.	
Endangered Populations	
The Atlas of NSW Wildlife Data Unit identified seven endangered populations of flora species listed under the TSC Act that may potentially occur within the study site and adjacent regions. Five of these have preferred habitat which was identified within the study area during the field survey. These species / populations were targeted during the field survey, but none were observed in the areas inspected. They are not considered likely to occur within the boundaries of the Project Area and are therefore not evaluated further in this report.	

<table>
<tr><th>Stage 1 GFDA and CPF</th><th>Pipeline</th></tr>
<tr><td colspan="2">Threatened Flora Species</td></tr>
<tr><td>Eleven flora species listed under the TSC Act and EPBC Act were identified as having potential habitat in the Stage 1 GFDA and CPF locations. These species were targeted during the field study, however none were detected.</td><td>Nineteen flora species known to occur or potentially occur within the study area and surrounding region are identified as being critically endangered, endangered or vulnerable under the EPBC Act and / or the TSC Act. Thirteen species are listed under the EPBC Act (four endangered and nine vulnerable) and 19 species are listed under the TSC Act (seven endangered and 12 vulnerable). Of the 19 threatened species identified as potentially occurring within the greater area, 14 have preferred habitat which was identified within the study area. These species were targeted during the field study, but only one was detected (Grevillea parviflora subsp. parviflora (small-flower grevillea)).</td></tr>
<tr><td>The majority of the proposed Stage 1 GFDA is grazed pasture. No threatened species identified as potentially occurring in the Project Area prefer grassland or pasture habitats.

Narrow bands of riparian forest occur in the GFDA. These are primarily associated with the Avon River and tributaries of the Avon.</td><td>The majority of the proposed gas pipeline passes through cleared pastures, intentionally avoiding other habitats wherever possible. No threatened species identified as potentially occurring in the Project Area prefer grassland or pasture habitats.

The proposed gas pipeline crosses streams of varying sizes. Narrow bands of riparian forest are intersected by the proposed pipeline in numerous locations.

The proposed pipeline route passes through or lies adjacent to a number of blocks of remnant vegetation with the potential to provide habitat for a variety of threatened species.

Open freshwater wetlands and timbered freshwater wetlands were recorded along the proposed pipeline route at several locations. Several threatened species (water birds and frogs) potentially occur in theses habitats. Significantly, the Green and Golden Bell Frog, which is listed as endangered and is reliant on open freshwater wetlands, has previously been recorded at 140 locations within 5 km of the Project Area.</td></tr>
<tr><td colspan="2">Threatened Fauna</td></tr>
<tr><td colspan="2">Forty seven threatened fauna species were identified as potentially occurring in the study area, including the Stage 1 GFDA, CPF locations and pipeline corridor. All 47 are listed as either vulnerable or endangered under the TSC Act and 13 are also listed as either vulnerable or endangered under the EPBC Act. This group is comprised of three amphibians, two reptiles, 24 birds and 18 mammals. Of the birds, 18 are woodland or forest species and six are wetland species. Of the mammals, 9 are bats.

The six LGAs through which the Project passes are subject to the provisions of SEPP 44 – Koala Habitat Protection. The pipeline traverses across some areas identified as Koala habitat and appropriate mitigations are proposed to avoid or minimise impacts.</td></tr>
</table>

Stage 1 GFDA and CPF	Pipeline
Migratory and Marine Protected Birds	
Twenty one bird species listed as Migratory and / or Marine under the EPBC Act were identified as potentially occurring within the Project Area. It is considered unlikely that the proposed development would have impacts of national significance on any of these species.	

Twelve weed species that are declared under the Noxious Weeds Act 1993 (NW Act) were recorded within or immediately adjacent to the study area (eight in AECOM (2009) and an additional four species in AHA (2009)). Under the NW Act, weed species are classified into five categories:

- Classes 1 and 2: The plant must be eradicated from the land and the land kept free of the plant.
- Class 3: The plant must be fully and continuously suppressed and destroyed.
- Class 4: The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local authority.
- Class 5: The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with.

Of the twelve declared weeds recorded, two are listed as Class 3 (giant Parramatta grass and serrated tussock), six species are listed as Class 4 (mistflower, water hyacinth, small leaf privet, large leaf privet, pampas grass and blackberry) and four as Class 5 (lantana, onion grass, oxalis and weeping willow).

A weed warning for alligator weed (*Alternanthera philoxeroides*) was observed for a section of the proposed pipeline at approximately KP 88.9. This species is listed as a Class 2 weed. No alligator weed was observed during the present survey, but the area had been inundated by recent rains, so young plants would be submerged and therefore not visible.

Some weed species are also recognised by the Commonwealth Government as Weeds of National Significance (WONS) based on their:

- Invasiveness and impact characteristics;
- Potential and current area of spread;
- Current primary industry, environment and socioeconomic impacts.

Weeds of national significance that were recorded in the proposed pipeline area included lantana and blackberry, but the only WONS recorded in the Stage 1 GFDA was weeping willow.

10.3 Potential Impacts – Stage 1 GFDA and CPF

The Ecological Assessment and identification of potential impacts are based on desktop studies and field investigations of areas considered most at risk of potential adverse impacts from construction and maintenance activities and provide a conservative, worst case assessment.

10.3.1 Construction

Potential impacts during the construction phase of the Stage 1 GFDA and CPF are primarily related to removal of native vegetation, and the disturbance of surface soils resulting from earthworks, vegetation clearing, watercourse crossings, vehicle movements on unformed tracks and other machinery operations. Impacts would also result from the establishment of temporary construction facilities such as laydown areas and the construction work camp. These facilities would however, be situated in accordance with the Locational Principles set out in **Section 5.2** of this EA in order to minimise potential impacts.

Erosion is of particular concern in waterways and steep areas. Erosion and dust can cause sedimentation of waterways, including streams and freshwater wetlands. Potential impacts arising from dust emissions would likely be short-term and reversible, but could affect vegetation communities and flora species through smothering. Erosion and sedimentation could continue after construction is completed and the impacts of sedimentation could persist after erosion has ceased.

The mitigation measures recommended in **Section 10.6** would generally be applied to avoid, minimise and/or mitigate the potential impacts of gathering lines on riparian areas within the Stage 1 GFDA.

10.3.2 Operation – Stage 1 GFDA and CPF

Once operational, the Stage 1 GFDA and CPF are not expected to result in notable ecological impacts.

10.4 Potential Impacts – Pipeline

10.4.1 Construction

Removal of Native Vegetation

Approximately 13.17 km of remnant native vegetation is transected by the proposed 95 km pipeline route. Clearing may be required for construction activities such as access tracks, batch plants, stockpile and storage areas. While exact locations for these requirements would not be finalised until pre-construction, it is anticipated that these would be located in existing cleared areas as far as possible to reduce the total area of vegetation loss. The Ecological Assessment (AECOM, 2009) and Addendum Report (AHA, 2009) considered the likely vegetation removal requirements for each vegetation community based on the width of clearing, which are presented in Table T12 and T13 in the Ecological Assessment (refer to AECOM (2009) and AHA (2009) of **Appendix G**). The Ecological Assessment and Addendum Report have identified defined points where a reduced ROW should be employed to reduce or avoid impacts. Areas where an HDD construction technique should be employed to further reduce impacts are also identified. Where potential impacts have been identified, environmental safeguards have been developed to avoid, minimise and/or mitigate these potential impacts, and are detailed in the Ecological Assessment (AECOM, 2009) and updated in the Addendum Report (AHA, 2009). These findings are summarised in **Section 10.6** below.

The most wide-spread impact likely to arise from the pipeline construction is the loss of native vegetation. However, this is largely a reversible impact. Once the proposed pipeline has been constructed, there is potential to allow tree, shrub and ground storey vegetation to naturally re-establish over a majority of the corridor, with the exception of a 3 m strip on either side of the actual pipeline to be kept free of trees and shrubs to protect the pipe from potential root damage and facilitate ongoing inspection and maintenance.

As such, subject to landholder property management practices, it is expected that over the medium term (typically around 20 years) significant portions of the proposed pipeline construction footprint would naturally regenerate following the initial rehabilitation period.

Other potential impacts of the pipeline construction upon flora and fauna are further detailed in **Appendix G** (AECOM (2009) and AHA (2009)) include:

- Creation of edge effects where the pipeline would run adjacent to previously undisturbed vegetation. As the majority of the proposed route has been cleared previously and the landscape is highly fragmented, the potential impacts in this respect are not considered to be significant. Nevertheless, **Section 10.6** and **Chapter 25** outline safeguards designed to avoid, minimise and / or mitigate these potential impacts;

- Direct impacts to ground-dwelling fauna species resulting from the temporary barrier to movement of these species due to trenching or entrapment in the open trench;
- Direct and indirect impacts to fauna species burrowed or sheltered in the soil during excavation works;
- Impacts to water quality from earthworks and watercourse crossings;
- Impacts to aquatic habitats / ecology at watercourse crossings;
- Impacts on SEPP 14 wetlands;
- Exposure of Acid Sulfate Soils which may impact on ecological values (refer to **Chapter 17** for further detail on the management of Acid Sulfate Soils);
- Soil compaction, erosion, sedimentation and dust emissions;
- Spread of plant pathogens;
- Barrier effects to wildlife movements; and
- Construction waste.

In order to minimise potential impacts, a range of mitigation measures would be implemented. These are detailed in **Section 10.6** and **Chapter 25.**

Key Threatening Processes

The proposed pipeline may also result in a number of potential impacts which are considered key threatening processes under the EPBC act and/or the TSC Act. A key threatening process is defined as such if it threatens or may potentially threaten the survival, abundance or evolutionary development of a native species or ecological community. The following key threatening processes may occur as a result of the pipeline component of the Project:

- Loss of hollow bearing trees;
- Removal of dead and fallen timber;
- Removal of bushrock;
- Spread of environmental weeds; and
- Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands.

An assessment of potential impacts associated with each of these key threatening processes is provided in the Ecological Assessment (**Appendix G**). Mitigation measures in **Section 10.6** and **Chapter 25** have been identified to avoid, minimise and / or mitigate these potential impacts. Provided the recommendations are implemented, potential impacts are not expected to be significant.

Different methods for crossing watercourses are described in **Section 5.6.4**. Watercourses with permanent high water flows and stream ordering greater than 3rd order (using the Strahler system) or environmentally sensitive areas would be crossed using HDD to avoid impacts to surface water, aquatic ecology and riparian vegetation. Watercourses identified as 3rd order streams with variable water flows would be crossed utilising an open trench with stream diversions, where required. The use of stream diversions is deemed suitable for streams with flows greater than 1000 L/s and is recognised by industry standards (APIA, 2005).

The table below illustrates the key issues identified during the ecological assessment and the initial management options recommended to avoid impacts. The table below also summarises the residual impacts. Reference should also be made to **Figures 10.1 – 10.20**.

Table 10-2: Summary Key Ecological Issues and Residual Effects

Site ID	Issue	Initial Management Recommendation	Residual Impact
KP25.1	Riparian rainforest vegetation at Karuah River.	HDD	HDD to be implemented. Potential impacts to riparian vegetation and watercourse avoided. No residual impacts.
KP27.8	Riparian vegetation along Ramstation Creek.	Open trench with flow diversions, if required. Potential HDD, if high water flows present.	If open trenching is proposed then clearing would be confined to minimum width (10 m). Water flows would be maintained and measures implemented to avoid erosion, downstream sedimentation and spread of weeds. Access tracks to be situated along existing tracks and to avoid drainage lines, where possible. No significant residual impacts.
KP 28.5 to KP 29.4	Avoid vegetation within road reserve.	Utilise the powerline easement to the east or the cleared pasture to the west.	This recommendation would be incorporated into the detailed design. No significant residual impacts identified.
KP 32.3 to KP 38.8	Minimise clearing of native vegetation in the large remnant vegetation block along Black Camp Road.	Utilise the existing cleared roadway and reducing the width of the ROW	Existing cleared roadway to be utilised and reduction in the width of the ROW to avoid significant residual impacts.
KP 36.5 to KP 37.2	Avoid clearance of native vegetation.	Movement of the proposed pipeline west into cleared pasture and the powerline easement to avoid remnant eucalypt forest.	This recommendation would be incorporated into the detailed design. No significant residual impacts identified.
KP37.7	Crossings of permanent streams to avoid impacts to hydrological flow regimes and impacts to existing riparian vegetation at Black Camp Creek.	Implement flow diversions, if required.	The flow regime of this watercourse is variable, depending on rainfall events, so open trench construction techniques would be suitable when water flow is low. Open trench with flow diversions and environmental management measures would be employed at these two locations if water flows are increased. Reduced ROW to minimise impacts to riparian vegetation.

Site ID	Issue	Initial Management Recommendation	Residual Impact
KP41.1	Crossings of permanent streams to avoid impacts to hydrological flow regimes and impacts to existing riparian vegetation at Cedar Tree Creek.	Implement flow diversions, if required.	The flow regime of this watercourse is variable, depending on rainfall events, so open trench construction techniques would be suitable when water flow is low. Open trench with flow diversions and environmental management measures would be employed at these two locations if water flows are increased. Reduced ROW to minimise impacts to riparian vegetation.
KP 46.4 to KP 46.5	Avoid clearance of Hunter Lowland Redgum Forest.	Movement of the proposed pipeline east into the road alignment and / or regrowth forest on the western side of the road to avoid remnant Redgum Forest.	This recommendation would be incorporated into the detailed design. Current maps show the alignment used to assess potential ecological aspects on which basis these recommendations have been developed. No significant residual impacts identified.
KP 50.3	Crossing of Bridge Creek.	Open trench during dry conditions as HDD not possible (refer to Section 3.6.3 of AHA (2009).	Additional recommendations include: Minimal width ROW to be used for riparian vegetation, avoidance of mature Eucalypt trees, sandstone benches to be avoided and management of cobbles in creek bed. No significant residual impacts identified.
KP 54.9 to KP 55.7	Avoid clearing of native vegetation in the proposed Nature Refuge.	Minimum width ROW through the powerline easement.	Minimum width ROW to be implemented. No significant residual impacts identified.
KP 59.9	Minimise impacts to the Small-flower Grevillea in the powerline easement.	Detailed survey and preparation of management plan (refer to Section 5.1 of Appendix G).	Recommendations within the management plan would minimise impacts. A monitoring plan would be established. An offset strategy would be developed to compensate for residual impacts that cannot be avoided or mitigated.
KP 60.5 to KP 63.8	Avoid clearing of native vegetation in Wallaroo National Park.	Minimum width ROW through the powerline easement.	Pipeline alignment through the National Park reduces amount of clearance required (alternate alignment outside the NP required further clearance of native vegetation). In principle agreement from NSW NPWS for this alignment. Minimum ROW to be used and Flora and Fauna Management Plan to avoid indirect and downstream impacts. No significant residual impacts identified.

Site ID	Issue	Initial Management Recommendation	Residual Impact
KP 68.2	Avoidance of impacts to freshwater wetland.	Use of thrust bore or HDD during wet conditions.	Thrust Bore to be implemented in wet conditions. No residual impacts identified.
KP 68.9 to KP 69.8	Avoidance of impacts to freshwater wetland.	Pipeline route diverted slightly to the north to avoid freshwater wetland. Use of thrust bore or HDD during wet conditions.	Thrust Bore to be implemented in wet conditions. No residual impacts identified.
KP 70.4	Avoidance of impacts to approximately 30 m of paperbark swamp forest.	Use of HDD.	HDD to be implemented to avoid paperbark forest and to continue across the Williams River. No significant residual impacts identified.
KP 71.5 to KP 83	Minimise removal of intact native vegetation and avoid Hunter Lowland Redgum Forest.	Use of reduced ROW and avoid Redgum Forest, where possible. Habitat offset may be required.	Minimum width ROW to be implemented. No significant residual impacts identified. An offset strategy would be developed to compensate for residual impacts that cannot be avoided or mitigated.
KP 74.3	Avoid native vegetation at Deadmans Creek which is identified as ‘Preferred Koala Habitat’.	Use of HDD or thrust bore.	HDD to be implemented to avoid impacts to Deadmans Creek and surrounding vegetation. No significant residual impacts identified.
KP 92.5 to KP 93.6	Avoid Hunter River and SEPP 14 Coastal Wetlands.	Use of HDD.	HDD to be implemented to avoid impacts to SEPP 14 wetland and Hunter River. No significant residual impacts identified.
KP 94 to KP 94.9	Avoid Hunter River and SEPP 14 Wetlands.	Use of HDD.	HDD to be implemented to avoid impacts to SEPP 14 wetland (No. 830 and 831) and Hunter River. No significant residual impacts identified.
General	Removal of native vegetation.	CEMP with provisions to minimise and appropriately manage removal (refer to **Chapter 25**)	An offset strategy would be developed to compensate for residual impacts that cannot be avoided or mitigated.
General	Spread of plant pathogen.	CEMP and OEMP to include plant pathogen hygiene strategy	No significant residual impacts identified.
General	Loss of hollow bearing trees, dead and fallen timber.	CEMP and OEMP to include management strategies for flora and fauna (refer to **Appendix G**).	No significant residual impacts identified.

Site ID	Issue	Initial Management Recommendation	Residual Impact
General	Removal of bushrock.	CEMP and OEMP to include management strategies for flora and fauna (refer to **Appendix G**).	No significant residual impacts identified as material removed for the ROW would be returned to the rehabilitated ROW.
General	Spread of environmental weeds.	CEMP and OEMP to include weed management strategy (refer to **Chapter 25**).	No significant residual impacts identified.
General	Alteration to natural flow regimes.	CEMP and OEMP to include water management provisions, particularly with respect to erosion and sediment controls and water crossings (refer to **Chapter 12, 17, 22** and **25**).	No significant residual impacts identified.
General	Impacts from Acid Sulfate Soils.	CEMP to include ASS Management Plan (refer to **Chapter 17** and **25**).	No significant residual impacts identified.

In order to minimise potential impacts during the construction of the pipeline, a range of mitigation measures would be implemented. These are detailed in **Section 10.6** and **Chapter 25.**

10.4.2 Operation

Some activities involved with ongoing easement maintenance during the operation of the pipeline are recognised as threats to some listed flora species in NSW. Maintenance activities which can cause potentially negative impacts include:

- Slashing and clearing of regrowth;
- Spraying of weeds;
- Wild fire;
- Soil compaction;
- Erosion, sedimentation and dust emissions;
- Trampling by vehicles and machinery.

Priority action statements to address these potential impacts generally require that where threatened species or their potential habitats occur, planning and maintenance staff shall be made aware of threatened species before road, trail, or easement maintenance activities commence and processes are in place to avoid impacting upon them.

Impacts potentially arising from maintenance of the easement have particular relevance in this proposal to the population of small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) recorded during the field surveys within a previously cleared 25 m wide powerline corridor at approximately KP 59.9. The NPWS Threatened Species Information Sheet for small-flower grevillea (NPWS, 2002) identifies that the species often occurs in slightly disturbed areas such as easements. Therefore, widening and maintenance of easements and vehicular use are recognised threats to populations. High frequency fire may impact on populations and it is important that the interval between successive fires is sufficient to allow adequate accumulation of seeds in the soil seedbank for subsequent seedling recruitment. Although small-flower grevillea is not dependant solely on regeneration from seed, this form of regeneration is important for maintaining genetic diversity within populations.

10.5 Summary of Potential Impacts on EPBC Act Protected Matters

The ecological surveys and assessment undertaken for the Project have taken into consideration matters protected under the EPBC Act. While some Matters of NES do not relate to ecological matters, all have been included here for clarity:

- World Heritage Areas: The Barrington Tops World Heritage Area lies 17km distance at the nearest point to the Project and so no direct or indirect impacts are anticipated;
- National Heritage Places: The Gondwana Rainforests within the Barrington Tops World Heritage Area (as noted above) would not be impacted by this Project;
- Listed threatened species and ecological communities;
- Migratory species protected under international agreements;
- Ramsar wetlands of international importance;
- Commonwealth Marine Area: There are none within the vicinity of the Project; and
- Nuclear Action: This Project does not constitute a nuclear action.

A summary of the matters potentially interacting with the Project and the potential impacts is provided in the following sections.

10.5.1 Threatened Species and Ecological Communities

Threatened Flora Species

Fourteen flora species are listed under the EPBC Act (six endangered and eight vulnerable). Of the 14 threatened species identified as potentially occurring within the greater area, 10 have preferred habitat that was identified within the study area. The sources of potential impacts to these species resulting from the Project are listed Table T14 of AECOM (2009) (refer **Appendix G**), and assessed in Section 4 of **Appendix G**.

These species were targeted during the field study, but only one species was detected, a single population of *Grevillea parviflora* subsp*. Parviflora* (listed as Vulnerable under the EPBC Act), which was recorded at approximately KP 59.9 along the proposed pipeline route The population extended approximately 200 m along the corridor and was estimated to contain several hundred to a thousand plants. No specific management plan is currently in place for this population, as it was not previously known to be present in the easement. However, the population appears to be coping effectively with the current management regime.

NPWS (2002) noted that competition and shading from tick bush can limit the spread of this species, so regular slashing may even assist the population by reducing competition. Comparison of population sizes within the easement and surrounding native vegetation might provide circumstantial support for this possibility.

A multi-faceted management plan for the Small-flower Grevillea would be prepared including a detailed survey, monitoring program, mitigations to minimise impacts and an offset strategy to compensate for any residual impacts that cannot be avoided or mitigated (refer to **Chapter 25**).

An assessment of significance was undertaken in accordance with the significant impact criteria outlined in the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* for the 10 threatened flora species with the potential to occur within the Project Area (refer Table T15 of AECOM (2009) and Appendix B of AHA (2009) in **Appendix G**). Provided appropriate mitigation measures as proposed in this EA and **Appendix G** are implemented, the Project is unlikely to have significant impacts on these species.

Threatened Fauna Species

Ten threatened fauna species identified as either vulnerable or endangered under the EPBC Act were listed as potentially occurring in the Project Area, comprising three amphibians, three birds, and four mammals (including one bat species). None of these species were detected during field surveys. Provided appropriate mitigation measures as proposed in this EA and **Appendix G** are implemented, the proposed Project is unlikely to have any significant impacts on these species.

An assessment of significance was undertaken in accordance with the significant impact criteria outlined in the EPBC Act *Policy Statement 1.1 Significant Impact Guidelines* for the 10 threatened fauna species with the potential to occur within the Project Area (refer Table T16 of AECOM (2009), and Appendix B of AHA (2009) - **Appendix G**). Potential impacts to freshwater / coastal wetlands and associated threatened fauna species, such as the Green and Golden Bell Frog, would be avoided as these areas would be HDD. Potential impacts to flora and fauna relating to the disturbance of ASS would also be managed by an ASSMP (refer to **Chapter 17** and **25**). These assessments concluded that the Project would not result in a significant impact to the species identified.

Threatened Ecological Communities

One ecological community listed under the EPBC Act as critically endangered was identified as having the potential to occur within and surrounding the Project area, being *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*. Targeted searches were made for this ecological community during the field survey but it was not observed in the areas inspected. Furthermore, the tree species that are recognised as dominant and characteristic of this ecological community were not recorded within the areas inspected (**Appendix G**).

The *Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions* is an EEC under the TSC Act, which is situated along the pipeline route from KP 75.7 to 76.2. Mitigations would be implemented to minimise removal of this community as detailed in **Section 10.6** and **Appendix G** (AHA, 2009).

10.5.2 Migratory and Marine Species

A total of 21 bird species listed as Migratory and / or Marine under the EPBC Act were identified as potentially occurring within the Project Area. It is considered unlikely that the proposed development would have impacts of national significance on any of these species. Table T11 in AECOM (2009) (refer **Appendix G**) summarises the distribution, ecology, habitat requirements and assesses the potential impacts for these 21 bird species. Eighteen of these species are also assessed in Appendix B of AHA (2009) (**Appendix G**). Provided appropriate mitigation measures as proposed in this EA and **Appendix G** are implemented, the Project is unlikely to have any significant impacts on these species.

10.5.3 Ramsar Wetlands

The southern end of the pipeline lies about 1 km upstream of the Hunter Estuary Wetlands, which is a listed Ramsar wetland. Potential impacts similar to those listed for the pipeline (**Section 10.4.1**) have been identified which have the potential to indirectly affect these wetlands.

Provided appropriate mitigation measures as proposed in this EA and **Appendix G** are implemented, the Project is unlikely to have any significant impacts on this wetland.

10.6 Summary of Vegetation Removal

A summary of the vegetation removal requirements is provided in **Table 10-3** based on information compiled from AECOM (2009) and AHA (2009) in **Appendix G**. Detailed information regarding the removal of vegetation along the pipeline route is provided in a table in the Explanatory Note of **Appendix G**.

Table 10-3: Summary of vegetation to be removed along the pipeline route

Vegetation	Area to be Removed (hectares)
Dry foothills spotted gum	9.195
Rainforest	0.275
South Coast Shrubby Grey Gum	1.41
Ironbark	2.59
Redgum / apple	0.1
Spotted Gum - Ironbark Forest	1.505
Grey Gum – Stringybark – Bloodwood ± Spotted Gum Ironbark Forest	2.64
Forest Red Gum / Spotted Gum Woodland (Hunter Lowland Redgum Forest EEC)	0.23
Riparian Communities	0.22
Wetlands (including SEPP 14 wetlands)	0
Total Area	**18.17**

10.7 Environmental Safeguards

An extensive range of environmental safeguards, mitigation measures and monitoring and management programmes have been identified and would be undertaken in accordance with the Ecological Assessment (AECOM, 2009) and Ecological Addendum (AHA, 2009) (refer **Appendix G**) as part of the Project. These environmental safeguards are discussed below as they relate to pre-construction, construction and operational phases of the Project. A majority of safeguards relate to the pipeline corridor. Where relevant, mitigation measures relating to the Stage 1 GFDA and CPF are specified.

10.7.1 General Safeguards

Construction Environmental Management Plan (CEMP)

The CEMP would include provisions for the preconstruction, construction and operational stages of the development. The CEMP would detail specific management strategies to be implemented during the construction phase of the proposed development, including:

- Site induction and training with respect to flora and fauna issues;
- Wildlife-clearance surveys would be required to be undertaken by appropriately qualified persons immediately ahead of vegetation clearing operations to avoid disturbance to threatened fauna species (refer to **Chapter 25**);
- ASS would be managed in accordance with an ASS Management Plan (ASSMP) to be protective of fauna species and preventative of off-site and downstream effects, particularly in the vicinity of freshwater wetlands, as detailed in **Chapter 25**;
- Soil management plan as it pertains to soil handling and stockpile management to be protective of flora and fauna species and preventative of direct and indirect downstream impacts;
- Water management plan particularly with respect to erosion and sediment controls and water crossings;
- Waste management plan particularly with respect to water crossings and potential downstream effects;
- Landscaping and rehabilitation plan;
- Weed management plan with respect to vehicle and plant and equipment transport;
- Plant pathogen management strategy; and
- Develop and implement offset strategies for residual biodiversity impacts.

The CEMP would also provide general safeguards (refer to Section 5.2 of AECOM (2009)) in **Appendix G**) in order to:

- Minimise clearing of native vegetation for all components of the Project;
- Minimise impacts from removal of large hollow-bearing trees, dead trees and fallen timber and surface rock;
- Minimise disturbance to watercourse crossings, freshwater wetlands and their associated vegetation; and
- Manage earthworks to minimise impacts on threatened fauna species.

Operational Environmental Management Plan (OEMP)

The OEMPs would be developed for operation and maintenance of gas wells, gas gathering lines, CPF and the transmission gas pipeline. The OEMPs would include:

- Site inductions relating to flora and fauna issues;
- Weed management and monitoring plan;
- Plant pathogen management plan; and
- Landscaping/rehabilitation monitoring and maintenance plan.

Induction programs to induct all site workers involved in operation and maintenance activities into the requirements of the OEMP would be developed. Induction would be required prior to their commencement of duties.

10.8 Residual Impacts

Mitigations proposed in **Section 10.6** and **Chapter 25** would ensure that impacts to flora and fauna for the proposed works would be avoided or minimised. Where impacts are unavoidable or cannot be mitigated, an offset strategy would be developed in consultation with DECCW to compensate for any residual impacts (refer **Chapter 25**).

10.9 Conclusion

The ecological assessment identified that impacts as a result of the proposed development during the construction and operational phase of the Project would be limited to the following:

- Clearing of approximately 18.17 ha of native vegetation;
- No significant impacts to EECs. Some minor impacts to one population of Small-flower Grevillea would be required in accordance with multi-faceted management plan (refer to AECOM (2009) in **Appendix G**).
- Some minor impacts to the Hunter Lowland Redgum Forest EEC (0.23 ha removed), however mitigations would be implemented to minimise impacts (refer to AHA, 2009);
- No significant impacts to National Parks or nature reserves;
- No significant impacts to threatened flora and fauna species listed at both State and Commonwealth levels;
- No significant impacts on EPBC Act Protected Matters;
- No significant impacts to migratory and marine species;
- No direct impacts to RAMSAR wetlands; and
- No direct impacts to SEPP 14 wetland areas.

The potential ecological issues associated with the development would be managed through construction and operational environmental management plans (refer to **Chapter 25**) and any residual impacts through the development of an offset strategy.

As such, the issues identified are not considered to represent a significant constraint to the proposed development.

11.0 Land Use

This chapter addresses existing and proposed future land use in the areas affected by the proposed project and the relationship of the proposal to these land uses. The chapter assesses the potential impacts of the Project upon existing and future surrounding land use and presents mitigation measures where appropriate.

11.1 Overview

The Project encompasses an area running from Gloucester in the north to Hexham in the south and thus has the potential to impact upon a variety of different land uses and activities. The project passes through six LGAs including Gloucester, Great Lakes, Dungog, Port Stephens, Maitland and Newcastle.

The proposed Stage 1 GFDA and CPF are situated within Gloucester Shire on predominantly rural land currently zoned 1(a) under Gloucester LEP 2000.

The gas pipeline traverses all six LGAs and follows an established power easement for part of its length. The proposed corridor traverses approximately 201 parcels of land, largely zoned for rural purposes but including land zoned for special uses, residential development and environmental protection. The southern extent of the pipeline, at the site of the proposed Hexham Delivery Station, is zoned for industrial use.

The proposed Stage 1 GFDA, CPF and pipeline are permissible within the relevant land use zones, as detailed in **Chapter 6** of this EA. In addition, extensive consultation has been undertaken with local Councils and affected landowners in relation to the siting and design of the various project components. The views of landholders and the local community have been given careful consideration in relation to the location of wells, gathering lines, the CPF and the pipeline to ensure that impacts upon landowners and other stakeholders are minimised. Further, flexibility has been built into the Project to allow for potential land use issues to be accommodated in the final stages of design, construction and operation of the Project.

11.2 Concept Area

The Concept Area comprises a broader area of land within the bounds of PEL 285 within which the Proponent intends to construct and operate further gas wells as future stages of the Project (refer to **Figure 5.1**).

The land comprising the Concept Area is located within the Gloucester Shire and Great Lakes LGAs, encompassing largely rural/agricultural land, however the township of Gloucester, land owned by Gloucester Coal Ltd. and certain land zoned for environmental protection is also included within this area which extends as far north as Barrington but lies just to the east of the village.

Land uses within the Concept Area are largely as described below for the Stage 1 GFDA Project Area with additional key land use features including:

- The township of Gloucester comprising a mix of commercial, industrial, residential and recreational land uses; and
- Land zoned as environmentally sensitive, which is protected for its scenic and scientific value.

In recognition of the particular constraints which these land uses may pose for the future location of gas wells, a set of locational principles has been developed for the location of future wells and associated infrastructure within the Concept Area. These principles are detailed in **Section 5.2** of the EA and their adoption would ensure that the specific values of lands within the Concept Area are protected in any future development proposals. As previously stated in this EA, future development within the Concept Area would be subject to detailed assessment as part of separate project application/s for the proposed works.

11.3 Existing and Surrounding Land Use

11.3.1 Stage 1 GFDA and CPF

As previously mentioned, the proposed Stage 1 GFDA and CPF are located approximately 100 km north of Newcastle within the Gloucester Shire. Stage 1 of the GFDA is situated on rural land currently used for a mix of grazing and rural residential land uses.

The CPF Site 1 is located on land zoned for rural purposes under both the current LEP and the draft LEP 2009. The land is currently owned by the Proponent and is known as the Tiedeman Property. CPF Site 1 is currently vacant, consisting of mainly grassland on relatively flat terrain. The property also contains the Stratford Pilot Project, as discussed in **Section 3.3.2**.

The CPF Site 7 is located on land currently zoned for rural purposes and zoned for heavy industrial purposes under the Draft LEP 2009. CPF Site 7 is located on land currently owned by Gloucester Coal, on a parcel of land adjacent to a rail loop which currently services Stratford Colliery. The site is currently vacant and consists predominantly of grassland with some scattered sparse vegetation. A large stand of vegetation is located in the south eastern portion of the parcel of land, however this would not be affected by the Project.

Surrounding land uses to both CPF Site 1 and Site 7 include coal mining, agriculture, rural residential land and the Glen Nature Reserve (some 3 km to the south-east of CPF Site 7) with key surrounding infrastructure including the North Coast Railway Line and The Bucketts Way.

Agriculture

Agriculture is the principal source of employment within Gloucester Shire, with over 20% of the workforce employed in this industry (Hunter Development Brokerage, 2006). Agriculture within the Gloucester Shire was traditionally centred around timber and dairying, however these industries have declined significantly over the past eight years with beef cattle being Gloucester’s major agricultural enterprise. Emerging agricultural industries in the local area include fruit, eggs and lucerne (Hunter Development Brokerage Pty Ltd, 2006).

NSW DPI mapping of Agricultural Suitability classifies land according to its agricultural capacity as shown in the table below.

Table 11-1: Agricultural Land Suitability Classes

Class	Description
Class I	Land capable of regular cultivation for cropping (cereals, oilseeds, fodder etc) or intensive horticulture (vegetables, orchards). Has very good capability for agriculture, where there are only minor or no constraints to sustained high levels of production. Will include irrigated areas with high production.
Class II	Land suitable for cultivation for cropping but not suited to continuous cropping or intensive horticulture. Has a capability for agriculture but where constraints limit the cropping phase to a rotation with improved pastures and thus reduce the overall level of production.

Class	Description
Class III	Land suitable for grazing. Well suited to pasture improvement and can be cultivated for an occasional cash crop or forage crop in conjunction with pasture management. Overall level of production is moderate as a result of high environment costs which limit the frequency of ground disturbance. Has moderate capability for agriculture. Pasture lands are capable of sustained high levels of production although conservation measures may be required.
Class IV	Land suitable for grazing and not suitable for cultivation. Agriculture is based on native pasture or improved pastures relying on minimum tillage techniques. Overall level of production is low. Environmental constraints make arable agriculture uneconomic.
Class V	Land suitable only for rough grazing or land not suitable for agriculture. Agricultural production is very low to zero. Sever or absolute constraints to production imposed by environmental factors.

(*Source: NSW Department of Primary Industries, as cited by Hunter Development Brokerage Pty Ltd, 2006)*

According to the DPI mapping and classification system, there is no Class I land within the Gloucester Shire and only 0.2% of mapped land within the Shire is of Class II. Land comprising the GFDA, Concept Area and CPF site is generally classified as suitable for grazing, ranging from Class III to Class IV.

Mining

Gloucester Shire contains limited coal-bearing deposits which are currently mined under Coal Authorisations 31 and 315 held by Gloucester Coal Ltd. Two coal mines exist within the Shire, being Stratford Colliery (commenced in 1995 and closed mid-2003) and Bowens Road North Mine which commenced operation in 2003. The Duralie Mine (owned by Gloucester Coal Ltd.) is also located to the east of Clareville (Great Lakes LGA), approximately 40 km south of the township of Gloucester. Stratford Colliery is situated immediately to the east of the proposed CPF 7 and within the Stage 1 GFDA while the Duralie mine is located to the south of the Stage 1 GFDA.

Coal from the Gloucester Coal operations is processed at a coal handling and preparation plant at Stratford Colliery. There is continued coal mining exploration being done in the Gloucester Basin with concept studies underway to support mining beyond 2030 (Gloucester Coal Ltd, 2009). Gloucester Coal holds coal exploration license EL6904 which covers an area of land south of Stratford Colliery.

Other mining activities in the Shire include ruby mining in the upper reaches of the Little Manning River. Gas exploration has been occurring within the Gloucester basin since the early 1970s as detailed in **Section 1.1.1.**

Rural Residential

Gloucester Shire attracts numerous retirees from Sydney and Newcastle looking for a rural lifestyle. Many 100 hectare rural blocks have been purchased by such retirees to be used for hobby farms or simply ‘lifestyle blocks’. This trend is expected to increase into the future.

Environmental Protection

Gloucester Shire contains a number of National Parks and State Forests as well as Wilderness Areas (the Barrington Wilderness) and World Heritage (Barrington Tops). In addition, Gloucester LEP 2000 zones a range of areas ‘Environmental Protection’ in respect of their scenic or environmental values. The Shire is recognised for its natural beauty making it a popular tourist attraction. Tourism is an important contributor to the local economy with tourist expenditure in 2004/05 reaching $21 million (Hunter Development Brokerage Pty Ltd, 2006) and relying largely on the natural attributes of the area.

11.3.2 Pipeline

The proposed gas transmission pipeline would extend from the CPF to the HDS. This route extends across all six LGAs described in **Section 11.1** and as such, comes into contact with a range of land uses, the most dominant being:

- Agricultural;
- Mining;
- Rural residential;
- Residential;
- National Park; and
- Industrial.

The northern section of the pipeline runs through the LGAs of Gloucester, Dungog and Great Lakes where the predominant land uses affected are agricultural. Agricultural land within these LGAs falls largely within Classes 3, 4 and 5 with small amounts of Class 2 land (refer to **Section 11.2.2** for detailed description of these classifications). Agricultural land uses in Gloucester and Dungog comprise largely beef and dairy farming with scattered beef and horse studs. Forestry occurs in the north of this section but is not widespread. Within the Great Lakes LGA, agriculture is dominated by beef and dairy farming, poultry and horticulture. Rural residential development and hobby farms are increasingly common in the traditional grazing areas. Poultry farming is most prevalent around the village of Stroud Road and the pipeline passes in close proximity to at least one such establishment. Certain land in the township of Stroud and its immediate surrounds is proposed to be rezoned for residential or rural residential development, however this land is located some distance from the proposed pipeline route. Mining is largely restricted to the far north of the pipeline route, within the Gloucester Shire near Stratford. Vegetated areas such as State Forests, National Park and Regional Vegetation Corridors exist in the lands surrounding the proposed pipeline, however the preferred route avoids these areas wherever possible. Other notable land uses in the northern section of the pipeline include a human waste facility and various forms of infrastructure including power lines, telecommunications cables, roads and railway lines.

The southern section of the pipeline is generally defined as that passing through the LGAs of Port Stephens, Maitland and Newcastle. Land use in this southern section is more urbanised than that in the north with the pipeline route largely passing through areas of rural residential and industrial land, although agricultural land is also affected. Agriculture in the southern pipeline area is dominated by beef cattle, dairying, poultry, equine enterprises and viticulture. The preferred route crosses some Class II and III agricultural land in proximity to rivers and watercourses but predominantly affects Class IV and V land which is not considered suitable for regular cultivation. Within the Maitland LGA, the pipeline runs to the east of the Thornton North Release Area which is proposed to be rezoned and developed for residential purposes with an expected population of some 9,500 people. In the far south, the pipeline passes through SEPP14 wetlands (HDD crossing) and ends at the site of the HDS, within an established industrial area. Other notable land uses in the proximity of the southern section of the pipeline include Newcastle Airport, Department of Defence lands, extractive industry, native vegetation and various forms of infrastructure as described above, however with the exception of some native vegetation and infrastructure, the pipeline does not directly impact upon these land uses.

The pipeline alignment has been selected to utilise sections of existing easements containing existing transmission line infrastructure, in order to minimise impacts on surrounding land uses along the pipeline corridor. Where possible, the pipeline would be restricted to the existing easement width. In some sections, the existing easement would need to be expanded. This would be undertaken in consultation with relevant landowners and easement service providers.

11.4 Future and Surrounding Land Use

11.4.1 Stage 1 GFDA and CPF

The Gloucester Shire Local Environmental Study (LES) prepared by Hunter Development Brokerage Pty Ltd identifies a number of emerging industries in the region which may influence future land use and subdivision in the Shire. These include:

- Agribusiness;
- Aquaculture;
- Further intensive animal rearing (e.g. goats, rabbits, turkeys, alpaca, sheep);
- Viticulture;
- Olive growing;
- Fruit growing;
- Boutique agricultural enterprises;
- Organic farming;
- Greenhouse horticulture and hydroponics; and
- Timber production.

The LES recognises that the majority of these enterprises would require smaller rural land parcels than the current minimum 100 hectare lot size in Rural 1(a) zone. In recognition of this, Gloucester Shire Council may allow for smaller lot sizes subject to specific studies. Under the Draft LEP 2009, the minimum lot size in the RU1 Primary Production zoning which applies to a large portion of the Stage 1 GFDA is 100 ha.

In addition, the LES highlights the increasing demand for residential and rural residential lots in the Gloucester Shire and predicts that this demand would increase further due to the attraction of retirees from Sydney and Newcastle to the Shire for lifestyle reasons. It is therefore reasonable to assume that residential and rural residential use of land, including that which is currently considered to be agricultural land might increase in the future.

The LES also notes the potential for the buffer land adjacent to the Stratford Colliery to be rezoned for industrial purposes (see **Figure 4.1**). This includes the site of the proposed CPF Site 7. A Draft LEP has been prepared by Gloucester Council and has been publically exhibited by the DoP (22 June 2009 until 14 August 2009). Under the Draft LEP, CPF Site 1 is zoned as for rural purposes (RU1) and the CPF Site 7 is zoned for heavy industrial purposes (IN3). As such, CPF Site 7 is considered to integrate well with planned future land use in the area. CPF Site 1 would generally be consistent with the objectives of the rural zone, and would not impact the objectives of this zone outside the footprint of the CPF. Upon decommissioning, the CPF would be decommissioned and returned to a land use compatible with the current land use zoning at the time of decommissioning.

11.4.2 Pipeline

Future land use surrounding the northern section of the pipeline is largely described above, with trends towards increasing rural residential development in the traditional grazing lands reflected in all LGAs covering the north of the pipeline route.

The southern section of the route, partially included within the sub-region known as the Lower Hunter, is covered by the Lower Hunter Regional Strategy (LHRS), prepared by the DoP to guide development in the region over the next 25 years. The strategy applies to the five local government areas of Newcastle, Lake Macquarie, Port Stephens, Maitland and Cessnock. Key objectives of the LHRS are to:

- Provide 115,000 new homes to cater for a projected population growth of 160,000 people;
- Plan for up to 66,000 new jobs and ensures an adequate supply of employment land;
- Promote growth in centres a greater choice of housing and jobs in Newcastle's CBD and specified major centres;
- Create important green corridors of land with high environmental value, to be managed for conservation purposes and that are align with existing public reserves, some of which would be expanded; and
- Protect high quality agricultural land, and natural resources such as water aquifers and extractive materials.

Of relevance to the proposed gas transmission pipeline, the LHRS identifies regionally significant lands including green corridors and renewal areas as well as earmarking certain release areas for future development. Regionally significant lands are identified in the LHRS for conservation and / or planning for future management. A brief summary of some of the regionally significant lands identified in the vicinity of the Project Areas is provided below.

Green corridors

Green corridors are to be managed for their biodiversity and conservation values. Additions to the existing reserves are proposed to be achieved through the transfer of government lands for management under the *National Parks and Wildlife Act 1974*, as well as through the dedication by major landholders of significant additional lands.

Areas surrounding Hexham including the Hexham Swamp have been identified in the Lower Hunter Regional Strategy (DoP, 2006) as part of the Watagan to Stockton Green Corridor. The Watagan to Stockton Green Corridor provides a range of habitat linkages, including links between wetlands and ranges in the south western section, koala habitat, heath and vulnerable aquifers that supply drinking water to the Region in the central sections, and wetlands and lowland coastal forests, fringing the shores of Port Stephens in the eastern region. Due to significant land use constraints including flooding, acid sulfate soils and noise from the RAAF airbase, the corridor supports a combination of environmental values, hazards and the distance to serviced centres, which renders the much of the area unsuitable for new large scale urban development.

The Watagan to Stockton Green Corridor is located within the vicinity of the pipeline route and HDS, but land included within the Green Corridor does not overlap or adjoin land affected by the Project. Impacts associated with the construction of the HDS and pipeline in the vicinity of the Green Corridor would be temporary in nature and are not expected to result in significant off site impacts. Operational impacts of the pipeline would be negligible with the pipeline to be located below the ground surface within the power easement, therefore not impacting on the visual amenity, operational effectiveness or management efficiency of the Green Corridor.

Renewal Corridors

Five renewal corridors have been designated as part of the LHRS, situated along strategic transport routes and link strategic centres. These corridors present opportunities for economic renewal and/or housing renewal and intensification.

- Maitland Road (Newcastle West to Mayfield);
- Tudor Street (Newcastle West to Broadmeadow);
- Brunker Road (Nine Ways to Adamstown);
- Main Road, Edgeworth (Glendale to Edgeworth); and
- Pacific Highway (Charlestown to Gateshead).

The proposed pipeline route does not encroach upon the renewal corridors identified in the LHRS and construction and rehabilitation of the pipeline is expected to be completed prior to further extensive development of these areas. The proposed pipeline is therefore not expected to present significant impacts upon the identified renewal areas.

Release Areas

Major priority release areas and areas where planning for release is well advanced are:

- Thornton North (up to 7000 dwellings);
- Cooranbong (up to 3000 dwellings);
- Bellbird (up to 4000 dwellings); and
- North Raymond Terrace (up to 5000 dwellings — subject to detailed consideration of airport noise impacts).

Other major release sites include Lochinvar (up to 5000 dwellings), Anambah (up to 4000 dwellings), Wyee (up to 2000 dwellings) and Branxton–Huntlee (up to 7200 dwellings).

The proposed pipeline route does not encroach upon the identified release areas and is not expected to have a significant impact upon their future development.

11.5 Potential Impacts

The potential impacts of the Project in relation to land use are related to all project components, including the Stage 1 GFDA, the CPF and the gas transmission pipeline. The proposed siting of all three components has been developed in close consultation with landowners and other stakeholders with a key aim being to minimise potential impacts to both existing and future proposed land use. A range of alternatives has been considered with respect to the CPF location and the preferred pipeline route with the final proposed locations being informed by stakeholder negotiation and consultation. A certain level of flexibility has been built into the proposed well locations and the final pipeline alignment to allow for minor shifts in location to accommodate landowner preference and final environmental and engineering considerations. The potential land use impacts have been separated into the three project components for clarity.

11.5.1 Stage 1 GFDA

The proposed Stage 1 GFDA would have direct impacts upon land use in terms of the construction and installation of wells, however it is not expected that the presence of this infrastructure would significantly restrict land use activities due to the scale and proposed siting. Construction activities would include site preparation and environmental controls, earthworks associated with the laying of gas and water gathering lines and drilling, fraccing and completion of the wells which would result in a restriction of access to affected land during the construction period. This would be largely temporary impact with the construction compound being significantly reduced from 90 m x 90m to 15 m x 15 m upon completion of construction works. A construction workforce camp would also be required during the drilling program to accommodate for a peak construction workforce of 100 people which would have the potential for land use impacts. The construction workforce camp would likely be sited on land zoned for rural purposes within the Stage 1 GFDA and would be temporarily required, during the construction phase of the Stage 1 GFDA (approximately 18 months or longer depending on the development option).

Potential impacts upon surrounding land use within the Stage 1 GFDA during the construction period include:

- Amenity impacts including noise, air quality (dust) and visual;
- Traffic generation;
- Hazard and risk;
- Water quality impacts;
- Impacts in relation to access to the well sites for construction purposes which may require access over private land; and
- Potential impacts upon tourism in the local area.

These potential impacts are discussed in detail in **Chapters 9, 12, 13, 14, 15, 16** and **18** where mitigation measures have been recommended for their management. Generally, a CEMP would be prepared in respect of the works to address the management of potential impacts during the construction period (refer to **Chapter 25** for further detail). In relation to access arrangements, these would be negotiated with the relevant landholder to ensure that impacts are minimal and manageable. In some cases, the impacts may be beneficial to the landowner as access roads would be constructed / upgraded in selected locations to suit existing and future planned property layout and land management plans/practices. Construction works within the Stage 1 GFDA would be completed over a period of 18 months to 5 years dependant upon the development scenario adopted as described in **Section 4.2**. It is worth noting that adverse construction impacts would be temporary and short-term and would largely cease upon completion of construction which is expected to take some 6-8 weeks at each well site. Further, proximity to residences was a key consideration in the siting of wells such that, in general, a minimum distance of 200m is maintained between each well site and the nearest dwelling in order to minimise potential impacts.

A constraints analysis would be undertaken to determine suitable siting for the construction workforce camp based on locational principles (refer to **Section 5.2)** in addition to consultation with relevant landowners. The construction workforce camp would not result in land sterilisation as it would be temporary in nature and the land would be rehabilitated upon the decommissioning of the construction camp (refer to **Chapter 22)**.

During production, potential land use impacts associated with the Stage 1 GFDA would be focused upon the perceived loss or sterilisation of the land for other uses (e.g. agriculture or coal mining) and the potential constraints upon the use of land directly affected by the well due to the presence of the infrastructure. However, the siting of wells is based on constraints analyses (see **Section 5.2**) which includes landowner consultation and the siting of gas wells and associated infrastructure (e.g. gas and water gathering lines) adjacent to existing fence lines and access tracks where possible to minimise potential restrictions on the agricultural use of the land.

The land proposed for the Stage 1 GFDA and broader Concept Area is largely rural land which would traditionally have been used for agricultural purposes. As discussed previously in **Section 11.2.2**, the DPI maps classifying agricultural land generally identify the Stage 1 GFDA and Concept Area as ranging from Class III to Class IV which can support some grazing. The proposed development of the Stage 1 GFDA would however, not preclude the use of the land for agriculture. Certain agricultural uses could coexist with the presence of scattered gas wells and any restriction on the agricultural use of the land would be completely removed upon decommissioning of the wells. Land uses that may be restricted by the gas and water gathering lines and associated infrastructure includes the planting of deep rooted plant species (including orchards), which would require a minimum distance of 3 m from underground infrastructure. Additionally, cultivation techniques that require deep ripping of the surface in the vicinity of the gas and water gathering system may also be excluded.

The utilisation of constraints analyses in determining the siting of gas wells and associated infrastructure would minimise limitations to land use or land sterilisation (refer **Section 5.2**). The proposed Stage 1 GFDA and future development of the Concept Area is therefore not seen as a threat to agriculture in the local area.

The Stage 1 GFDA overlaps both coal exploration tenements as well as various Mining Leases owned by Gloucester Coal covering their Stratford Colliery.

In the past, CSG exploration activities have co-existed with coal exploration activities throughout PEL 285 and neither activity has been compromised.

Generally, there is no reason why open cut coal mining activities and CSG production, as contemplated by the Concept Plan and concurrent Project approvals sought, cannot co-exist over the same area. This is clear from the fact that the shallow coal seams which are the subject of open cut mining are not targets for CSG extraction because of their proximity to the surface and the relatively low gas contents as compared to the coal at such depth. Coal seams below open cut mining operations can be targeted for CSG production through directional drilling without impact upon surface operations. Gloucester Coal have allowed access to their land for the drilling of production wells for the Stratford Pilot and discussions are being undertaken between Gloucester Coal and AGL regarding land access agreements for exploration wells and purchasing options for the siting of the CPF at CPF Site 7. It is recognised that operational protocols would be required in areas where CSG operations and coal mining activities co-exist, but this should not be a major barrier to efficient extraction of the respective target resources.

In Queensland, overlapping tenures of CSG production and underground mining has been the main focus of efficient resource utilisation planning. In circumstances of competing claims between CSG production and underground coal mining, co-operation agreements between the parties are required. In practice, such agreements have been negotiated successfully to allow complementary development to take place.

In the Gloucester Basin underground coal mining is not currently contemplated, although in due course this may become commercially and technically feasible. It is clear that due to the high gas contents of the coals, underground coal mining could not proceed safely without some level of pre-drainage of gas. Notwithstanding, it is expected that should underground mining in the Gloucester Basin be proposed in the future, co-operation arrangements similar to those in Queensland could be agreed between the parties to allow both coal and CSG to be extracted from the land.

As discussed above, in relation to general constraints on the use of land, the proposed siting of wells has been discussed with landowners to ensure that restrictions upon the use of land affected by a well are minimised and that infrastructure is positioned to minimise potential nuisance to landowners where possible. The area of land which would be subject to such restriction would be limited to the well production compound area of 15 m x 15 m and as such, is considered unlikely to pose significant constraints to the use of surrounding land. The position of access roads on private land would be negotiated with the relevant landowner and sited to benefit all parties wherever possible. Further, the production life of the wells is expected to be approximately 15 years. Once the well becomes non viable for gas production, the well head would be plugged and the site rehabilitated with no residual impact upon the land use capability of the site.

Tourism is a vital component of the local economies of many of the LGAs affected by the proposal, particularly those in the north of the Project Area and Concept Area. Tourism in these areas is largely focussed around the natural and scenic attributes of these areas such as Gloucester and Barrington Tops and the associated National Park and World Heritage Area.

The proposed Stage 1 GFDA and CPF are located some distance from Gloucester and Barrington Tops and the surrounding National Park and avoid lands zoned for environmental protection for their scenic value within the Gloucester Shire. Further, a visual assessment has been undertaken in respect of the Project and concludes that, given the siting, design and scale of the proposed project components, the proposal would not significantly affect the natural or scenic value of the area. The proposed works have been sited and designed to avoid impacts upon local tourist attractions and are not expected to have a significant impact upon tourism in the affected LGAs.

Other potential land use impacts during the well production phase include:

- Amenity impacts such as noise, visual and air quality;
- Hazard and risk; and
- Traffic generation.

These impacts are discussed and mitigation measures recommended where appropriate in **Chapters 9, 12, 13, 14, 15, 16** and **18.**

11.5.2 CPF

The proposed location for the CPF and associated infrastructure would be located within the Stage 1 GFDA, either at CPF Site 1 (The Tiedeman Property) or CPF Site 7 (adjacent to the railway loop at Stratford Colliery)**.**

CPF Site 1 is situated on land currently owned by the Proponent, known as the Tiedeman Property. CPF Site 1 is currently vacant, consisting of mainly grassland on relatively flat terrain. The property also contains the Stratford Pilot Project, as discussed in **Section 5.10**. Access to the Stratford Pilot Project is currently via Tiedmans Lane, however access to the site would be established via Wenham Cox Road if the CPF was to be constructed at this site. The nearest sensitive receptor is located approximately 1300 m from Site 1.

CPF Site 7 is located on land currently owned by Gloucester Coal, on a parcel of land adjacent to a rail loop which currently services Stratford Colliery. The site is currently vacant and consists predominantly of grassland with some scattered sparse vegetation. A large stand of vegetation is located in the south eastern portion of the parcel of land, however this would not be affected by the Project. Due to the limited sight distances to access this parcel of land off Parkers Road, alternative access would be required through the adjacent property to the south of Parkers Roads from The Bucketts Way as shown in **Figure 5.10.** The nearest sensitive receptor is located approximately 460 m from Site 7.

The potential land use impacts of either of these potential sites for the purposes of the CPF are largely related to amenity impacts upon surrounding residential properties.

The potential amenity impacts of the proposed CPF include:

- Visual impacts during construction and operation;
- Noise impacts during construction and operation;
- Air quality impacts during construction and operation;
- Hazard and risk; and
- Traffic impacts during construction and operation.

These impacts are discussed in detail in **Chapters 9, 12, 13, 14, 15, 16** and **18** of this EA and are considered to be manageable with the implementation of recommended mitigation measures.

In relation to the operation of the Stratford Colliery rail loop and the crossing of this railway line by gathering lines and the gas pipeline (particularly if CPF Site 7 is adopted), boring techniques would be utilised to ensure that the rail loop would operate as normal during construction of the facility.

The CPF Site 7 would be considered to integrate well with planned future land use in the area. It is noted that, as previously mentioned, the CPF Site 7 location is zoned for heavy industrial purposes (IN3) under the Draft LEP (2009).

11.5.3 Gas Pipeline

The potential impacts of the gas pipeline upon land use are largely related to the construction phase, although some restriction of land use within the final pipeline corridor would remain permanently.

The potential impacts of the proposed pipeline include:

- Amenity impacts including visual, noise, air and traffic generation;
- Hazard and risk;
- Temporary loss of, or change to land access;
- Impacts upon infrastructure such as roads and railways;
- Spread of weeds;
- Impacts upon environmentally sensitive areas; and
- Impacts upon continued/future use of land.

The construction of the pipeline would likely necessitate the establishment of a temporary construction workforce camp to accommodate up to 300 people during the peak construction period. The siting of the construction workforce camp would be proximate to the pipeline and would be based on the locational principles in **Section 5.2**, and consultation with relevant landowners. The construction workforce camp would be temporarily required, during the construction phase of the pipeline (up to 12 months).

Amenity Impacts

The potential amenity impacts of the proposed pipeline are discussed and mitigation measures recommended where appropriate in **Chapters 9, 12, 13, 14, 16** and **18** of this EA. In addition, the hazards and risks associated with the construction and operation of the pipeline are detailed in **Chapter 15**.

Hazard and Risk

A PHA has been prepared in respect of the Project (**Appendix I**) and the findings summarised in **Chapter 15**. The PHA recommends a range of mitigation measures in order to ensure that the potential impacts of the pipeline upon surrounding land uses (particularly sensitive land uses such as residences, hospitals and child care centres) are minimised. The PHA finds that, subject to the recommended mitigation measures, the level of hazard and risk posed by the proposed pipeline is within the relevant guidelines and standards published by the DoP.

Loss of/Changes to Access to Land

The preferred pipeline corridor traverses approximately 201 parcels of land and would be buried below the ground surface with a minimum of 750mm of cover. Access would be required across properties for the construction works which has the potential to inconvenience landholders. The preferred pipeline route has been chosen in consultation with landowners to ensure disturbance is minimised and similarly, access arrangements for construction would also be made in consultation with landowners. It is not anticipated the installation of the pipeline would result in significant adverse impacts to agricultural practices due to the short term nature of the construction works. The pipeline would be laid, backfilled and rehabilitated during the construction phase allowing most previous land use activities to resume over the pipeline with the exception of excavation and planting of deep-rooted vegetation.

Impacts upon Infrastructure

Major infrastructure encountered within the pipeline corridor includes roads, railways and power lines. AGL has undertaken consultation with the owners and operators of this infrastructure (as detailed in **Chapter 7** of this EA) and the pipeline route has been selected in consideration of the location of such infrastructure in order to minimise impacts and enable continued operation of the road and rail networks with minimal disruption during and after construction and operation.

It is proposed that the crossing of major roadways and railways would be undertaken by boring below the surface to pass under the road or railway line thus avoiding significant disruption. **Chapters 5** and **Chapter 16** provide further detail on the location and method of road and rail crossings. Road and rail crossings would be undertaken in accordance with relevant standards and guidelines in consultation with relevant local and State authorities.

The selected process for the proposed pipeline corridor also considered known areas of future road development within the region and specifically the F3 to Raymond Terrace Pacific Highway upgrade. This section of the Pacific Highway upgrade represents the closest location for proposed roadway upgrade works to the Project. The pipeline would cross the Pacific Highway in the vicinity of Hexham, however HDD would be used to avoid surface impacts to the Pacific Highway. Therefore it is not expected that the proposed pipeline route for the Project would affect the upgrade of the Pacific Highway or any other proposed road upgrade.

The proposed pipeline route has been selected to follow existing infrastructure corridors where possible, to minimise potential impacts upon land use and the environment. The pipeline would be clearly identified with regular marker signs to minimise accidental excavation during future works. Minimum distances would be maintained between the proposed pipeline and existing infrastructure (as required by relevant standards and guidelines) and close consultation would be undertaken with relevant authorities prior to, during and following construction activities. Co-location of the pipeline within an existing easement also minimises the impacts upon the long-term use of land due to the level of restrictions already existing in relation to works within the easement corridor.

Spread of Weeds

Given the expansive distance of the proposed pipeline, the potential for weed dispersal exists, particularly during the construction phase. This may occur through vehicle movements along the route disturbing weeds inadvertently and transferring seed or spores to adjacent areas. The clearing of access ways, construction of pipeline corridors, and traversing of fields has the potential to encounter weed species.

In order to minimise the potential spread of weed species along the proposal area, a Weed Management Plan (WMP) would be prepared detailing weed eradication and management measures and safeguards. The WMP would include measures such as vehicle wash areas and cleaning protocols to reduce the likelihood of dispersal of species. Further discussion of the potential impacts and proposed management of weeds is provided in **Chapter 10** of this EA.

Environmentally Sensitive Areas

Environmentally sensitive areas identified within the vicinity of the proposed project include National Park, State Forest, regionally significant agricultural lands, green corridors and wetland / swamp lands. There are no national parks or state forests located in the Concept Area, including the Stage 1 GFDA. The pipeline corridor has been selected to avoid these areas wherever possible, however the route does encroach within a National Park and does cross certain wetlands. The section of the pipeline which traverses the Wallaroo National Park does however lie within an established easement and a reduced ROW would be used in this location. As such, impacts within the area would be minimal as further mitigation as described in **Chapter 10** would be applied. Consultation has been undertaken with the National Parks and Wildlife Service (NPWS) with regard to this section of the pipeline and in principle agreement has been given by NPWS for the proposed approach. The potential impacts upon wetland areas are also discussed in detail in **Chapter 10** of this EA and mitigation measures such as the use of HDD in certain locations are proposed in order to avoid significant impacts.

The location of the construction workforce camp would be based on locational principles (refer to **Section 5.2)** to avoid environmentally sensitive areas.

The regional significance of agriculture has been considered in the planning phase of the proposal and prior to the commencement of works landholders potentially impacted as a result of the works would be consulted regarding access and potential disruptions to operations / land management practices. It is considered that these impacts are most likely to occur during the excavation and preparation works for the pipeline installation. Land disturbed as a result of the Project would be rehabilitated immediately after completion of works to allow normal operations to resume as soon as possible. The project would be staged to minimise disruption times and works would be undertaken in close consultation with relevant parties.

As mentioned in **Section 11.2.4**, the proposed pipeline route would not affect land within the Watagan to Stockton Green Corridor.

The proposal would involve excavation works for the pipeline to the north of the Hexham Swamp. There are SEPP14 wetlands located within the pipeline route (approximately 93 - 94km mark) which would be HDD to avoid disturbances to the wetland areas. The Hexham Swamp forms part of the Lower Hunter Estuary, which contains significant wetland areas that are of significance for migratory shorebirds. The Lower Hunter Estuary area also contains the second largest area of mangroves in NSW (DECC, 2006) and is an important area for both feeding and roosting site for a large seasonal population of shorebirds and as a waylay site for transient migrants. The Lower Hunter Estuary also provides important nursery habitat (spawning grounds) for marine organisms including commercial species of fish and prawns. The Hunter Estuary Wetlands are listed internationally under the Ramsar Convention because of their unique mix of wetland types, importance for maintaining biological diversity and conservation of migratory shorebirds. Potential impacts and recommended mitigation measures in respect of this sensitive area are discussed in detail in **Chapters 10 and 17** of this EA.

Future Land Use

Upon completion of construction of the pipeline, affected land would be backfilled and rehabilitated to its previous condition. Following survey of the final pipeline corridor, a final easement would be established over the pipeline, likely to comprise a corridor approximately 20 m in width which would be attached to the title of the affected property. Most land uses and activities would still be able to take place over the easement, including agricultural activities such as cultivation, cropping and grazing. Activities and land uses which may be restricted within the easement area (and possibly within a certain distance of the easement) include:

- Planting of deep rooted plant species (including orchards). A minimum distance of 3 m from the pipeline is generally applied to the planting of vegetation greater than 1 m in height, subject to approval from the pipeline owner;
- Construction of buildings; and
- Earthworks/excavation.

Whilst the pipeline easement would result in certain permanent restrictions on the use of affected land, the siting of the pipeline over private land was selected in consultation with relevant landowners and appropriate compensation paid to those affected. Wherever possible, the pipeline has been located within existing easements or along fencelines to minimise such impacts. This approach also considers the potential for future subdivision and development of land with siting of the pipeline selected in consultation with landowners to minimise the potential for sterilisation of future subdivision/development opportunities.

11.6 Rehabilitation and Future Use of Project Area

11.6.1 Stage 1 GFDA and CPF

Upon expiration of the life of the wells, each well would be decommissioned in accordance with the process described in **Chapter 5** of this EA. Land comprising the Stage 1 GFDA would be rehabilitated and returned to its previous use, which is anticipated to be some form of agricultural use or rural residential use.

Similarly for the CPF, upon completion of the Project the plant would be decommissioned. It is anticipated that the site may be redeveloped for industrial use for CPF Site 7. CPF Site 1 would be redeveloped with a land use compatible with the land use zoning at the time of decommissioning.

11.6.2 Gas Pipeline

The proposed pipeline would be buried underground and protected by easements to ensure that future landowners and other stakeholders are aware of the location of the pipeline and any restrictions on the use of land within the easement. The pipeline is not anticipated to have a significant impact upon the future land use of the affected area. Upon expiration of the life of the Project, the pipeline would be abandoned in accordance with the regulator’s guidelines. The easement would be extinguished from the title and the above ground infrastructure removed.

11.7 Safeguards

Safeguards in respect of potential land use impacts are largely built into the design and planning of the Project and are related to the siting of wells, plant and infrastructure and the level of input sought affected stakeholders. Flexibility has also been incorporated into the siting of the Project components to allow for further consideration of land use and other issues at the detailed design stage. Additional mitigation measures proposed in respect of land use impacts include:

- Ongoing consultation with affected landowners throughout the detailed design phase of the Project and prior to and during the construction and operation phases of the Project. Consultation undertaken to date has resulted in the proposed siting of the Project components which are the final result of an iterative process in which landowner views were frequently sought and considered.
- The adoption of the environmental envelope approach allows for the movement of well locations within a 600m x 600m grid square and the movement of the pipeline alignment 50 m in either direction to create the ability to address and accommodate future issues as they arise.
- Establishment of locational principles to guide the location of future wells and infrastructure within the Concept Area to provide some level of understanding about what the community and relevant authorities might expect of the future well field development in this area. This approach allows for flexibility in the final siting of wells and infrastructure based upon future detailed environmental investigations and surveys.
- Locational principles for siting of the construction workforce camp within the Stage 1 GFDA and proximate to the pipeline.
- A Construction Workforce Management Plan which would be contained in the CEMP would be prepared to manage potential impacts associated with the construction workforce camps.
- Acoustic attenuation and mitigation provided where necessary as recommended by the Project noise assessment to ensure impacts upon surrounding land uses (particularly residential land) are minimised.
- Landscape screening to be provided as recommended in the visual assessment to ensure visual impacts are minimised.
- Access arrangements during construction and operation to be negotiated with relevant landholders and stakeholders well in advance of commencement of works.
- Rehabilitation to be undertaken as soon as practical upon completion of construction works to allow normal farming practices to resume.
- Access to properties and farming land would be maintained during works. Should the works require closure of access, a detailed consultation program would be undertaken with affected stakeholders and landholders.
- Where possible, the pipeline route would remain within existing infrastructure easements.
- Upon completion of construction activities disturbed areas (excluding the Stage 1 GFDA) would be rehabilitated to restore the areas to their original land use. This would ensure that usual land use practices would be able to resume during the operational phase of the Project.

- Upon completion of the Project, the entire site would be rehabilitated, including restoration of the Stage 1 GFDA in accordance with regulatory and landholder requirements. The rehabilitation would restore the area to original land use and ensure minimal lasting impacts of the Project remain.

11.8 Residual Impacts

The proposal would require the crossing of properties and the disturbance of land which has the potential to disrupt normal farming activities and cause some potential nuisance to residents. These impacts would be temporary and short-term during the construction period only. This would be mitigated by a detailed CEMP which would address access arrangements and relevant work details with individual landholders and stakeholders. **Chapter 25** provides further detail on CEMP. As discussed in **Section 11.3.3** above, longer term, more permanent impacts would occur in relation to the restriction of certain land uses and activities within the final pipeline easement, however the location of the pipeline has been chosen to minimise such impacts and the large majority of landowners have agreed to the location of the pipeline over their properties. Many agricultural activities can still take place within the easement and appropriate compensation would be paid to affected land owners in relation to the pipeline easement.

11.9 Conclusion

Given the proposed mitigation measures including rehabilitation and consultation, it is not expected that the proposal would result in adverse impacts to land use within the region. Some minor short term impacts are anticipated due to crossing properties to allow for the pipeline installation, however immediately upon completion of the installation works the areas would be rehabilitated to allow normal practices to resume during operation.

12.0 Surface Water

This Section assesses water quality and management issues associated with the Concept Area and Project Area, including the Stage 1 GFDA, the CPF and the pipeline. Potential impacts and mitigations during the construction, operation and rehabilitation phases of the Project are also investigated.

12.1 Concept Area

Concept Plan approval is sought for the staged development of the Concept Area for the extraction of CSG resources. The Concept Area is located within the catchment areas of the Manning and Karuah Rivers. Concept Plan approval would include the development of further wells within the Concept Area. The construction and operation of the CPF is also included in the Project Application and it should be noted that its capacity is sufficient for the future wells in the Concept Area. As such, the Concept Application for the Concept Area only includes the construction and operation of the additional well sites and gas and water gathering lines.

Development within the Concept Area would comprise similar activities to the proposed development of the Stage 1 GFDA. Potential impacts to surface water quality during construction, operation and rehabilitation would be similar to those identified for the Stage 1 GFDA. Potential impacts to surface water would include:

- Increased turbidity / sedimentation from various earthworks, watercourse crossings for the gas and water gather lines and other activities;
- Contamination of surface waters from activities;
- Increased salinity of surface waters and detrimental impacts to surrounding vegetation as a result of accidental release of saline drill, frac and/or produced waters during drilling and well development; and
- Diversion / alteration of natural drainage patterns through the construction of access roads and grading / development of areas.

Further assessment of potential impacts to surface water would be included as part of a subsequent application/s for future development of the broader Concept Area.

Concept PLan Approval may also be sought for the occasional discharge of treated water to a designated discharge point. This would only be required during periods of prolonged high rainfall, when downstream users would not have need for the treated water generated from the Project. Water to be discharged would be treated to meet acceptable standards. Further environmental studies and monitoring would be undertaken prior to future project approvals to determine a designated discharge point.

The Manning River Catchment covers an area of approximately 8,190 km^2 which includes the northern portion of the Concept Area. Rivers and creeks within the Manning valley are unregulated and do not have major rural dams, therefore most water users rely on natural flows for their water supplies. The major tributaries of the Manning River within the Concept Area include the Barrington and Gloucester Rivers which rise in the Barrington Tops and Gloucester Tops respectively. Tributaries generally flow in an easterly direction through alluvial valleys before entering the Manning River. In the upper catchment, Gloucester draws its water directly from the Barrington River.

The Concept Area consists partly of the Manning and the Great Lakes Catchments with rivers and tributaries flowing generally from west to east. They rise in the Barrington Tops and fall through the escarpments to form deep, well defined drainage paths. The Rivers within the northern section of the Concept Area are within the Manning River catchment. The waterways within south of the Concept Area form part of the Great Lakes Catchment. Due to the steep relief in the region, many other smaller streams and seasonal rivers contribute to these rivers and waterways. Watercourses present within the Concept Area, which may require to be crossed for the water and gas gathering system include:

- Avon River;
- Gloucester River; and
- Other creeks and unnamed watercourses.

12.2 Existing Environment – Project Area

12.2.1 Stage 1 GFDA

The Avon River, within the Manning River catchment, is the primary watercourse which passes through the Stage 1 GFDA. The Avon River rises to the south west of Gloucester and joins the Gloucester River north of Gloucester. Waukivory Creek and Dog Trap Creek are also located within the Stage 1 GFDA, in addition to a number of smaller unnamed tributaries. These watercourses form part of the Manning River Catchment. All of the rivers and creeks in the Manning River Catchment are unregulated and most water users rely on natural flows for their water supplies.

Gloucester and surrounding low-lying land and river flats are prone to flooding, having experienced severe floods in 1929 and 1978. The rivers and creeks within the Stage 1 GFDA are subject to flooding and water velocities in these rivers can be high after heavy rainfall. Well site locations within the Stage 1 GFDA would be located within the Avon River Floodplain and may experience flooding on occasions. The areas most affected by flooding in Gloucester, as identified on the Flood Planning Land Maps for the Gloucester Draft LEP (2009), are the river flats between the town of Gloucester and the Gloucester River which are not located within the Stage 1 GFDA. Nevertheless, rural communities and farms along the floodplains beyond the river flats may be isolated for several days after extreme rainfall events (Gloucester Shire Council, 2006).

The wellhead infrastructure would be designed to be able to withstand submergence during a flood event. The control panel is located at height and would not likely be submerged, however, it could be easily replaced if damaged during a flood. Control panels for individual well sites could be shut down remotely if flood waters were anticipated to exceed a certain level and advanced warning was received.

12.2.2 CPF Site

The proposed location for the CPF and associated infrastructure would be located within the Stage 1 GFDA, either at CPF Site 1 (the Tiedeman Property) or CPF Site 7 (adjacent to the railway loop at Stratford Colliery) as detailed in **Section 3.3.2** and shown in **Figure 5.9** and **Figure 5.10**.

CPF Site 1 would be located within 500m of the Avon River and of Dog Trap Creek (refer to **Figure 5.2**). CPF Site 7 would be located approximately 1.6km to the southeast of the Avon River and 2km to the north of Coal Creek. As the potential CPF locations are within the Stage 1 GFDA, flood regimes and other watercourses in the area are similar to those described above in **Section 12.2.1**. Either CPF Site is not identified on the Gloucester Draft LEP (2009) Flood Planning Land Mapping.

12.2.3 Pipeline Corridor

The major rivers located within the proposed pipeline corridor are the Hunter River, Williams River and the Karuah River, and are described below.

Hunter River

The Hunter River flows in a south westerly direction from Glenbawn Dam in the north of the catchment to meet the Goulburn River near Denman. From Denman it flows in a south-easterly direction through Singleton and Maitland to meet the South Pacific Ocean at Newcastle. All creeks and rivers within the Hunter catchment are tributaries of the Hunter River.

Primary land use in the catchment reliant on the Hunter River includes power generation, coal mining, heavy industries, irrigated agriculture, infrastructure within Newcastle (the second largest urban area in NSW), and fisheries. A number of dams have been built in lower sections of the Hunter River to regulate flows, minimising the risk of flooding and promoting the abovementioned activities. Major water management issues include water quality, declining native fish population numbers, increased development (both urban and industrial), poor riparian vegetation cover, altered stream form, high stock and domestic use of groundwater, and riparian usage on unregulated streams.

Williams River

The Williams River catchment occupies the north eastern part of the Hunter River catchment rising in the Barrington Tops. It is the main drinking water supply catchment for the lower Hunter Valley. Potable water is stored in the Chichester Dam in the upper reaches of the Williams River and at Grahamstown Dam, located to the east of Raymond Terrace. The catchment is predominantly rural, with grazing and dairying being the main agricultural activities. The three townships of Dungog, Clarence Town and Seaham are surrounded by traditional and hobby farms. Part of the 80,000 hectare Barrington Tops National Park is located in the upper catchment.

The Hunter Catchment Blueprint identifies the Williams River as a priority area on the basis of several criteria:

- The Williams River is a high value river system, particularly in relation to the conservation value of the riparian corridor;
- The upper catchment around Dungog is identified as a high hazard area in relation to slope stability / mass movement;
- Some parts of the Williams River catchment are identified as acid sulfate soil risk areas;
- The lower Williams River catchment is identified as a priority riverine corridor; and
- Although not specifically identified by location, the Williams River catchment also contains regionally significant vegetation and habitats.

Karuah River

The Karuah River catchment is bordered by the Manning River Catchment to the north and the Hunter River Catchment to the south. The Karuah River rises in the Barrington Tops and runs over 90 km in length, discharging at Port Stephens. The townships of Stroud, Stroud Road and Booral obtain their water from the Karuah River via the MidCoast Water Treatment Plant at Stroud, in addition to activities including dairy, beef and oyster farming downstream. A large portion of the upper catchment is managed by State Forests for timber production, grazing and conservation. The water quality of the Karuah River deteriorates during times of high flow and during dry times. The Wastewater Treatment Plant at Stroud currently discharges into Mills Creek, which flows to the Karuah River.

12.3 Sensitivity Assessment

12.3.1 Methodology

Sensitivity criteria were used to classify watercourses as detailed in **Table 12-1**. Watercourses assessed were those identified on 1:25,000 topographic mapping from the NSW Department of Lands. Information to determine the sensitivity criteria for the watercourses was sourced from:

- Aerial imagery, topographic maps and GIS data;
- Strahler Stream Ordering System (Strahler, 1964);
- Classification and characteristics of waterway type (Fairfull and Witheridge, 2003);
- SEPP 14 / RAMSAR Listing; and
- Field observations from ecological surveys undertaken for the Project (refer **Chapter 10**).

Table 12-1: Sensitivity criteria used to classify watercourses

Environmental Attributes	Sensitivity		
	High	**Medium**	**Low**
Stream Order (Strahler System)	3rd Order (or higher)	2nd Order	1st Order
Status of Riparian Vegetation discerned from aerial photography and field reconnaissance	Riparian vegetation in good condition	Riparian vegetation in moderate condition	No riparian vegetation - highly disturbed
Presence of threatened species or habitat	Present	Not Present	Not Present
Protected wetland areas (SEPP 14)	Present	Not Present	Not Present
Sensitivity of downstream water users	Potable water source, sensitive downstream water users	Less sensitive downstream water users (e.g. may tolerate temporary increase in sediment loading)	Minimal sensitive downstream users
Stream class ordering for fish habitat (Fairfull and Witheridge, 2003) (refer **Table 12-2**)	Class 1 or Class 2	Class 3	Class 4

The Strahler system used for the sensitivity criteria (**Table 12-1**) is a commonly used system to define stream size based on the hierarchy of tributaries. First order streams are likely to be minor watercourses, increasing in size and order as watercourses join up (Strahler, 1964). In the region, first order streams (e.g. drainage lines) have small catchments, typically exhibiting low to zero flow for extended periods during dry weather and flow after heavy rainfall (http://www.rivers.gov.au/River_Management_Issues/index.aspx).

The classification and characteristics of waterway type (Fairfull and Witheridge, 2003) for fish habitat is shown below in **Table 12-2.** This classification system works in reverse to the Strahler system, with a 1st class fish habitat being the most sensitive. The assessment of the presence of, and impacts on endangered or threatened species, is part of the ecological assessment of the EA (refer **Chapter 10**).

Table 12-2: Classification of watercourses based on characteristics for fish habitats (Source: Fairfull & Witheridge, 2003)

Classification	Characteristic of Waterway Type
Class 1 Major fish habitat	Major permanently or intermittently flowing waterway (e.g. river or major creek), habitat of a threatened fish species.
Class 2 Moderate fish habitat	Named permanent or intermittent stream, creek or waterway with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.
Class 3 Minimal fish habitat	Named or unnamed waterway with intermittent flow and potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or recognised aquatic habitats.
Class 4 Unlikely fish habitat	Named or unnamed waterway with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free standing water or pools after rain events (e.g. dry gullies or shallow floodplain depressions with no permanent aquatic flora present).

Examples of Construction Techniques

Different methods for crossing watercourses are described in **Section 5.6.4**. Watercourses with permanent high water flows and stream ordering greater than 3rd order (Strahler system) would be crossed using HDD to avoid impacts to surface water and riparian vegetation. Such watercourses include the Hunter, Karuah and Williams Rivers. Watercourses identified as 3rd order streams with variable water flows would be crossed utilising an open trench with stream diversions, where required. The use of stream diversions is deemed suitable for streams with flows greater than 1000 L/s and is recognised by industry standards (APIA, 2005). Watercourses where stream diversions may be utilised are indicated in **Table 12-3** and **Table 12-4**. For small, intermittent drainage lines and streams of stream order typically less than 3rd order (Strahler system), open trench techniques would be utilised, ensuring that works for the watercourse crossing be completed in the least amount of time possible in order to minimise potential impacts (refer to **Section 12.5.3** for further safeguards).

As such, the application of “High” is directly related to the environmental attributes. “High” for a greater than 3rd order watercourse may require an HDD technique as opposed to a 3rd order watercourse for which the construction technique noted above would be appropriate.

12.3.2 Assessment

Stage 1 GFDA

A list of the watercourses likely to be crossed by the gas gathering lines and trunk lines, their sensitivity and the proposed method for crossing the watercourse is provided in **Table 12-3.**

CPF Site

There are no identified watercourses within the development footprint of CPF Site 1 and CPF Site 7. CPF Site 1 would be located within 500m of the Avon River, Dog Trap Creek and an unnamed watercourse (refer to **Figure 5.2**). CPF Site 7 would be located approximately 1.6 km to the southeast of the Avon River and 2 km to the north of Coal Creek. Neither CPF site is identified on the Gloucester Draft LEP (2009) Flood Planning Land Mapping. Management of surface water is discussed further in **Section 12.5.2.**

Pipeline Corridor

A list of the watercourses to be crossed by the proposed pipeline, their sensitivity and the proposed method for crossing the watercourse is provided in **Table 12-4**, with numbered reference to the watercourse crossings in **Figure 10.2** to **10.20**. Some watercourses are crossed multiple times and as such, each crossing has been assessed separately. In the case that CPF Site 1 is preferred, **Figure 10.1** indicates the indicative pipeline route. The watercourse crossings for this section of the pipeline are those with the prefix 'T' in **Table 12-4**.

The overall sensitivity rating for each watercourse as shown in **Table 12-4** was based on the combination of sensitivity criteria. As a general rule, 1st Order streams are classified as of low sensitivity, 2nd Order as of medium sensitivity and 3rd (or higher) as of high sensitivity. However, there are some exceptions to this (e.g. 2nd order streams deemed low sensitivity or some 1st order streams deemed medium sensitivity) depending on the significance of other sensitivity criteria (e.g. status of riparian vegetation and proximity to sensitive receptors). Findings from the ecological assessment (**Appendix G**) and other specialist surveys undertaken by the Proponent have also assisted in determining the preferred watercrossing methods based on the quality of riparian vegetation present and the significance of watercourses to be crossed.

Table 12-3: Watercourses Crossing Assessment within Stage 1 GFDA

Watercourse	Sensitivity	Crossing Method
Avon River (crossed three times)	High	Thrust Bore or HDD
Waukivory Creek (crossed four times)	Medium	Open Trench with flow diversions if required
Dog Trap Creek (crossed six times)	Medium	Open Trench with flow diversions if required
Avondale Creek (crossed five times)	Medium	Open Trench with flow diversions if required
Approximately 35 unnamed minor watercourses / drainage lines	Low	Open Trench

Table 12-4: Watercourse Crossing Assessment for Pipeline Route

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
T1	Dog Trap Creek	3rd Order, Class 2 Fish Habitat	High	Open Trench with flow diversions if required
T2	Unnamed watercourse	1st Order	Low	Open Trench

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
T3	Unnamed watercourse	1st Order	Low	Open Trench
T4	Unnamed watercourse	2nd Order	Low	Open Trench
T5	Unnamed watercourse	1st Order	Low	Open Trench
1	Unnamed watercourse	1st Order	Low	Open Trench
2	Unnamed watercourse	1st Order	Low	Open Trench
3	Coal Creek	2nd Order	Medium	Open Trench with flow diversions if required
4	Spring Creek	3rd Order	Medium	Open Trench with flow diversions if required
5	Unnamed watercourse	3rd Order	Medium	Open Trench with flow diversions if required
6	Unnamed watercourse	1st Order	Low	Open Trench
7	Unnamed watercourse	1st Order	Low	Open Trench
8	Unnamed watercourse	1st Order	Low	Open Trench
9	Unnamed watercourse	2nd Order	Low	Open Trench
10	Unnamed watercourse	1st Order	Low	Open Trench
11	Unnamed watercourse	2nd Order	Low	Open Trench
12	Unnamed watercourse	1st Order	Low	Open Trench
13	Unnamed watercourse	1st Order	Low	Open Trench
14	Unnamed watercourse	1st Order	Low	Open Trench
15	Bull Creek	3rd Order, Class 2 Fish Habitat	High	Open trench with flow diversions if required
16	Unnamed watercourse	1st Order	Low	Open Trench
17	Unnamed watercourse	1st Order	Low	Open Trench

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
19	Sandy Gully	3rd Order	High	Open Trench with flow diversions if required
20	Chainey Flat Creek	3rd Order	High	Open Trench with flow diversions if required
21	Unnamed watercourse	1st Order	Low	Open Trench
22	Unnamed watercourse	1st Order	Low	Open Trench
23	Unnamed watercourse	1st Order	Low	Open Trench
24	Unnamed watercourse	3rd Order	Medium	Open Trench with flow diversions if required
25	Unnamed watercourse	1st Order	Low	Open Trench
26	Unnamed watercourse	2nd Order	Low	Open Trench
27	Unnamed watercourse	1st Order	Low	Open Trench
28	Unnamed watercourse	1st Order	Low	Open Trench
29	Unnamed watercourse	1st Order	Low	Open Trench
30	Unnamed watercourse	1st Order	Low	Open Trench
31	Unnamed watercourse	1st Order	Low	Open Trench
32	Unnamed watercourse	1st Order	Medium	Open Trench
33	Unnamed watercourse	2nd Order	Medium	Open Trench
34	Unnamed watercourse	1st Order	Low	Open Trench
35	Unnamed watercourse	2nd Order	Medium	Open Trench
36	Unnamed watercourse	1st Order	Low	Open Trench
37	Groom Creek	2nd Order	Medium	Open Trench
38	Unnamed watercourse	1st Order	Low	Open Trench
39	Unnamed watercourse	2nd Order	Low	Open Trench

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
40	Unnamed watercourse	1st Order	Low	Open Trench
41	Unnamed watercourse	2nd Order	Low	Open Trench
42	Unnamed watercourse	2nd Order	Low	Open Trench
43	Unnamed watercourse	2nd Order	Low	Open Trench
44	Unnamed watercourse	1st Order	Low	Open Trench
45	Unnamed watercourse	1st Order	Low	Open Trench
46	Unnamed watercourse	2nd Order	Low	Open Trench
47	Unnamed watercourse	2nd Order	Low	Open Trench
48	Unnamed watercourse	1st Order	Low	Open Trench
49	Unnamed watercourse	1st Order	Low	Open Trench
50	Unnamed watercourse	2nd Order	Low	Open Trench
51	Karuah River	>3rd Order, Class 1 Fish Habitat, joins to the Hunter River	High	HDD
52	Unnamed watercourse	1st Order	Low	Open Trench
53	Dingo Creek	3rd Order	Medium	Open Trench with flow diversions if required
54	Ramstation Creek	3rd Order	High	Open Trench with flow diversions. Possible HDD, depending on environmental conditions and Creek flow.
55	Barnes Creek	3rd Order	High	Open Trench with flow diversions
56	Unnamed watercourse	1st Order	Low	Open Trench
57	Unnamed watercourse	1st Order	Low	Open Trench

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
58	Unnamed watercourse	2nd Order	Low	Open Trench
59	Unnamed watercourse	2nd Order	Low	Open Trench
60	Unnamed watercourse	1st Order	Low	Open Trench
61	Unnamed watercourse	1st Order	Low	Open Trench
62	Unnamed watercourse	3rd Order	High	Open Trench with flow diversions if required
63	Unnamed watercourse	1st Order	Low	Open Trench
64	Unnamed watercourse	1st Order	Low	Open Trench
65	Unnamed watercourse	2nd Order	Low	Open Trench
66	Unnamed watercourse	2nd Order	Low	Open Trench
67	Unnamed watercourse	1st Order	Low	Open Trench
68	Unnamed watercourse	3rd Order	Medium	Open Trench
69	Unnamed watercourse	2nd Order	Low	Open Trench
70	Black Camp Creek	3rd Order	High	Open Trench with flow diversions if required
71	Unnamed watercourse	2nd Order	Low	Open Trench
72	Unnamed watercourse	1st Order	Low	Open Trench
73	Unnamed watercourse	2nd Order	Low	Open Trench
74	Unnamed watercourse	3rd Order	High	Open Trench with flow diversions if required
75	Unnamed watercourse	2nd Order	Low	Open Trench
76	Unnamed watercourse	1st Order	Low	Open Trench
77	Cedar Tree Creek	3rd Order	High	Open Trench with flow diversions if required

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
78	Unnamed watercourse	2nd Order	Low	Open Trench
79	Unnamed watercourse	1st Order	Low	Open Trench
80	Unnamed watercourse	2nd Order	Low	Open Trench
81	Unnamed watercourse	1st Order	Low	Open Trench
82	Unnamed watercourse	1st Order	Low	Open Trench
83	Unnamed watercourse	2nd Order	Medium	Open Trench with flow diversions if required
84	Unnamed watercourse	1st Order	Low	Open Trench
85	Little Black Camp Creek	3rd Order	High	Open Trench with flow diversions if required
86	Unnamed watercourse	1st Order	Low	Open Trench
87	Unnamed watercourse	1st Order	Low	Open Trench
88	Unnamed watercourse	2nd Order	Low	Open Trench
89	Unnamed watercourse	1st Order	Low	Open Trench
90	Unnamed watercourse	1st Order	Low	Open Trench
91	Gravelly Creek	3rd Order, Class 2 Fish Habitat	Medium	Open Trench with flow diversions if required
92	Unnamed watercourse	2nd Order	Low	Open Trench
93	Unnamed watercourse	2nd Order	Low	Open Trench
94	Unnamed watercourse	2nd Order	Low	Open Trench
95	Unnamed watercourse	2nd Order	Low	Open Trench
96	Unnamed watercourse	1st Order	Low	Open Trench
97	Unnamed watercourse	2nd Order	Medium	Open Trench with flow diversions if required
98	Unnamed watercourse	1st Order	Low	Open Trench

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
99	Unnamed watercourse	2nd Order	Low	Open Trench
100	Unnamed watercourse	1st Order	Low	Open Trench
101	Unnamed watercourse	2nd Order	Medium	Open Trench with flow diversions if required
102	Unnamed watercourse	2nd Order	Low	Open Trench
103	Unnamed watercourse	3rd Order	Low	Open Trench with flow diversions if required
104	Unnamed watercourse	1st Order	Low	Open Trench
105	Unnamed watercourse	1st Order	Low	Open Trench
106	Unnamed watercourse	2nd Order	Low	Open Trench
107	Unnamed watercourse	2nd Order	Low	Open Trench
108	Unnamed watercourse	1st Order	Low	Open Trench
109	Unnamed watercourse	1st Order	Low	Open Trench
110	Unnamed watercourse	1st Order	Low	Open Trench
111	Unnamed watercourse	2nd Order	Low	Open Trench
112	Unnamed watercourse	2nd Order	Low	Open Trench
113	Unnamed watercourse	3rd Order, Class 2 Fish Habitat	Medium	Open Trench
114	Unnamed watercourse	3rd Order, Class 2 Fish Habitat	Medium	Open Trench with flow diversions if required
115	Boatfall Creek	3rd Order, Class 2 Fish Habitat	Medium	Open Trench with flow diversions if required
116	Unnamed watercourse	1st Order	Low	Open Trench
117	Unnamed watercourse	1st Order	Low	Open Trench
118	Unnamed watercourse	1st Order	Low	Open Trench
119	Unnamed watercourse	1st Order	Low	Open Trench

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
120	Unnamed watercourse	1st Order	Low	Open Trench
121	Flaggy Creek	3rd Order	Low	Open Trench with flow diversions if required
122	Unnamed watercourse	1st Order	Low	Open Trench
123	Unnamed watercourse	1st Order	Low	Open Trench
124	Unnamed watercourse	2nd Order	Low	Open Trench
125	Unnamed watercourse	1st Order	Low	Open Trench
126	Unnamed watercourse	1st Order	Low	Open Trench
127	Unnamed watercourse	1st Order	Low	Open Trench
128	Unnamed watercourse	2nd Order	Low	Open Trench
129	Unnamed watercourse	1st Order	Low	Open Trench
130	Unnamed watercourse	1st Order	Low	Open Trench
131	Unnamed watercourse	2nd Order	Low	Open Trench with flow diversions if required
132	Unnamed watercourse	2nd Order	Low	Open Trench
133	Unnamed watercourse	2nd Order	Medium	Open Trench with flow diversions if required
134	Unnamed watercourse	1st Order	Low	Open Trench
135	Unnamed watercourse	1st Order	Low	Open Trench
136	Unnamed watercourse	1st Order	Low	Open Trench
137	Unnamed watercourse	1st Order	Low	Open Trench
138	Unnamed watercourse	1st Order	Low	Open Trench
139	Unnamed watercourse	1st Order	Low	Open Trench
140	Unnamed watercourse	1st Order	Low	Open Trench

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
141	Unnamed watercourse	2nd Order	Low	Open Trench
142	Unnamed watercourse	1st Order	Low	Open Trench
143	Unnamed watercourse	1st Order	Low	Open Trench
144	Unnamed watercourse	1st Order	Low	Open Trench
145	Unnamed watercourse	2nd Order	Low	Open Trench
146	Unnamed watercourse	2nd Order	Low	Open Trench
147	Unnamed watercourse	1st Order	Low	Open Trench
148	Unnamed watercourse	2nd Order	Low	Open Trench
149	Unnamed watercourse	2nd Order	Low	Open Trench
150	Unnamed waterbody	Intermittent	Low	Open Trench
151	Unnamed watercourse	1st Order	Low	Open Trench
152	Unnamed waterbody	Intermittent	Low	Open Trench
153	Unnamed waterbody	Intermittent	Low	Open Trench
154	Williams River	>3rd Order, Class 1 Fish Habitat, joins to the Hunter River	High	HDD
155	Unnamed watercourse	1st Order	Low	Open Trench
156	Carmichaels Creek	1st Order	Low	Open Trench
157	Carmichaels Creek	2nd Order	Medium	Open Trench with flow diversions if required
158	Unnamed watercourse	1st Order	Low	Open Trench
159	Unnamed watercourse	1st Order	Low	Open Trench
160	Jackass Creek	2nd Order	Medium	Open Trench with flow diversions if required

I.D. Number	Watercourse	Relative Sensitivity Criteria	Sensitivity	Proposed Crossing Method
161	Unnamed watercourse	1st Order	Low	Open Trench
162	Deadmans Creek	3rd Order	Medium	HDD
163	Unnamed watercourse	1st Order	Low	Open Trench
164	Unnamed watercourse	1st Order	Low	Open Trench
165	Hunter River	>3rd Order, Class 1 Fish Habitat, Fishery downstream	High	HDD
166	Unnamed watercourse	1st Order	Low	Open Trench
167	Unnamed watercourse	1st Order	Low	Open Trench
168	Unnamed watercourse	1st Order	Low	Open Trench
169	Scotch Creek	1st Order	Low	Open Trench
170	Greenways Creek	2nd Order, Woodberry Swamp nearby	Medium	Open Trench with flow diversions if required
171	Unnamed watercourse	1st Order, Woodberry Swamp nearby	Medium	Open Trench with flow diversions if required
172	Constructed Drainage Channel	1st Order, Woodberry Swamp nearby	Medium	Open Trench with flow diversions if required
173	Constructed Drainage Channel	2nd Order, Woodberry Swamp nearby	Medium	Open Trench with flow diversions if required
174	Constructed Drainage Channel	2nd Order, Woodberry Swamp nearby	Medium	Open Trench with flow diversions if required
175	Constructed Drainage Channel	2nd Order, Woodberry Swamp nearby	Medium	Open Trench with flow diversions if required
176	Constructed Drainage Channel	2nd Order, Woodberry Swamp nearby	Medium	Open Trench with flow diversions if required
177	Hunter River and SEPP14 wetlands	>3rd Order, Class 1 Fish Habitat, Fishery downstream	High	HDD
178	SEPP14 wetlands and Hunter River	>3rd Order, Class 1 Fish Habitat, Fishery downstream	High	HDD

* Identification numbers T1 to T5 represent indicative locations along the pipeline route between CPF Site 1 and the northern extent of the pipeline should Site 1 be the selected CPF location (ref. **Figure 10.2**).

12.4 Potential Impacts

12.4.1 Stage 1 GFDA

The Stage 1 GFDA would involve the construction, operation, closure and rehabilitation of gas wells and of the gas/water gathering system and access roads, as well as the establishment of a temporary construction workforce camp for up to 100 people during the peak of construction in the Stage 1 GFDA.

The siting of wells within the Stage 1 GFDA was determined based on a constraints assessment as described in **Section 5.2** and shown in **Figure 5.4**, which included heritage and ecologist surveys, noise and visual assessments and consultation with landowners in order to avoid and / or minimise impacts from the gas wells. Constraints criteria utilised included:

- Vegetation criteria;
- 40 m buffer around major watercourses;
- 20 m buffer around minor watercourses;
- 200m buffer around residences for noise criteria;
- Terrain and erosion criteria (slope);
- Land and Heritage criteria;
- Visual exposure from dwellings;
- Transportation Infrastructure criteria;
- Electricity infrastructure criteria;
- Existing mining operations criteria; and
- View shed criteria.

Potential impacts to surface water resulting from the Stage 1 GFDA have been assessed with regard to the phase of development, including construction, operation, closure and rehabilitation as described below.

Construction

Activities during the construction of the Stage 1 GFDA (i.e. gas wells, gas/water gathering system, access roads and a construction workforce camp) that have the potential to impact surface water quality include earthworks (grading, trenching and excavating), stockpiling of materials, drilling and fracture stimulation. Potential impacts resulting from these works may include:

- Increased turbidity / sedimentation of surface waters resulting from wind and water erosion and sediment laden runoff from material stockpiles, earthworks, access roads, construction traffic, gas gathering line trench earthworks, well surface locations and the construction workforce camp;
- Contamination of surface waters from effluent mismanagement at the construction workforce camp.
- Increased turbidity / sedimentation of surface waters if flooding or high rainfall occurs during the construction process;
- Increased turbidity and sedimentation during the construction of the gas gathering system when crossing flowing watercourses;
- Contamination of surface waters as a result of accidental spillage of fuel or other contaminants (e.g. Bentonite) from drill rigs, support vehicles and passenger vehicles;

- Increased salinity of surface waters and detrimental impacts to surrounding vegetation as a result of accidental release of saline drill, frac and/or produced waters during drilling and well development. Provided safeguards in **Section 12.5.1** are implemented, accidental release of saline drill, frac and/or produced water during drilling and well development would not likely have significant environmental impacts;
- Diversion / alteration of natural drainage patterns through the construction of access roads and grading / development of areas; and
- Loss of water retention of the environment due to increases in hardstand areas and clearing / earthworks.

Operation

The proposed extraction of CSG within the Stage 1 GFDA is anticipated to result in the production of water from well sites, known as 'produced water', being water contained within the coal seams which flows readily during gas extraction. Scenario modeling of well water production has indicated that during the operation of the proposed Stage 1 GFDA, produced water could be expected to equate to an average of 2 ML/day. This is considered to represent a conservative upper bound for water production for the Stage 1 GFDA.

The quality of produced water is likely to vary across the basin, though results to date from the pilot project have indicated that the water is generally quite saline with a high Sodium Adsorption Ratio (SAR) (see **Section 4.4.2)**. As such water treatment would be required prior to disposal of the water, as described in **Section 5.5.3**. A number of alternatives have been proposed for the treatment of produced water and the destination of the treated water as further detailed in **Section 4.4.2**.

Potential impacts to surface water during the operation of the Stage 1 GFDA may include:

- Increased contamination / salinity of surface waters and detrimental impacts to surrounding vegetation as a result of the accidental release of produced water through the leak of water pipes in the water gathering system and / or the rupture or overflow of the water holding ponds. Provided safeguards in **Section 12.5.1** are implemented, accidental release of produced water during the operation of the Stage 1 GFDA would not likely have significant environmental impacts;
- Increased salinity / contamination into surface water from the accidental release of saline drill, frac and produced water from storage tanks or during workovers;
- Diversion / alteration of natural waterflows via the infiltration of surface water into the trench system at watercourse crossings for the water/gas gathering system;
- Contamination of surface waters as a result of accidental spillage of fuel or other contaminants from rigs, work areas, support vehicles and passenger vehicles;
- Increased sedimentation / turbidity / contamination of surface water if flooding occurs; and
- Localised disruptions to the flow of flood waters due to the presence of plant and infrastructure at well surface locations.

Rehabilitation

The rehabilitation of well sites and gas / water gathering line footprint areas would include backfilling of excavated areas, installation of appropriate sedimentation and erosion control methods, re-contouring of reduced well footprint area and gas / water gathering line footprint, revegetation and reconstruction and stabilisation of stream banks and drainage lines as further described in **Chapter 22.** During the initial and final rehabilitation phases, potential impacts to surface water quality may include:

- Turbidity / sedimentation from the release of sediment-laden runoff from vehicles;
- Erosion / scouring of re-contoured and rehabilitated areas during periods of high rainfall and runoff; and
- Changes to natural drainages and flows.

The construction workforce camp would be rehabilitated to pre-disturbance conditions or better in consultation with the relevant landowner. This would include removal of infrastructure, regrading and contouring if required and re-establishment of pasture or native species. Potential impacts associated with erosion and sedimentation during initial and final rehabilitation phase are not anticipated to significantly affect the environment and are further discussed in **Chapter 22.**

12.4.2 CPF Site

Construction

Works required for the construction of the CPF including the water treatment facility, storage ponds, the ancillary power generation facility and other associated infrastructure such as access roads may include earthworks (grading, trenching and excavating) and stockpiling of materials. Potential impacts on water quality resulting from these works may include:

- Increased turbidity / sedimentation of surface waters resulting from wind and water erosion and sediment laden runoff from material stockpiles, earthworks, access roads and construction traffic;
- Increased turbidity / sedimentation of surface waters if flooding or high rainfall occurs during the construction phase;
- Contamination of surface waters as a result of accidental spillage of fuel or other contaminants (e.g. Bentonite, concrete) from construction vehicles, passenger vehicles and during the construction of the CPF;
- Diversion / alteration of natural drainage patterns through the construction of access roads and grading / development of areas;
- Loss of water retention of the environment due to increases in hardstand areas and clearing / earthworks; and

Operation

Potential impacts to surface water during the operation of the CPF and associated infrastructure include:

- Increased salinity / contamination into surface water from the accidental release of saline brine from the RO water treatment plant or from trucks transporting the brine / solid salt waste;
- Concentrated volumes of stormwater runoff from hardstand areas such as the roof of the CPF and access roads and
- Diversion / disruption of floodwaters due to the presence of buildings / structures.

There have been numerous options considered for the management of produced water as detailed in **Section 4.4.2.** It is proposed that produced water be treated by RO desalination in order to provide treated water for other downstream uses as described in **Section 5.5.4.** The residual saline brine from the water treatment process would be further evaporated to a solid waste for potential downstream use or appropriate disposal as detailed in **Chapter 23**.

12.4.3 Pipeline Corridor

Potential impacts to surface water along the pipeline corridor are considered in the sections below with regard to the phase of development, including construction, operation, and initial and final rehabilitation.

Construction

Activities during the construction of the pipeline that have the potential to impact surface water quality include earthworks, grading, trenching, excavating, stockpiling of materials, access track and construction workforce camp construction and the movement of vehicles and plant. Potential impacts resulting from these works may include:

- Pollution / contamination of surface water as a result of accidental spillage of fuel, coating product or other contaminants from drill rigs, support vehicles, personnel vehicles and from other activities / plant;
- Increased turbidity / sedimentation of surface waters resulting from wind / water erosion and sediment laden runoff from material stockpiles, earthworks, access roads, ROW, temporary work areas, construction traffic, clearing of riparian vegetation at some watercourse crossings and ground disturbance at construction camp;
- Contamination of surface waters from effluent mismanagement at the construction workforce camp;
- Increased turbidity / sedimentation of surface waters if flooding or high rainfall occurs during the construction period;
- Pollution / contamination of surface water if water used for hydrostatic testing is released into waterway;
- Changes in natural drainage patterns, waterway channel or bank form through the construction works associated with the pipeline. This has the potential to result in downstream erosion and sedimentation; and
- Negative impacts to sensitive wetland vegetation species due to the lowering of wetland water levels adjacent to the pipeline trench (approximately 40 m from pipeline trench) if prolonged dewatering of the trench is required in waterlogged areas.
- Negative impact to groundwater dependent vegetation due to the potential lowering of the water table preventing roots from accessing water if prolonged dewatering of the pipeline trench is required in waterlogged areas. Wetland areas would be HDD (refer to **Chapter 10**) to avoid or minimise impacts to these areas. Acid Sulfate Soils (ASS) would also be managed in accordance with an ASSMP as further detailed in **Chapter 25**.

Watercourse Crossings

Impacts to the surface water in minor watercourses would be considered negligible if the construction works (open trenching) occur while the watercourses are dry and the appropriate mitigation measures are incorporated, as described in **Section 12.5**. Open trenching is a suitable method of crossing watercourses / drainage lines with low sensitivity. Open trenching with stream flow diversion may also be used to reduce impacts to surface water where water flows are present in watercourses as described in **Section 5.6.4**. Horizontal Directional Drilling of major and highly sensitive watercourses would be utilised, which would significantly reduce impacts to the surface water of these watercourses.

Potential impacts to surface water due to watercourse crossings include:

- Increased erosion / sedimentation along watercourse banks where riparian vegetation is removed for open trench watercourse crossings (with or without flow diversions);
- Increased turbidity / sedimentation of surface waters if flooding or high rainfall occurs during the construction period, particularly at watercourse crossing locations which are under construction;
- Indirect impacts to downstream aquatic vegetation and aquatic species (e.g. fish, platypus and insects) due to increased erosion / sedimentation from the Project; and
- Disturbances to natural water flows at water course crossings due to preferential infiltration of water along the pipeline in the trench.
- Turbidity / pollution / contamination of surface water, in the unlikely event that the HDD drill bit intersects with a natural fracture in the bed of the watercourse potentially releasing bentonite mud into the watercourse. This would have the potential to impact the watercourse until the HDD is completed and the bentonite is dispersed. The HDD method is, itself, a mitigation to avoid impacts to sensitive watercourse and associated riparian vegetation and such events are deemed unlikely to occur.

Operation

Potential impacts to surface water would be limited during the operation of the pipeline as there would be minimal ground disturbance. Potential impacts include:

- Changes to existing surface water drainage / flow patterns due to the preferential flow of water along the pipeline and associated bedding materials in the soil profile (linear alignment). This has the greatest potential to occur in the vicinity of watercourse crossings as water from the watercourses may divert into the trench if proper safeguards are not emplaced;
- Scouring and local ponding effects along the pipeline footprint during heavy rainfall events soon after the pipeline construction (prior to the settling of the berm of the backfill);
- Increased turbidity and sedimentation of waterways due to erosion from pipeline maintenance vehicles, particularly in areas consisting of waterlogged soils; and
- Increased turbidity and sedimentation of waterways if the pipeline is exposed due to scouring / erosion, particularly at waterway crossings;

Rehabilitation

The rehabilitation of the pipeline corridor would involve backfilling of excavated areas, installation of appropriate sedimentation and erosion control methods, revegetation and reconstruction and stabilisation of stream banks and drainage lines at watercourse crossings, as further described in **Chapter 22.** During the initial and final rehabilitation phases, potential impacts to surface water quality may include:

- Turbidity / sedimentation from the release of sediment-laden runoff from vehicles;
- Erosion / scouring of recontoured and rehabilitated areas during periods of high rainfall and runoff; and
- Changes to natural drainages and flows.

During the decommissioning and final rehabilitation of the pipeline, there would likely be minimal environmental impacts. It is currently anticipated that the pipeline would remain *in situ* post decommissioning, and as such minimal ground disturbance would occur.

The construction workforce camp would be rehabilitated to pre-disturbance conditions or better in consultation with the relevant landowner. This would include removal of infrastructure, regrading and contouring if required and re-establishment of pasture or native species.

Potential impacts associated with erosion and sedimentation during initial and final rehabilitation phase are not anticipated to significantly affect the environment and are further discussed in **Chapter 22.**

12.5 Environmental Safeguards

The Project would involve the preparation and implementation of a CEMP covering each of the Stage 1 GFDA, CPF and pipeline prior to commencement of construction, which would detail specific management and mitigation to minimise potential impacts to surface water. In respect of surface water quality, the CEMP would detail erosion and sedimentation controls, water flows, runoff and drainage. Further details are provided in **Chapter 25**.

12.5.1 Stage 1 GFDA

Construction

The following safeguards would be implemented to avoid / minimise impacts to surface water during the construction phase of the Stage 1 GFDA:

- The installation of surface water diversion berms or the like in steep sloping areas and areas where natural drainages have been altered to assist in diverting ‘clean’ water runoff away from the gathering line footprint, well sites, access roads, graded areas and work areas where required and particularly for periods of high rainfall / runoff to minimise the likelihood of flooding and sedimentation;
- Silt fences and other sediment control devices would be installed and maintained on downslope of stockpiles and between construction areas and watercourses to minimise sedimentation;
- All stockpiles (e.g. bed material, bank material, top and sub soil, vegetation) would be kept separate and appropriately managed with erosion and sediment control measures;
- Stockpiles shall not impede surface drainage as far as practicable;
- Clearing of vegetation and the exposure of bare sediment would be minimised as much as practicable to minimise erosion;

- Vehicles would utilise access tracks and designated roadways where possible to minimise erosion and sedimentation;
- Worksites, the construction workforce camp, parking areas, site-offices, stockpiles and other ancillary works areas would be located in existing cleared areas, away from waterways or other sensitive areas;
- Human wastes (effluent/sewage) generated at construction workforce camps would be managed in accordance with a Waste Management Plan;
- Gas and water gathering line routes would be designed to avoid large remnant riparian vegetation patches in order to cross watercourses at sites with no or limited native vegetation, wherever possible;
- Watercourse crossings (open trench) for the gas/water gathering system would be undertaken during no flow or low-flow conditions and temporary flow diversions would be installed if moderate flows are present as required. Sensitive watercourses may be crossed using thrust bores or HDD techniques to avoid impacts on these watercourses (refer to **Table 12-3** and **Table 12-4)**;
- The construction of watercourse crossings would be done as rapidly as possible with the open trench across the watercourse crossing being open for the minimum amount of time to minimise the potential for erosion and turbidity;
- Construction vehicles would be kept well maintained and personnel would be trained and provided with spill response kits at each well site location;
- Drilling fluid and produced water spill prevention and response procedures would be put in place.

Operation

OEMP would be prepared and implemented prior to operation of the Stage 1 GFDA refer (**Chapter 25**). Safeguards for surface water in the OEMP would include:

- The installation of a surface water drainage system for hardstand areas to prevent erosion / sedimentation from the concentration of water in some areas;
- Design of gas wells so that they can be shut-in or opened remotely from the CPF as described in **Chapter 5.** This feature is available to ensure the safety and control of wells;
- Design measures would be implemented 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 within the CPF;
- Design of gas wells so that the wellhead, separator and meter run could be safely submerged for an extended period of time with no risk to the environment or the infrastructure. The infrastructure at wellheads would not impede the natural movement of floodwaters in the event of a flood;
- The relocation of unsecured plant and equipment from low-lying areas when flood warnings are received;

- Implementation / utilisation of appropriate flood warning systems to allow for the maximum amount of time to remove unsecured plant from flood-prone areas and to enable operations on flood-prone land to be made secure. 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 onsite, 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 operational phase of development;
- Inspection / auditing of all plant and infrastructure following a flood event to ensure that all elements are operating effectively, and necessary rehabilitation works are carried out immediately;
- Installation of low water traps in low areas of the gathering system to allow for the removal of water that may collect. This would be emptied and contained for disposal to the produced water storage pond as required;
- Incorporation of design measures to ensure that isolation valves on the gathering system would close, isolating each well field and shutting off gas flow to prevent uncontrolled release;
- Maintenance and personnel vehicles would be kept well maintained and personnel would be trained and provided with spill response kits at each well site location; and
- Regular maintenance of the gas/water gathering system including visual inspection to identify potential leaks in the water gathering system.

Rehabilitation

The nature of the rehabilitation works such as backfilling of excavated areas, installation of appropriate sedimentation and erosion control methods, revegetation and reconstruction and stabilisation of stream banks and drainage lines at watercourse crossings (see **Chapter 22)** are in themselves safeguards to minimise erosion, sedimentation, turbidity and other direct and / or indirect environmental impacts associated with the Project.

The construction workforce camp would also be rehabilitated to pre-disturbance conditions or better in consultation with the relevant landowner. General safeguards to minimise impacts to surface water as further described in **Chapter 22** include:

- Installation and maintenance of sediment and erosion control measures, such as silt fencing surrounding exposed areas and stockpiles;
- Stockpiling of soil and mulched vegetation during the construction period where possible for reuse during the initial rehabilitation phase. Topsoil and subsoil would be replaced in the appropriate order;
- Stockpiling of topsoil away from flood prone areas;
- Recontouring of surfaces to match the surrounding land and natural drainage lines;
- Re-establishment of native species or pasture, as required;
- Installation of trench breakers at watercourse crossings, on either side of the watercourse to prevent disturbances to natural flows; and
- Fencing of rehabilitated areas with stock proof fencing where required minimising unauthorised access and maximising success of rehabilitation works.

12.5.2 CPF Site

Construction

Safeguards to be implemented to avoid / minimise impacts to surface water during the construction phase of the CPF include:

- Preparation of a Soil and Water Management Plan (SWMP) as part of the CEMP, specifically addressing the construction of the CPF Site;
- Preparation of a Erosion and Sediment Control Plan, specifically addressing the CPF site;
- Installation of surface water diversion berms or equivalent in steep sloping areas and areas where natural drainages have been altered to assist in diverting 'clean' water runoff away from the CPF footprint, access roads, graded areas and work areas where required;
- Installation and maintenance of silt fences and other sediment control devices on the downslope of stockpiles and between construction areas and watercourses to minimise sedimentation, particularly during heavy rainfall;
- Maintenance and personnel vehicles would be kept well maintained and personnel would be trained and provided with spill response kits;
- Additional water storage areas for storage of produced and treated water would be constructed in accordance with design and engineering specifications to minimise environmental impacts, including:
  - Cut-and-fill construction techniques to avoid the need to import soil from other sites;
  - Storage capacity to take into consideration probable water production rate as well as climatic conditions, in order to minimise the risk of spillage;
  - Installation of geomembrane liner to eliminate leaching;
  - Design of the pond with sufficient freeboard to ensure management during exceptional conditions;
  - Implementation of and adherence to operational procedures to minimise risk of spillage.

Operation

During the operation of the CPF, the following safeguards would be implemented to minimise / avoid impacts to surface water:

- The installation of a surface water drainage system for hardstand areas around the CPF to prevent erosion / sedimentation from the concentration of water in certain areas;
- Adoption of monitoring and reporting procedures to check the integrity of the water storage ponds and identify any leaks;
- Regular monitoring of storage pond water levels to minimise the risk of overflow / spillage;
- The provision of spill kits at the CPF site to allow for a rapid response in the case of an accidental spill to minimise potential environmental impacts;
- Installation of bunding around chemical storage areas to prevent runoff of contaminant in the case of a spill;

- Human wastes (effluent/sewage) generated at the CPF would be managed in accordance with a Waste Management Plan to minimise likelihood of surface water impacts (refer to **Chapter 25)**;
- Treatment of waste water: the volume of waste from the produced water would be greatly reduced through RO desalination treatment and subsequent evaporation of the brine as detailed in **Section 5.5.4.** As such, the residual waste would be a solid salt product and treated water would be utilised by downstream users (see **Chapters 4 and 23**). Set procedures would be emplaced for the removal of the residual salt product from the RO plant by truck (if required) in accordance with accepted disposal guidelines and with appropriate safeguards as further detailed in **Chapter 23** (e.g. tarpaulins covering trucks, sealed loads, etc). Such procedures would be incorporated into the OEMP and would assist in avoiding and minimising spills. The solid salt product would be either transported to a salt processing plant or would be disposed of at a licenced waste facility depending on the composition and classification of the final product as described in **Chapter 23**.

Rehabilitation

- Surfaces would be re-contoured and landscaped to match the surrounding land and natural drainage lines would be re-instated.

12.5.3 Pipeline Corridor

Construction

Safeguards would be implemented throughout the construction of the pipeline to minimise / avoid impacts to surface water. These would be incorporated into the CEMP and would include:

- Preparation of a SWMP which would adhere to the APIA *Code of Environmental Practice – Onshore Pipelines* (APIA, 2005) as well as relevant sections of Landcom's Managing Urban Stormwater: Soils and Construction (Landcom, 2004) prior to construction as described in **Chapter 17**. Mitigation measures relating to surface water may include:
  - The installation of surface water diversion berms or the like in steep sloping areas to assist in diverting 'clean' water runoff away from the ROW, the construction camp and other work areas where required;
  - Installation and maintenance of silt fences and other sediment control devices on the downslope of stockpiles and between construction areas and watercourses to minimise sedimentation;
  - Human wastes (effluent/sewage) generated at construction workforce camps would be managed in accordance with a Waste Management Plan to minimise likelihood of surface water impacts (refer to **Chapter 25**);
  - All stockpiles (e.g. bed material, bank material, top and sub soil, vegetation) would be kept separate and appropriately managed with erosion and sediment control measures;
  - Stockpiles shall not impede surface drainage as far as practicable;
  - Clearing of vegetation and the exposure of bare sediment would be minimised as much as practicable and a reduced ROW would be used in areas consisting of sensitive vegetation or riparian vegetation to minimise impacts; and
  - Vehicles would utilise access tracks and designated roadways where possible to minimise erosion and sedimentation.

The CEMP would incorporate spill response procedures for fuels and other chemicals to be used during the construction process. This would include:

- The provision of spill response kits and trained personnel at each worksite and along the ROW;
- Prohibition of vehicle maintenance or refuelling within a designated distance of any surface water body;
- Chemical storage sites would be contained within bunded area to catch any accidental spills and would not be located proximate to waterways and drainage lines as far as practicable; and
- The management of hydrostatic test water would form part of the CEMP as the Proponent is yet to finalise the logistics regarding hydrostatic testing. Precautions would be taken to avoid spills / leaks of the hydrostatic water.

The CEMP would also include construction workforce management procedures and waste management procedures to minimise impacts to surface water from the construction workforce camp.

12.5.4 Watercourse Crossings

At identified watercourse crossings, the Proponent would construct a crossing to an acceptable standard according to sensitivity criteria as shown in **Table 12-1.**

The majority of watercourses / drainage lines which would be crossed for the pipeline corridor have intermittent water flows (i.e. only flow during and immediately after rainfall events). Nevertheless, sensitive watercourses with permanent high water flows (e.g. Hunter River, Williams River and Karuah River) would be crossed using HDD as described further in **Section 5.6.4** and **Table 12-3** and **Table 12-4**. HDD can avoid the majority of impacts to the riparian vegetation, berms and surface water quality of watercourses.

Open trenching of less sensitive watercourses would be undertaken during no or low flow conditions where possible. Open trenching during dry periods would avoid impacts to water quality ensuring that appropriate rehabilitation of the watercourse crossing are undertaken. Open trenching with stream flow diversions may be used when moderate water flows are present to further reduce potential impacts to the surface water.

Ecology surveys undertaken as part of this EA (refer **Appendix G**) further identified watercourses / riparian vegetation of high sensitivity and these findings assisted in determining the watercourse crossing technique to be employed and the secondary management measures to avoid indirect or downstream effects. Safeguards specific to watercourses may include:

- Avoiding impacts to hydrological flow regimes at crossings of 3rd order streams with variable flows. Open trench construction techniques would be suitable when waterflows are not present or very low. Open trench with flow diversions and environmental management measures would be employed when waterflows are increased (typically greater than 1000 L/s).
- Minimise clearing of native riparian vegetation at other watercourses by utilising existing clearings (where present) or utilising a reduced ROW width. Although riparian vegetation clearing would be minimised where possible, a wider ROW would be required at watercourse crossings with steep banks to allow for the temporary opening up of the bank to construct the pipeline. Such works would be undertaken in accordance with a SWMP to minimise impacts to surface water quality.

- Site-specific geotechnical investigations would be undertaken prior to HDD to identify the geology, potential issues and to select appropriate drill equipment. With HDD, the pipe is a sufficient depth beneath the watercourse to minimise the risk of contamination associated with natural faults in the riverbed;
- The construction of watercourse crossings would be done as rapidly as possible with the open trench across the watercourse crossing being open for the minimal amount of time to minimise the potential for erosion and turbidity. Open trenching during dry periods is not anticipated to have major negative impacts on fish movements due to the absence or lack of water flow. The temporary diversion of water flows is not anticipated to have major negative impacts on fish due to the short time that the diversion would be in place; and
- Watercourses and banks would be rehabilitated after construction as described in **Chapter 22**.

12.5.5 Wetlands

A range of safeguards would be adopted to minimise impacts to wetlands, surface water and acid sulfate soils which can affect water quality, including:

- Minimise disturbance to freshwater wetlands and their associated vegetation. A reduced ROW may be utilised and works would be undertaken in the minimum amount of time possible during the dry periods, where feasible, to minimise potential impacts;
- Monitoring water levels of nearby wetlands and / or sensitive water bodies for impacts associated with dewatering of the pipeline trench, which would be incorporated into the dewatering design (e.g. pumping rates);
- Utilise matting to minimise the compaction and / or erosion of soft or erodible soils in sensitive areas such as watercourses and wetlands during construction;
- Avoid impacts to the freshwater wetlands on Coastal Floodplains at KP 68 by diverting pipeline slightly to the north and utilising HDD (if conditions are wet) to avoid impacts to the EEC and potential habitat for protected fauna species at this location as described in **Chapter 10.**
- Preparation of an Acid Sulfate Soils Management Plan, in consultation with relevant authorities, to mitigate potential impacts from the disturbance of potential acid sulfate soils (PASS) in the vicinity of Hexham as described in **Chapter 17 and 25**. Management options considered for the Project (construction, operation and decommissioning) may include the following:
  - **Containment** within the soil profile in natural depressions, ponds or drains;
  - **Neutralisation** typically either lime ($CaCO_3$) or the bicarbonate (HCO_3) in seawater;
  - **Dilution** use of freshwater to raise the pH; and
  - **Transformation** reduction into stable compounds.

Operation

Environmental safeguards that would be implemented during operation of pipeline would be detailed in an OEMP which would be prepared and implemented prior to operation. The OEMP would include mitigation measures to minimise potential impacts to surface water, and would include:

- Regular monitoring and inspections of the pipeline during operation (especially after heavy rain) to identify scouring and possible exposure of the pipeline or other underground infrastructure. These areas would be rehabilitated to control further scouring and minimise turbidity / sedimentation;

The OEMP would also incorporate an Emergency Response Plan (ERP) detailing response measures for spills and leaks.

Rehabilitation

The pipeline corridor including watercourses and banks, the construction camp and laydown areas would be rehabilitated after the construction phase using techniques such as:

- The re-spreading of topsoil from where it was removed and the backfilling of sub-soil from where it was removed in the correct order to prevent soil inversion;
- Installation of matting that is incorporated with seedlings to assist in stabilising the underlying soil of the bank, where required;
- Installation of silt and sediment fences to filter surface water runoff where deemed necessary (i.e. particularly sensitive locations);
- In locations where berms are used along the ROW, regular breaks would be installed, particularly at drainage lines, to minimise disturbances to natural surface water flows and scouring / formation of ponds along the ROW;
- The replacement of items of value to the fishery (e.g. logs, large rocks and other snags) which may have been disturbed during the construction of the watercourse crossing;
- Installation of rocks, riprap, sandbags, and/or matting to minimise scouring, ensuring that these assimilate with the existing environment as much as possible;
- Reinstatement of disturbed drainage lines after the construction works using the same material that was removed for backfilling, where possible;
- Compaction of trench backfill to account for backfill settlement;
- For watercourse crossings to be open trenched, the disturbance corridor for the bed, bank and riparian vegetation would be the narrowest practicable for safe construction, utilising a reduced ROW width;
- Installation of trench breakers at watercourse crossings on either side of the watercourse to prevent disturbances to natural flows; and
- Avoidance of permanent above-ground structures within floodways so as to not impede flood waters, where possible.

The potential re-use of produced water once it has been treated (see **Chapter 23**) would allow for a beneficial use of the potential waste product to downstream users including the local community and local industry. Investigations are also currently underway into the potential downstream use of the solid salt produced from the RO desalination and brine evaporation treatment. There is potential for this product to be transported to a salt producer for further processing into saleable products. Such practices would have an overall positive impact for downstream users including the local community and local industry by providing a resource which is often undersupplied from a potential waste product.

12.6 Residual Impacts

Upon implementation of mitigation measures, residual impacts would mainly be limited to the construction phase of development and are not expected to be significant.

The minimisation of water use is proposed through the re-use of the water from well fraccing at other well surface locations and the reuse of the water between sections for hydrostatic testing. Waste water would be contained in the water holding ponds and treated to a quality suitable for disposal or reuse. Sediment and erosion control measures would minimise potential impacts associated with turbidity and as such there are not anticipated to be significant residual impacts resulting from the Project.

12.7 Conclusion

The assessment of surface water identified that impacts as a result of the proposed development would be limited to erosion / turbidity / sedimentation during the construction phase of the Project. The potential surface water issues associated with the development would be managed through construction and operational environmental management plans.

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.

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13.0 Groundwater

Based on review of existing data, a conceptual model of the hydrogeological regime within the Project Area has been developed. This section discusses the conceptualisation and data used to develop the model as well as potential impacts and mitigation measures for the well field, CPF and pipeline project area.

13.1 Hydrogeological Regime – Concept Area

Due to the regional scale of geology and geomorphology issues, the existing environment of the Concept Area with regard to hydrogeology is largely the same as that described for the Stage 1 GFDA Project Area (refer to **Section 13.2**).

Given that the activities included in the Concept Plan Approval are generally the same as those proposed within the Stage 1 GFDA, the potential impacts in relation to groundwater are anticipated to be largely the same as those predicted in respect to the Stage 1 GFDA. Further, more detailed assessment of the potential hydrogeological impacts of the future development of the Concept Area would form the subject of future project applications and environmental assessments in support of the subsequent works.

13.2 Hydrogeological Regime – Project Area

13.2.1 Geology and Geomorphology

As discussed in **Chapter 17**, the Concept Area and Project Area lie within the Gloucester Basin which comprises a northerly trending syncline with coal bearing Late Permian sequences approximately 1800 to 2500 m thick, overlying Early Permian volcanic rock. The top of the Permian section (now folded) has been truncated by erosion and is covered by alluvial soils.

The Gloucester Basin displays steep dips in excess of 60º on its flanks, dipping towards the north-south trending basin axis, meaning the coal seams are deeper to the west of the Stage 1 GFDA when compared to the eastern portion. Extensive faulting occurs throughout the Basin and coal drilling programs on the eastern flank have demonstrated the presence of several thrust faults (NSW Geological Survey, 1996).

The faulting known to exist within the Gloucester Basin is likely to have resulted in the development of secondary permeability and localised increases in aquifer hydraulic conductivities (Woodward-Clyde 1996). The faults, if filled with weathered material (generally of a much lower permeability than the surrounding rock) would also act as a barrier to groundwater flow.

The pipeline corridor extends southwards from the basin into an estuarine landscape featuring tidal creeks and swamps on its approach into Hexham.

13.2.2 Aquifer Systems

There are three recognised aquifer systems in the vicinity of the Stage 1 GFDA, however the complex geology makes distinction between these aquifers difficult in some areas. The aquifer systems comprise:

- A shallow alluvial aquifer (fresh to brackish water quality);
- A shallow bedrock aquifer (brackish to saline water quality; and
- A deep bedrock aquifer (saline and alkaline water quality).

These aquifers are discussed further below.

Shallow Alluvial Aquifer

The unconfined alluvial aquifer is present within alluvial soils associated with the Avon River and associated tributaries, such as Dog Trap Creek and Waukivory Creek. The alluvial soils comprise a sequence of silty sands, gravely sands and clays and the aquifer is known to yield sufficient quantities and quality of water for farm water supplies. The alluvial sediments are expected to pinch out towards the eastern and western limbs of the basin where the underlying Permian bedrock outcrops.

The depth to water from the surface within the alluvial aquifer ranges from approximately 2 m in the vicinity of the Avon River to approximately 20 m in bores located near the wells associated with the Stratford pilot trial. The hydraulic conductivity of the alluvial aquifers has not been assessed, but is likely to vary depending on parent rock material.

Groundwater flow within the alluvial aquifer is expected to follow topography and generally flow from the margins of the Basin, located to the east and west of the Stage 1 GFDA, towards the centre of the basin and the Avon River. Groundwater may discharge into local streams and rivers, depending on the relative elevations of the potentiometric head/water level in the aquifer and the river bed. Conversely, streams may also form a source of recharge to the shallow alluvial aquifer where groundwater elevations are lower than the base of the stream or river. The majority of recharge for the shallow alluvial aquifer within the Project area however, is expected to be from direct infiltration of rainfall.

The bore search reported that groundwater quality within the shallow alluvial aquifer is fresh to brackish with electrical conductivity (EC) ranging from 500 to 1900 µS/cm (fresh to brackish), making the EC of the alluvial aquifer suitable for human and livestock consumption and irrigation.

Shallow Bedrock Aquifer

Shallow bedrock is generally present in the vicinity of the Stage 1 GFDA underlying the alluvial soils where they are present, and outcropping on the margins of the Basin where the alluvial soils are not present.

Borehole drilling logs provided by the Proponent for installed bores indicate the overburden comprises inter-layered sandstone, siltstone, mudstones and conglomerates. The permeability of the shallow bedrock aquifer may be higher near the surface where joints have been opened due to erosional stress release and weathering, therefore the depth of the shallow bedrock aquifer is likely to be dependant on the extent of weathering and the occurrence of permeable fracture zones.

Resource Strategies (2001) quoted a previous Golder Associates Pty Ltd report in which the hydraulic conductivity of the overburden (rock type not indicated) was reported as 1.7×10^{-4} m/day, indicating the shallow bedrock aquifer has relatively low permeability.

Recharge of the shallow bedrock aquifer would occur along the margins of the basin through direct infiltration into the exposed strata, or through infiltration from overlying alluvium. Groundwater within the shallow bedrock aquifer is therefore likely to flow from the margins of the basin towards the centre. It is likely that groundwater flow within the shallow bedrock aquifer is influenced by the reported fracturing and faulting present across the basin. Depending on the nature of the secondary permeability developed by the faulting (e.g. either open or closed fractures) seepage from the shallow bedrock aquifer to the deep bedrock aquifer will either be enhanced or restricted. As discussed below (based on monitoring well data) it appears that seepage from the shallow to deep aquifer is restricted.

Groundwater within the shallow bedrock aquifer is brackish to saline.

Deep Bedrock Aquifer

The deep bedrock aquifer is reported to have a very low primary or intergranular, porosity and permeability, however, joints and fractures impart a secondary or fracture permeability to the rock mass. Groundwater within the deep bedrock aquifer is generally confined and sub-artesian. It is noted that extended production testing in the Stratford Pilot area has indicated that not all coal seams were groundwater saturated and most water came from seams higher in the stratigraphic sequence.

The coal seams generally exhibit higher permeability than the relatively lower permeable overburden due to the presence of fractures, cleats and bedding plane partings. As such, the coal seams form the main aquifers (water yielding horizons) in the coal measures.

Resource Strategies (2001) reports that the faulting and low hydraulic conductivity of the overburden appear to have a controlling effect on the groundwater regime in the area, with the faults tending to compartmentalise the groundwater flow within the coal measures.

The hydraulic conductivity of naturally occurring fractures, if open, would be the limiting factor in the seepage of groundwater from the shallow aquifers to the production zone. Localised lowering of the water level in the deep aquifer would not dramatically increase naturally occurring seepage.

Groundwater within the coal measures is slightly alkaline and saline, with groundwater salinity increasing with depth. Electrical conductivity readings of up to 8700 µS/cm indicates the groundwater is generally unusable for human consumption and irrigation (with the exception of very salt tolerant crops only), but may be adequate for some livestock consumption.

13.2.3 Groundwater Usage

A review of information relating to all registered bores in the vicinity of the GFDA and CPF identified there are 65 registered bores within and immediately surrounding the Project Area. There are also likely to be many unregistered bores, some of which have already been identified during the preliminary works. The uses of the bores are described as being for:

- Stock watering;
- Irrigation;
- Domestic;
- Industrial;
- Waste disposal;
- Mining; and
- Monitoring.

Of the 65 registered bores, 35 are indicated to be for activities which are likely to involve groundwater abstraction (stock watering, irrigation, domestic, industrial, mining). Whilst bore details for a number of these wells were not provided in the bore search results, those for which detail was provided indicated that groundwater was abstracted from:

- Shallow alluvial aquifer; and
- Shallow bedrock aquifer.

The shallow bores which abstract groundwater in the alluvial aquifer are typically installed to less than 10 m below ground level (bgl). Those which exploit groundwater within the shallow bedrock aquifer are generally installed between 20 m bgl and 40 m bgl.

13.2.4 Pilot Trial

A series of pilot CSG extraction trials were conducted between 2004 and 2006 within the Stratford Pilot Project. These trials were scaled up in 2007 and 2008 to include additional extraction wells as described in **Section 5.2**. The trials comprised:

- Hydro-fracturing of the target coal seams;
- Extraction of groundwater; and
- Recovery of CSG.

The seams which were targeted for extraction by the trial were (refer **Figure 17.1**):

- Bowens Road;
- Glenview;
- Avon; and
- Triple.

The extraction of the methane is stimulated using a technique known as hydraulic-fracturing (‘fraccing’). Fraccing stimulation involves the injection of a stimulation fluid (typically water based), and sand into selected zones at high pressure. This technique widens paths in the coal seams to provide a conductive path for gas to flow freely to the well. The frac sand is locked in place by the pressure within the coal formation, while the injected and produced water is allowed to flow back to the well for pumping to the surface. As the water is removed, the resulting drop in reservoir pressure enables the gas to begin to desorb from the coal and flow to the wellbore.

Monitoring of water levels in surrounding wells was conducted during the extraction trials conducted in 2004. The following responses were noted:

- Water levels did not change in a shallow bore (inferred to have been installed into the alluvial soils) located approximately 200 m north of LMG03;
- Water and gas began producing from core hole DDH20C, an exploration hole located approximately 400 m north of LMGC03. The core hole was an unsealed, open borehole which penetrated into the coal seams at depth. The release of gas and water is inferred to be due to the partial dewatering of one of more of the coal seams stimulated at LMG03 and intersected by the core hole, allowing the methane (and entrained water) to flow from the hole. The core was subsequently sealed and cemented to DPI Guidelines; and
- An unnamed core hole located approximately 300 m south of LMG03 had part of its PVC surface casing raised out of the ground during the extraction trial. As with the response at DDH20C, the casing was likely to have been raised due to gas and water pressure building up in response to localised dewatering of the coal seams stimulated at LMG03 and intersected by the core hole.

The responses observed during the initial extraction trials indicate the following with respect to the coal seam hydrogeology:

- While dewatering of the coal seams completed in LMG03 was observed to have taken within the vicinity of LMG03 as evidenced by the two open core holes producing gas and water due to the dewatering, no drop in the alluvial aquifers was noted indicating that communication is unlikely to exist between the deep bedrock aquifers and the alluvial aquifers; and

- Dewatering during the trial does not appear to have affected the water levels in the alluvial aquifer, suggesting the rocks overlying the coal seams form a relatively impermeable confining layer. Consequently, shallow groundwater discharge into local creeks (if present) is also likely to have been unaffected (assuming groundwater within the alluvial soils is the only source of discharge into the streams).

It is noted that the open exploration holes within the vicinity of a proposed well will be seal and cemented to DPI guidelines. .

Based on extraction trials, approximately 2 ML of water is expected to be produced per day from the Stage 1 GFDA. Once extraction commences in the Concept Area (up to 300 wells, including the Stage 1 GFDA), produced water could be expected to be in the order of 6 ML per day, however this would be subject to further investigations as part of future project applications. The management and treatment of produced water is discussed in **Chapter 12**.

13.3 Potential Impacts

13.3.1 Stage 1 GFDA

The Stage 1 GFDA will comprise the installation of up to 110 producing wells and a gathering system. Due to the steeply dipping nature of the underlying strata, the total depth of the producing wells will vary, with the deepest wells being installed to the west of the Stage 1 GFDA and more shallow wells being installed to the east of the area where the dipping strata approaches the surface.

The production well design allows for the installation, and subsequent cementing of the casing which not only provides support for the well when subjected to the pressures associated with well completion and production operations, but would also maintain the integrity of aquifers that may be intersected (i.e. any intersected aquifers would be effectively isolated from the borehole).

The potential adverse impacts which may result from gas field development and methane extraction and mitigation measures for these potential impacts are provided in **Table 12-3**. The extraction of groundwater in association with the gas will result in drawdown of groundwater levels from within the deep bedrock aquifer (coal measures) in the vicinity of the well. As the number of operational wells increase (up to 110 in the Stage 1 GFDA), so too will the volume of groundwater being extracted and the subsequent area of drawdown. However, the lowering of groundwater levels is expected to predominantly affect the deep bedrock aquifer from where the groundwater is being extracted, and as the aquifer is not used for beneficial use in the vicinity of the Project area (due to its significant depth and brackish nature), adverse impacts are not expected.

Water quality of the bedrock aquifers (shallow and deep) is saline and becomes more saline with depth. Again, potential for cross contamination of groundwater aquifers would be minimised through the use of a pressure-rated steel casing in the production well design. All wells would be cased-off and cemented in accordance with the requirements of the DPI. The steel casing allows the Proponent to isolate specific horizons of interest from the other formations intersected by a well.

Table 13-1: Potential Impacts and Proposed Mitigation Measures

Potential Impact	Mitigation Measure
Dewatering of shallow aquifers	Production well design effectively seals overlying aquifers through installation of casing and cementing. Ensure production zones chosen are below identified beneficial aquifers and are not in communication with identified beneficial aquifers. Wells with higher than average water production rates would be investigated and if beneficial aquifers were suspected of being dewatered, remedial action would be implemented to seal these coal seams from production.
Increased aquifer permeability as a result of the fraccing and removal of groundwater	Data from the pilot testing discussed above indicate little if any response in the wells monitored.
Reduction in stream (base) flow if dewatering of the alluvial and shallow aquifers occurs as a result of fraccing and gas extraction	Monitoring of stream flow and water quality to occur during development.
Surface storage leakage of saline groundwater	Installation of appropriate low permeable lining (e.g. High Density Polyethylene liner) in proposed storage dams.

13.3.2 CPF

The construction of the CPF would involve clearing, grading and excavation works which would disturb the surface and subsurface soils. However, due to the limited depth of excavation required for CPF construction, the alluvial aquifer present at approximately 10 m depth is unlikely to be encountered.

Water collected from the wellheads will be transferred to a central storage through water gathering lines. The Proponent has an existing storage of 40 ML at the Stratford Pilot Project which may be utilised, however additional water storages may be required.

Depending on the construction of the water storages, the infiltration of water could cause mounding of the alluvial and shallow bedrock aquifers, raising water levels in the immediate vicinity of the ponds. In addition, the infiltration from surface water storages of saline groundwater from the deep bedrock aquifer (coal measures) could potentially impact shallow groundwater quality. Additional water storages for produced water will therefore be lined with a suitable impermeable liner to eliminate interaction with the local alluvial aquifer.

13.3.3 Pipeline

As described in **Chapter 5.6**, construction of the gas pipeline would involve clearing, grading and excavation works which would disturb surface and subsurface soils. The excavation methodology is detailed in **Section 5.6**. The maximum excavation depth of the trench required for construction of the pipeline is not likely to exceed 3 m.

It is unlikely that groundwater would be intercepted during excavation works for the pipeline along much of its alignment due to the shallow extent of excavation required. However, shallow groundwater levels may be encountered in the southern section of the pipeline where the pipeline passes through an estuarine landscape featuring tidal creeks and swamps on its approach into Hexham. The construction of the pipeline in an estuarine environment is not expected to impact groundwater levels or quality.

Due to the limited extent of excavation required for installation of pipelines, aquifer systems are not expected to be encountered in the pipeline project area. Potential impacts and management of saturated soils associated with the tidal creeks and swamps the pipeline will pass through are discussed in **Chapter 17**.

Adverse groundwater impacts resulting from construction of the pipeline are not anticipated.

13.4 Management of Impacts

13.4.1 Stage 1 GFDA

A Groundwater Management Plan would be prepared prior to the commencement of works as part of the CEMP/OEMP for the Project and would include:

- Details on the installation of a network of nested piezometers (within the target coal seams and shallow aquifers) to allow for monitoring of changes in water levels and quality in response to operations;
- A schedule for the monitoring of water levels prior to gas extraction in the Stage 1 GFDA to establish baseline groundwater conditions in both newly installed piezometers and existing bores, to enable assessment of changes in aquifer water levels in the vicinity of the Stage 1 GFDA;
- A schedule for the collection of groundwater samples from selected piezometers and wells to assess changes in water quality from aquifers present in the vicinity of the Stage 1 GFDA;
- Response procedure and management measures that would be implemented in the event that adverse impacts to groundwater are detected through the piezometer network or water quality monitoring programme;
- Wells with higher than average water production rates would be investigated and if beneficial aquifers were suspected of being dewatered, remedial action would be implemented to seal these coal seams from production;
- Contingency measures that would be implemented if the piezometer network indicated adverse impacts to shallow aquifers currently in use by surrounding property owners; and
- 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.

Further investigations would be undertaken on the regional hydrogeological characteristics of the area, and results would be incorporated into the Groundwater Management Plan where required.

13.4.2 CPF

Adverse impacts from the construction and operation of the CPF are not anticipated, with the potential exception of the ponds to be used to store groundwater extracted from the coal measures.

Water storages constructed and lined in accordance with current standards will limit infiltration of the extracted saline groundwater, which will in turn minimise the mounding of underlying groundwater levels and impacts to groundwater quality.

The installation of monitoring piezometers in the vicinity of the water storages and implementation of a Groundwater Management Plan will enable any adverse impact to be readily identified and managed.

13.4.3 Pipeline

Adverse groundwater impacts resulting from construction of the pipeline are not anticipated.

13.5 Conclusion

The hydrogeology of the Project Area is influenced by the geology which comprises steeply dipping strata and major faulting and fracturing. The faulting known to exist within the Gloucester Basin is likely to have resulted in the development of secondary permeability and localised increases in aquifer hydraulic conductivities. The faults, if filled with weathered material (generally of a much lower permeability than the surrounding rock) would also act as a barrier to groundwater flow.

The construction of the CPF and the pipeline are not expected to adversely impact the groundwater regime. The use of surface water storages to store saline groundwater extracted from the coal seams may result in the infiltration of saline waters to shallow aquifers. This may cause localised groundwater mounding in the vicinity of the ponds and may adversely impact groundwater quality. Construction of the water storages with an appropriate lining would mitigate these impacts.

Impacts to the groundwater regime including increased localised permeability and lowering of water levels may be experienced within the deep bedrock aquifer following fraccing and groundwater extraction from the target coal seams. However, as the deep aquifer is not used for any beneficial use within the vicinity of the Project area due to its depth and poor water quality, these impacts are expected to be of no significant consequence.

Fraccing of the coal seams for the extraction of gas is to occur deeper than the identified beneficial aquifers. As such, dewatering of beneficial aquifers as a result of fracture propagation is not expected. Furthermore the design of the production wells allows for the installation of casing which would maintain the integrity of aquifers.

The implementation of a Groundwater Management Plan would enable the groundwater regime in the vicinity of the Stage 1 GFDA and CPF to be monitored and any adverse impacts readily identified and managed.

14.0 Noise and Vibration

An assessment of the potential noise and vibration impacts of the project was undertaken by Atkins Acoustics and Associates Pty Ltd (Atkins). The assessment considers the construction and operational noise associated with the various project components. This chapter provides a summary of the noise assessment, the potential impacts identified and mitigation measures recommended. The full technical report, including methodology employed and details of all criteria and sound power levels, is provided in ***Appendix H****.*

14.1 Concept Area

The character of the Concept Area in terms of broad land use, residential density and road usage is similar to that described for the Stage 1 GFDA, CPF and HDS areas. The Concept Area encompasses largely rural/agricultural land, however the township of Gloucester, land owned by Gloucester Coal Ltd. and certain land zoned for environmental protection is also included within this area which extends as far north as Barrington but lies just to the east of the village. Ambient noise within the Concept Area is expected to be largely similar to that predicted for the Project Area.

The activities proposed within the Concept Area comprise the construction and operation of further gas wells and water and gas gathering lines. Potential noise impacts associated with the future development of the Concept Area would include:

- Construction works for additional gas wells; and
- Operation of the additional gas wells.

These potential impacts would be similar to those anticipated for the activities within the Stage 1 GFDA assessed in the following sections and would be managed in a similar fashion.

The pipeline, CPF and HDS for the current project application would be adequate to process the additional gas from the Concept Area and as such additional noise impacts are not anticipated for these components. The potential noise impacts relating to the CPF, pipeline and HDS are detailed in **Section 14.5** and safeguards provided in **Section 14.6.** Detailed noise assessment of future stages of the project would be undertaken as part of subsequent project applications; however the results of the noise assessment undertaken as part of this EA and future monitoring undertaken in respect of the Stage 1 GFDA, CPF and HDS would be incorporated into the planning of future stages within the Concept Area.

14.2 Project Area

14.2.1 Potentially Affected Receivers

Stage 1 GFDA and CPF

Residential receivers in the vicinity of the Stage 1 GFDA and the two potential CPF sites are shown in **Figure 14.1.** The proposed well site locations would generally be situated greater than 200 m from sensitive residential receivers in accordance with the locational principles for this Project (refer to **Section 5.2**). The nearest residential receiver to the CPF Site 1 is 1300 m and the nearest residential receiver to the CPF Site 7 is 460 m. Receivers identified for the purposes of the noise assessment in respect of the Stage 1 GFDA and CPF sites and their relative distance from the CPF sites are shown in **Table 14-1**.

Table 14-1: Identified Noise Receivers from CPF and Stage 1 GFDA

Reference Assessment Location	Reference Measurement Location #	Distance from CPF (m)
CPF Site 7 and Stage 1 GFDA		
P1	R2	1100
P2	R1	520
P3	R8	460
P4	-	1700
P5	-	1600
P6	-	1300
CPF Site 1 and Stage 1 GFDA		
P7	-	1900
P8	R5	1500
P9	-	1800
P10	R4	1400
P11*	-	480
P12	-	1600
P13	R7	1300
P14	-	1500

*P11 – This receptor is not considered a sensitive receiver as it is owned by the Proponent and is not inhabited.

Reference Measurement Locations indicate receptors at which background monitoring was undertaken.

The receptor locations were selected to provide information on the existing noise levels in areas with the most potential to be impacted by noise from the Stage 1 GFDA and CPF sites. The measurement locations selected include rural areas with limited traffic flows, areas exposed to road traffic noise and areas exposed to mining activities thus representing a range of ambient noise environments existing in the areas surrounding the Stage 1 GFDA and CPF.

Pipeline Corridor

Built up areas along the pipeline corridor include Nelson, Duckenfield, Woodberry and Tarro. Typically, residences are located in excess of 200 m of the centre-line of the proposed pipeline corridor, however some isolated residences are located within 30-100 m of the proposed route. The noise and vibration assessment therefore considered proposed construction activities and noise levels at various off-set distances to represent potential receiver locations. A detailed noise and vibration management plan would be prepared to ensure the management of potential impacts of the pipeline construction.

HDS

The HDS is located in an area zoned and developed with a mixture of industrial and residential uses. The area is subjected to noise from road traffic (Old Maitland Road and Pacific Highway) and local industrial activities. Receivers identified for the purposes of the noise assessment in respect of the HDS are provided in **Table 14-2**.

Table 14-2: Identified Noise Receivers from HDS

Reference Assessment Location	Reference Measurement location #	Distance from HDS (m)
P15 Tomago Caravan Park	R9	1300
P16 Punt Road	-	150
P17 217 Old Maitland Road	R10	330

Reference Measurement Locations indicate receptors at which background monitoring was undertaken.

14.3 Existing Environment

14.3.1 Local Meteorological Conditions

Stage 1 GFDA and CPF Site 1 and Site 7

Site investigations confirmed that the Gloucester area is subject to seasonal prevailing winds and temperature inversions. It is recognised that the effects of meteorological conditions can enhance or reduce noise propagation and noise experienced at distant receptors. In the near field, wind has minor influence on measured down wind sound levels. Wind effects become more important as distances increase. Depending on wind speed and distance from a noise source, up wind noise measurement levels compared to down wind conditions can vary by ±10dBA. Temperature gradients create similar enhancement effects to wind, however the effects are generally less than wind effects and uniform in all directions.

Hexham Delivery Station

The Hexham area in the vicinity of the HDS is also subject to seasonal prevailing winds and temperature inversions.

In accordance with INP procedures meteorological conditions have been analysed and considered as part of the noise assessment. Detailed information on prevailing wind and atmospheric stability is provided in the full noise and vibration assessment included as **Appendix H**.

14.3.2 Ambient Noise Environment – Stage 1 GFDA and CPF Sites and HDS

An assessment of the existing ambient noise was undertaken as part of the noise and vibration assessment to assist in the assessment of potential noise impacts from the proposed Stage 1 GFDA, CPF sites and HDS. The measurements included attended audits to identify sources contributing to the ambient noise and unattended noise monitoring. The results of monitoring were evaluated in accordance with the INP to confirm the Rating Background Levels (RBLs) and ambient noise levels.

The receptors in the Stage 1 GFDA consist mainly of rural residences, however receptors in proximity of CPF Site 7 which are located in proximity to the Stratford Colliery may be impacted by some background noise from mining activities. The results of ambient noise monitoring are detailed in **Appendix H** and are shown in **Table 14-3** for CPF Site 1 and **Table 14-4** for CPF Site 7. Residential properties in the vicinity of CPF Site 1 identified as being exposed to existing industrial/mining noise sources include R1, R2, and R8.

Table 14-3: Rating Background Levels (RBL) at CPF Site 1 (September 2008)

Reference Assessment Location	Reference Measurement location	Rating Background Level (RBL) (dBA)		
		Day	Evening	Night
P2	R1	37.6	40.0	37.2
P1	R2	35	34.0	31.2
P3	R8	34.5	35.2	34.5

Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays

Evening: 6.00pm to 10.00pm

Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays

Table 14-4: Rating Background Levels (RBL) at CPF Site 7 (September 2008)

Reference Assessment Location	Reference Measurement Location	Rating Background Level (dBA)		
		Day	Evening	Night
P10	R4	30.4	32.2	31.3
P8	R5	30.6	31.5	31.1
P13	R7	31.6	32.8	31.3

Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays

Evening: 6.00pm to 10.00pm

Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays

The measurement results for CPF Site 1 and Site 7 show that the evening RBLs are typically marginally higher than the daytime levels. This finding is not uncommon for rural areas where the ambient noise can be influenced by the wind in trees/grass and distant noise sources influenced by wind direction changes.

Receptors in the vicinity of the HDS are situated in proximity to the industrial area and surrounding road network and experience these background noise levels. The results of ambient noise monitoring are detailed in **Appendix H** and are shown in **Table 14-5** for the HDS. Receptor R10 near the HDS is affected by existing industrial noise sources.

Table 14-5: Rating Background Levels (RBL) at the HDS

Reference Assessment Location	Reference Measurement Location	Rating Background Level (dBA)		
		Day	Evening	Night
P15 Tomago Village Caravan Park	R9	49.9	47.5	45.7
P17 217 Old Maitland Road	R10	43.7	45.3	39.7

Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays

Evening: 6.00pm to 10.00pm

Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays

14.3.3 Ambient Noise Environment - Pipeline

As discussed previously in this chapter, the noise and vibration assessment considered proposed construction activities and noise levels at various off-set distances to represent potential receiver locations along the pipeline route.

Potential noise impacts in respect of the proposed pipeline have been assessed to identify the cause of potential noise impacts and methods to manage noise.

14.4 Project Noise Goals

The full technical report in **Appendix H** provides a detailed outline of all project noise goals for:

- Construction noise at the Stage 1 GFDA, both CPF sites, pipeline and HDS;
- Operational noise at the Stage 1 GFDA, both CPF sites, pipeline and HDS;
- Vibration, including annoyance and structural damage criteria; and
- Blast assessment goals including air-blast over pressure and ground vibration.

Construction

For major construction projects undertaken in NSW, DECCW recommends procedures for assessing noise are undertaken in accordance with the *Interim Construction Noise Guideline* (2009). The primary objective of the *ICNG* is aimed at managing noise from construction works regulated by the DECCW.

The procedures and recommendations published in the ICNG for assessing noise from construction activities are best regarded as planning tools. They are not mandatory, and their application for assessing construction noise is not determined purely on the basis of compliance or otherwise with numerical noise levels.

For the purpose of assessing and managing noise impact the ICNG procedures refer to the proposed construction hours and the duration of the works. For construction works extending more than three weeks a 'quantitative assessment method' is recommended. For construction works that are unlikely to affect an individual or sensitive land use for more than three weeks in total, the ICNG refers to a 'qualitative assessment method'.

The ICNG refers to quantitative assessment methods involving predicted noise levels and comparing them with levels developed from Chapter 4 of the Guideline. For assessment purposes the Rating Background Level (RBL) is used when determining the management assessment level.

The qualitative method for assessing noise is used for construction sites that are not likely to affect an individual or sensitive land use for more than three weeks. Where residences may be affected by noise, work practice methods should be considered and a community notification program be implemented together with a Noise Management Plan.

It should also be noted that the DECCW recognises that construction noise by nature is temporary and not always amenable to controls applied to permanent industrial sites. As such there is limited opportunity to reduce noise from construction activities, and DECCW recognises that the goals are not always satisfied.

Where feasible and reasonable measures have been considered and the noise level is predicted to be more than the target management level, the DECCW recommends that the proponent consult with the community.

Operation

An operational noise assessment has been undertaken in accordance with DECCW's Industrial Noise Policy (INP). With respect to what is considered to represent the current best practice for assessing environmental noise, the main aims are to control intrusive noise and manage increases in ambient noise (noise creep) from industrial sources. The intrusiveness of a noise is considered to be acceptable if the LAeq, 15 min level does not exceed the RBL by more than 5dBA.

In order to preserve noise amenity, the INP recommends that LAeq level from industrial sources should not normally exceed the recommended acceptable noise level assessed over the relevant assessment period, i.e. day, evening and night. Where existing LAeq levels are controlled by industrial noise, and the level approaches or exceeds the recommended acceptable level, noise assessment goals for new sources are normally set below the existing LAeq level in order to limit any further increase or noise "creep". Meeting the INP acceptable levels would normally protect the community from annoyance.

14.4.1 Stage 1 GFDA and CPF Sites 1 and 7

Construction

The construction project noise goals for the Stage 1 GFDA and CPF Site 1 and 7 are provided in **Table 14-6** below.

Table 14-6: Construction Noise Target Goals – Stage GFDA, CPF Site 1 and Site 7

Period	Sound Pressure Levels (dBA)				
	Existing RBL	Existing Amenity Level L_{Aeq}	Daytime Noise Goal L_{Aeq}	Evening Noise Goal L_{Aeq}	Night Noise Goal L_{Aeq}
CPF Site 1					
Reference Measurement Location R1 (Assessment Location P2)					
Day	37.6	57.1	48		
Evening	40.0	52.2		45	
Night	37.2	47.4			42
Reference Measurement Location R2 (Assessment Location P1)					
Day	32.1	49.6	42		
Evening	35.3	48.6		40	
Night	31.4	46.8			36
Reference Measurement Location R8 (Assessment Location P3)					
Day	34.5	57.1	45		
Evening	35.2	52.2		40	
Night	34.5	47.4			40
CPF Site 7					
Reference Measurement Location R4 (Assessment Location P10)					
Day	30.4	49.7	40		
Evening	32.2	39.8		35	
Night	31.3	43.4			35

Period	Sound Pressure Levels (dBA)				
	Existing RBL	Existing Amenity Level L_{Aeq}	Daytime Noise Goal L_{Aeq}	Evening Noise Goal L_{Aeq}	Night Noise Goal L_{Aeq}
Reference Measurement Location R5 (Assessment Location P8)					
Day	30.6	56.1	41		
Evening	31.5	52.7		36	
Night	31.1	49.9			36
Reference Measurement Location R7 (Assessment Location P13)					
Day	31.6	57.1	42		
Evening	32.8	45.4		37	
Night	31.3	46.4			36

Operation

The operation project noise goals for the CPF are provided in **Table 14-7** below. It is noted that Section 1.4.1 of the Industrial Noise Policy (INP) in relation to operational noise, recognises that in setting assessment goals, the levels established in accordance with the INP procedures are best regarded as planning tools. The levels determined in accordance with the recommended procedures are not mandatory, and an application for a noise producing development is not determined purely on the basis of compliance or otherwise of noise goals. Other factors that need to be taken into account in the determination include economic consequences, other environmental effects and the social worth of the proposal.

Table 14-7: Operational Project Noise Goals - CPF Sites 1 and 7

Period	Sound Pressure Levels (dBA)				
	Existing RBL	Existing Amenity Level L_{Aeq}	Recommended Amenity Goal L_{Aeq}	Intrusive Goal L_{Aeq}	Project Noise Goals L_{Aeq}
CPF Site 1					
Reference Measurement Location R1 (Assessment Location P2)					
Day	37.6	63.4	55	43	43
Evening	40.0	56.8	45	43	43
Night	37.2	61.6	40	42	42
Reference Measurement Location R2 (Assessment Location P1)					
Day	32.1	49.6	55	37	37
Evening	35.3	48.6	45	37	37
Night	31.4	46.8	40	36	36
Reference Measurement Location R8 (Assessment Location P3)					
Day	34.5	57.1	55	40	40
Evening	35.2	52.2	45	40	40

Period	Sound Pressure Levels (dBA)				
	Existing RBL	Existing Amenity Level L_{Aeq}	Recommended Amenity Goal L_{Aeq}	Intrusive Goal L_{Aeq}	Project Noise Goals L_{Aeq}
Night	34.5	47.4	40	40	37
CPF Site 7					
Reference Measurement Location R4 (Assessment Location P10)					
Day	30.4	49.7	50	35	35
Evening	32.2	39.8	45	35	35
Night	31.3	43.4	40	35	35
Reference Measurement Location R5 (Assessment Location P8)					
Day	30.6	56.1	50	36	36
Evening	31.5	52.7	45	36	36
Night	31.1	49.8	40	36	36
Reference Measurement Location R7 (Assessment Location P13)					
Day	31.6	57.1	50	37	37
Evening	32.8	45.4	45	37	37
Night	31.3	46.4	40	36	36

Notes: Daytime: 7.00am to 6.00pm Monday to Saturday, 8.00am to 6.00pm Sunday and Public Holidays.
Evening: 6.00pm to 10.00pm.
Night: 10.00pm to 7.00am Monday to Saturday, 10.00pm to 8.00am Sunday and Public Holidays

14.4.2 HDS

Construction

The construction project noise goals for the HDS are provided in **Table 14-8** below.

Table 14-8: Construction Noise Target Goals – HDS

Period	Sound Pressure Levels (dBA)				
	Existing RBL	Existing Amenity Level L_{Aeq}	Daytime Noise Goal L_{Aeq}	Evening Noise Goal L_{Aeq}	Night Noise Goal L_{Aeq}
Reference Measurement Location R9. Tomago Village Caravan Park					
Day	49.9	55.4	60		
Evening	47.5	55.2		53	
Night	45.7	55.1			53
Reference Measurement Location R10. 217 Old Maitland Road					
Day	43.7	56.0	54		
Evening	45.3	51.8		50	
Night	39.7	52.9			45

Operation

The operation project noise goals for the HDS are provided in **Table 14-9** below.

Table 14-9: Operation Noise Target Goals – HDS

Period	Sound Pressure Levels (dBA)				
	Existing RBL	Existing Amenity Level L_{Aeq}	Recommended Amenity Goal L_{Aeq}	Intrusive Goal L_{Aeq}	Project Noise Goals L_{Aeq}
Reference Measurement Location R9 (P15 Tomago Village Caravan Park)					
Day	49.9	55.4	60	55	55
Evening	47.5	55.2	50	53	45
Night	45.7	55.1	45	51	45
Reference Measurement Location R10 (P17 217 Old Maitland Road)					
Day	43.7	56.0	60	49	49
Evening	45.3	51.8	50	50	42
Night	39.7	52.9	45	45	43

14.5 Potential Impacts

14.5.1 Stage 1 GFDA

Construction

Construction activities associated with the Stage 1 GFDA which have the potential to generate noise include:

- Site preparation activities including earthworks and movement of heavy vehicles;
- Production well drilling;
- Production casing running and cementing;
- Well completion which may include perforating and fracture stimulation, or an alternative completion;
- Installation of pumps and surface facilities; and
- Site cleanup and rehabilitation.

For the Stage 1 GFDA development, generally, a single vertical well head is proposed at each well site location. However, subject to geological and environmental constraints, co-location of up to four wells may occur at each well site, therefore potential noise impacts of this arrangement have been considered as a worst case scenario.

The construction of each well, including site preparation, drilling, completion and clean up is expected to take between 6 to 8 weeks per well site location if 24 hour drilling is utilised and up to 10 weeks if daytime drilling is utilised. Details of the construction process and a description of the specific activities involved is provided in **Section 5.4** of the EA. Typical plant and equipment to be used for the construction and completion of wells within the Stage 1 GFDA and associated sound power levels are shown in **Appendix H.**

Predicted noise levels resulting from the Stage 1 GFDA construction activities, relative to the distance from the construction works are shown in **Table 14-10** below. The construction noise target goals for the Stage 1 GFDA, as shown in **Table 14-6** range between 40 – 43 dBA (daytime), 35 – 37 dBA (evening) and 35 – 36 dBA (night).

Table 14-10: Predicted Noise Levels from Construction Activities - Stage 1 GFDA - dBA

Construction Activity	Distance from Construction Activity (m)						
	25	100	250	500	1000	2000	3000
Access track construction	78	66	58	52	46	40	36
Site clearing	83	71	63	57	51	45	41
Site Preparation / clean up	77	65	57	51	45	39	35
Well construction (including drilling)	79	67	59	53	47	41	37
Fraccing	91	79	71	65	59	53	49
Gas Gathering System installation	73	61	53	47	41	35	31

Noise controls and mitigation requirements during the well head development would be considered on a site-specific basis and managed in accordance with a Noise Management Plan. As part of the NMP additional ambient background noise monitoring would be undertaken to confirm site specific target assessment goals. For the purpose of this assessment the range of ambient background noise levels presented in **Table 14-6** have been adopted to develop the construction target noise assessment goals.

As shown in the table above, the modelling results indicate that noise levels during construction activities associated with the Stage 1 GFDA would exceed the construction noise target goals at some residential properties without secondary noise controls, depending on the relative distance to the activity. It is noted however, that sound power levels were taken from non-attenuated drilling equipment.

General principles that are available to reduce noise from drilling activities involve maximising benefits from directivity characteristics of drilling rig, location of offices and other ancillary buildings to provide shielding, ‘cut & fill’ operations in the formation of the work pad to maximise shielding for exposed residential receivers and the location of excavated fill material and/or installation of temporary noise walls. Sound attenuated drill rigs would be used as a standard for this project and therefore noise levels are anticipated to be lower than those predicted.

Fraccing would require the use of secondary noise controls such as portable acoustic screens to minimise noise impacts. Activities would be undertaken with the use of screens and other mitigation. Where exceedances are unavoidable, consultation would be undertaken with the landowner to ensure that the potential impacts are minimised. The short term nature of fraccing, limited to three to four hours per well site means that potential impacts resulting from this activity would be felt for a limited time only with no residual impact beyond completion of the works.

Noise controls and mitigation requirements would be considered on a site-specific basis and managed in accordance with a Noise Management Plan. Well site construction would be undertaken with the goal of achieving compliance with relevant criteria. Where compliance cannot be achieved at a receptor with all feasible and reasonable mitigation in place, consultation would be undertaken with the affected receptor to manage noise impacts during construction. Options such as restricting the use of certain equipment and timing of activities likely to generate significant noise impacts would also be considered to minimise noise impacts.

Where practical and feasible, plant selections, temporary noise controls and work practices would be considered to minimise noise impacts. With the adoption of acoustic screens, work practices and plant with acoustic enclosures, noise could be sufficiently managed during the construction period. During evening and night time hours, drilling would be undertaken using sound attenuated drilling equipment and portable acoustic barriers. Where exceedances occur, drilling outside of typical construction hours would take place in consultation with affected landowners.

Further mitigation measures in respect of construction noise for the Stage 1 GFDA are outlined in **Section 14.6**.

Construction Traffic

Vehicle movements associated with the initial delivery of plant and equipment for the drilling phase of the development are detailed in **Chapter 16** and **Appendix H.**

Each mobilisation of drilling plant for each well site location would require some 62 heavy vehicle movements and there may be a need for this equipment to travel off-site onto the surrounding local road network in order to access other well sites within the Stage 1 GFDA, however this is expected to occur infrequently.

For the traffic noise modelling it was assumed that construction activities could generate up to 30-40 car movements per hour with 10% heavy vehicles. With an average pass-by traffic speed of 50kph, the predicted LA_{eq} 1 hour at 30 m of 51dBA satisfies the daytime 55/60dBA target noise assessment goals for local and collector roads, respectively. Passby LA_{max} noise levels from cars and trucks at 30 m are predicted to range between 56-72dBA as indicated in **Appendix H**

Operation

Based upon observations and measurements taken from the Proponents existing pilot wells, the main operational noise sources associated with the Stage 1 GFDA are the valves and the pump-motor. Typical sound power levels associated with this plant is shown in **Appendix H.**

The results of nearfield noise measurements confirmed that the equivalent sound power level from the well head plant was 70dBA 10^{-12} Watts. The sound power level for the generator if installed would be in the order of 75-80 dBA. At 50 m from the well head the predicted equivalent sound pressure level is in the order of 35-38dBA. Considering the distance separation to existing residential dwellings, noise from the Stage 1 GFDA well network would be described as minimal and low risk in terms of potential impacts. Noise modelling would be undertaken during the detailed design phase to ensure that project noise goals are satisfied.

Given that the nearest identified residential receptor is located no closer than 200m as part of the locational principles from the nearest indicative well site location, the noise impacts of an operating well upon surrounding residential properties is well within the operational project noise goals for all identified receptor locations and is considered to be insignificant.

Considering the spacing between well heads (generally 600 m), it is not anticipated that there would be any measurable cumulative noise effects from the well network. Considering the distance separation to existing residential dwellings, noise from the Stage 1 GFDA well network would be described as insignificant and low risk in terms of potential noise impacts.

The co-location of up to 4 wells at each well site location has also been considered as a worst case scenario. The assessment concluded that the equivalent operational noise level for four operating wells at 100 m is predicted to be approximately 29-32 dBA or similar to noise levels experienced in a quiet bedroom.

Decommissioning and Rehabilitation

Decommissioning and rehabilitation of the Stage 1 GFDA may result in certain minor and temporary noise impacts, similar to those predicted for the site clean up activities during the construction phase and would be similarly managed to ensure impacts are minimised.

14.5.2 CPF Site 1 and Site 7

Construction

The construction of the CPF would involve a number of potential noise generating activities including:

- Site preparation;
- Foundation preparation;
- Concrete pours;
- Erection of structures;
- Installation of plant and surface facilities; and
- Site clean up.

Construction of the CPF would be undertaken over an approximately 12 month period. Hours of work would typically be daytime hours as specified in **Chapter 5**. For the purposes of assessment of construction noise, typical plant noise levels in relation to the CPF are shown in **Appendix H.**

The CPF construction would require delivery of construction plant and materials to the site prior to construction which would represent the main traffic volumes in respect of the CPF facility (refer to **Chapter 16** and **Appendix H**). The CPF construction would also generate some 36 light vehicle movements per day over the anticipated construction period of 12 months although traffic would be staggered to reflect the construction program.

Noise modelling for traffic from the project assumed a worst case scenario, that construction activities could generate up to 30-40 car movements per hour with 10% heavy vehicles. With an average pass-by traffic speed of 50kph, the predicted LA_{eq} 1 hour at 30 m of 51dBA satisfies the daytime 55/60dBA target noise assessment goals for local and collector roads, respectively.

The predicted noise levels resulting from the CPF construction are shown in **Table 14-11** below. The daytime target assessment noise goals for the Stage 1 GFDA (including CPF Sites 1 and 7) range between 40 – 43 dBA for CPF Site 1 and 45 – 48 dBA for CPF Site 7 (refer **Table 14-6**).

Table 14-11: Predicted Noise Levels from Construction Activities – CPF Sites 1 and 7

Construction Activity	Distance from Construction Activity (m)						
	25	100	250	500	1000	2000	3000
Access track construction	76	64	56	50	44	38	34
Site preparation	80	68	60	54	48	42	38
Civil and construction	83	71	63	57	51	45	41

Noise level predictions may exceed the target assessment noise goals at some receivers during construction activities. Noise controls and mitigation would be managed in accordance with a NMP which would form part of the CEMP for the project. Where practical and feasible, plant selections, temporary noise controls and work practices would be considered to minimise noise impacts. To manage noise impacts during the construction of the CPF consultation would be undertaken with affected landowners. With the adoption of acoustic screens, work practices and plant with acoustic enclosures, noise could be sufficiently managed during the construction period.

Operation

The main operational noise sources associated with the CPF plant would be related to the gas powered generators, compressors, compressor cooler fans, pumps, fans and valves. In order to ameliorate operational noise, a number of measures have been incorporated into the preliminary design of the plant including:

- Acoustic enclosures;
- Low noise rated valves; and
- Low noise rated compressors, fans and pumps.

Appendix H presents a summary of manufacturers and measured sound power data adopted for noise modelling of the CPF and assessing compliance with the project operational noise goals.

Noise from the two potential CPF sites was modelled with the DECCW approved ENM computer model. Section 5.3.1 of the INP guidelines recommends that atmospheric stability and wind effects be assessed when they occur for 30% of the time or more in any assessment period or season. Considering the meteorological and seasonal wind data, calm conditions and north, northeast and northwest winds have been assessed together with Class E temperature inversions. The meteorological scenarios modelled are detailed in **Appendix H** and in **Table 14-12**

Noise contour plots produced from the ENM modelling are presented in **Figure 14.1** for calm conditions. The contours are presented for descriptive and visual purpose only. **Table 14-12** presents a summary of the predicted noise level contributions from each of the potential CPF sites. Exceedences of the relevant Project Noise Goals are indicated in bold.

Table 14-12: Predicted Sound Pressure Level Contributions from CPF Sites 1 and 7

Description	Predicted Sound Pressure Level Contributions (dBA)							Project Noise Goal (dBA)		
	Meteorological Conditions									
	1	2	3	4	5	6	7	Day	Evening	Night
CPF Site 1										
P7	29	31	30	27	27	30	29	36	36	36
P8	34	34	32	30	30	34	32	36	37	36
P9	30	32	32	31	31	31	31	35	37	36
P10	**44**	**45**	**46**	**45**	**45**	**45**	**45**	36	36	36
P11	24	21	24	27	27	26	29	36	36	36
P12	31	27	29	34	34	35	**37**	37	38	36
P13	28	24	26	30	30	30	31	36	36	36
CPF Site 7										
P1	28	25	23	24	24	29	25	37	39	36

Description	Predicted Sound Pressure Level Contributions (dBA)							Project Noise Goal (dBA)		
	Meteorological Conditions									
	1	2	3	4	5	6	7	Day	Evening	Night
P2	38	42	41	36	36	41	37	43	45	42
P3	40	**46**	**44**	39	39	**43**	**42**	40	40	37
P4	26	32	32	30	30	30	31	35	35	35
P5	26	32	33	32	32	30	32	35	35	35
P6	31	35	36	35	35	34	**36**	35	35	35

1. Calm (day/evening): relative humidity of 60%, and air temperature of 20°C;
2. Northeast wind (summer/evening): 2m/sec, relative humidity of 60%, and air temperature of 20°C;
3. North wind (summer/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
4. Northwest wind (autumn/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
5. Northwest wind (spring/night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
6. Temperature gradient 2°C/100m elevation, relative humidity of 60%, and air temperature of 15°C, and
7. Temperature gradient of 2°C/100m elevation, 2m/sec northwest wind, relative humidity of 60%, and air temperature of 15°C.

The noise modelling summarised in Table 17 for CPF Site 7 show that the recommended project noise goals are exceeded at the P3 residence. A marginal (1 dBA) noise exceedance is predicted at the P6 residence when the effects of prevailing north winds and temperature inversions are considered. The noise modelling results identified that the generators, compressors and compressor cooling fin fans contribute to the predicted noise exceedances. To achieve an additional 9-10dBA cumulative noise reduction, the generator and compressor noise controls require upgrading. Management options that could be considered to reduce the site noise emissions include upgraded acoustic treatments, and built structures around the generators and compressors.

The noise modelling summarised in **Table 14-12** for CPF Site 1 show that the project noise goals are exceeded at P10 for calm and adverse meteorological conditions. The plant contributing to the predicted noise exceedances include the generators, compressors and compressor cooling fin fans. To achieve the 10dBA site noise reduction, the generator and compressor enclosures and compressor cooling fin fan noise controls would require upgrading and/or secondary noise control structures.

The noise modelling results identified that the generators, compressors and compressor cooling fin fans contribute to the predicted noise exceedances. A 10 dBA noise reduction is required to achieve noise goals at these locations. To achieve the additional 10 dBA cumulative noise reduction the generator and compressor enclosures would be upgraded and the fans reselected or located to maximise screening by on-site structures.

The results of the noise modelling show that, with the upgrading of the compressor and generator acoustic enclosures and additional compressor cooling fan noise controls as described, the project noise goals would be satisfied. As part of the project design development and assessment when final details of the plant and equipment are confirmed, a further noise assessment would be undertaken to establish and confirm the extent of noise mitigation required.

14.5.3 Pipeline

Construction

The construction of the pipeline would involve a range of potentially noise generating activities including:

- Site access and clearing;
- Site levelling using graders, excavators and bulldozers;
- Trenching;
- Delivery of pipe and pipe stringing (including welding);
- Laying of pipe and backfilling; and
- Temporary work areas and a construction camp.

Where required, preparation of working areas would utilise a front end loader and/or dozer. Should rock be encountered, use of rock hammers or small explosive blast may be required.

Construction of the pipeline would be undertaken on a scrolling basis over a period of approximately 12 months. Construction works would typically be undertaken on a 37 day cycle with crews working 28 days on followed by 9 days off as described in **Section 5.6**. It is envisaged that potential impacts from construction activities would occur at any one location for a period of some 3 weeks.

Typical plant and equipment to be used during the construction of the pipeline and associated sound power levels are detailed in **Appendix H.**

Vehicle movements on public roads associated with the construction of the pipeline and laydown areas would be largely generated through the initial delivery of plant, equipment and materials as detailed in **Chapter 16** and **Appendix H**. Where possible, delivery of materials, plant and equipment for pipeline construction would be made outside of peak transport times to minimise potential disturbances to local traffic.

The traffic noise modelling indicated that the daytime 55/60dBA target noise assessment goals for local and collector roads are satisfied (refer to **Appendix H**).

A summary of predicted noise levels arising from pipeline construction activities at reference distances from construction is shown in **Table 14-13**. The results do not consider attenuation from topography or ground absorption. The target assessment noise goal in accordance with the INCG is RBL + 10 dBA. In the absence of background noise monitoring, the background RBL is assumed to be 30 dBA. As such, a target noise goal of 40 dBA would apply.

Table 14-13: Predicted Noise Levels from Construction Activities - Pipeline

Construction Activity	Distance from Construction Activity (m)						
	25	100	250	500	1000	2000	3000
Access track construction	72	60	52	46	40	34	30
Vegetation clearing	83	71	63	57	51	45	41
Earthworks	76	64	56	50	44	38	34
Pipe installation	77	65	57	51	45	39	35

Where practical and feasible, plant selections, temporary noise controls and work practices would be considered to minimise noise impacts. This would typically involve orientation of equipment, staging of activities, shielding and minimisation of simultaneous operations. To ensure noise levels are controlled and impacts managed during construction a CEMP would be prepared and implemented, which would include a NMP.

As discussed in **Section 14.3.2**, residences along the pipeline route are typically located in excess of 200 m from the pipeline, however there are some isolated residences within this distance. Exceedances of the target daytime construction noise goal are therefore expected during the construction period however these impacts would be temporary and generally short term. Mitigation measures in respect of construction noise for the pipeline are outlined in **Section 14.6.3**.

Construction of the gas transmission pipeline would also include crossing a number of watercourses and road/rail infrastructure which would require horizontal directional drilling (HDD) and thrust boring techniques. These activities would require twenty four (24) hour construction to maintain the integrity of the borehole. Construction periods of up to two months may also be required. Sufficient detailed design and planning has not yet been undertaken to determine the exact locations of these works, and would be dependent on factors including crossing depth, pipe diameter, setback distances from the crossing location as well as other design factors.

A noise impact assessment would be undertaken for HDD and thrust boring activities prior to construction as part of a Noise Management Plan, which would be included within the Construction Environmental Management Plan (CEMP). This would include identification of sensitive receptors, background noise monitoring (if required), prediction of noise levels and design of mitigation measures to manage noise impacts from these construction activities.

Vibration

The main source of ground vibration that has been identified and assessed is associated with the use of rock hammers.

During the excavation and construction activities associated with access tracks and preparation of trenches, it would be necessary to use plant and equipment that would generate ground vibration. To evaluate the likely effects of the construction activities, the vibration levels shown in **Appendix H** (Tables 21 and 23) have been included in the assessment.

Ground vibration from rock hammers could range up to 0.5mm/sec at a distance of 20 m, and would be below 0.3mm/sec at forty 40 m. Vibration levels at these distances satisfy the structural damage assessment goals and are expected to be acceptable from a human disturbance point of view.

Blast Assessment

Confined blasting may be required to remove rock outcrops and excavate footings. Blast holes would be drilled and filled with an explosive charge and detonated with the aid of primers and detonators. Impacts associated with blasting normally relate to air blast overpressure and ground vibration.

The results of the air-blast overpressure assessment show that the DECC/ANZECC air-blast overpressure goal (115dBLin) can be satisfied with the employment of controlled MIC's (1-3kg) at a distance of 200 m.

The results of the ground vibration assessment indicate that the DECC/ANZECC ground vibration goal (5mm/sec) is satisfied with the employment of controlled MIC's (1-3kg) at a distance of 200 m.

Operation

Once operational, noise relating to the pipeline would be negligible, therefore operational noise is not considered in relation to the pipeline.

14.5.4 Hexham Delivery Station

Construction

The construction stages for the Hexham site would include minor site preparation, concrete pours, installation of pipework and site cleaning up.

Table 14-14 presents the calculated noise levels from each phase of the site works. The target construction noise goal is 54 dBA.

Table 14-14: Predicted Noise Levels from Construction Activities - HDS - LAeq dBA

Construction Activity	Distance from Construction Activity (m)		
	100	250	500
Access construction	58	50	44
Earthworks	65	57	51
Civil and construction	69	61	55

Noise from the envisaged civil and construction works is predicted to satisfy the target daytime noise goal (54dBA) at the closest residential dwelling, P17, on Old Maitland Road. The target noise goal would be exceeded at P16 without mitigation measures in place, however with the adoption of acoustic screens, work practices and plant with acoustic enclosures, it is anticipated that that the target construction noise could be achieved.

Where practical and feasible, plant selections, temporary noise controls and work practices would be considered to minimise noise impacts.

The HDS construction would require delivery of construction equipment and various plant and construction materials to the site. Deliveries would be staggered to reflect the construction program with the site preparation equipment delivered first. The traffic noise modelling indicated that the daytime 55/60dBA target noise assessment goals for local and collector roads are satisfied (refer to **Appendix H**).

Operation

The main operational noise sources associated with the HDS include gas heaters, valves, fittings and radiated noise from pipe trains. Operational noise from the HDS would be dependent on design factors including the number of process trains, gas flow pressure and velocities, valve types, pipe sizes and the location of bends and valves. Configurations would be modelled during the detailed design phase, which would inform the final design, selection and configuration of plant to achieve the noise goals.

Appendix H presents a summary of manufactures and measured sound power data adopted for noise modelling and assessing compliance with the project noise goals.

Noise from the HDS was modelled with the DECCW approved ENM computer model. Noise contour plots produced from the ENM modelling are presented in **Appendix H** for calm wind conditions and shown in **Figure 14.2**. The contours are presented for descriptive and visual purpose only. For assessment purposes the closest residential dwellings were evaluated and three reference locations selected to model and assess operational noise contributions from the HDS. Two operational scenarios were modelled, high volume flow and low volume flow, to give an indication of different operational scenarios. **Table 14-15** presents a summary of the predicted noise level contributions from the HDS with exceedences highlighted in bold. The meteorological scenarios modelled are detailed in **Appendix H** and in **Table 14-15**

Table 14-15: Predicted Sound Pressure Level Contributions from the HDS during Operation

Reference Measurement Location	Reference Assessment Location	Predicted Sound Pressure Level Contributions (dBA) Meteorological Conditions						Project Noise Goals (dBA)
		1	2	3	4	5	6	
High Volume Flow								
-	P16 Punt Road	**68**	**65**	**66**	**70**	**69**	**70**	43
R10	P17 Residence Old Maitland Road	**59**	**59**	**60**	**63**	**60**	**65**	43
R9	P15 Tomago Village Caravan Park	34	30	30	44	38	**49**	45
Low Volume Flow								
-	P16 Punt Road	**46**	41	42	**47**	**47**	**48**	43
R10	P17 Residence Old Maitland Road	35	34	36	41	36	43	43
R9	P15 Tomago Village Caravan Park	14	9	10	24	19	30	45

1. Calm : relative humidity of 60%, and air temperature of 20°C;
2. Northeast wind (evening): 2m/sec, relative humidity of 60%, and air temperature of 20°C;
3. North North East wind (evening): 2m/sec, relative humidity of 60%, and air temperature of 20°C;
4. West North West (night): 2m/sec, relative humidity of 60%, and air temperature of 15°C;
5. Temperature gradient 2°C/100m elevation, relative humidity of 60%, and air temperature of 15°C, and
6. Temperature gradient of 2°C/100m elevation, 2m/sec northwest wind, relative humidity of 60%, and air temperature of 15°C.

The noise predictions show that the project noise goals are exceeded at the closest residential properties (P16 and P17) for calm and adverse meteorological conditions. With respect to the site boundaries that are shared with industrial and commercial properties the project noise goals are exceeded without the inclusion of secondary noise controls. The main sources contributing to the predicted noise exceedances include the valves, fittings and radiated noise from pipe trains.

As the distribution station design would be site specific and dependent on final operational specifications the design and noise control requirements would be determined during the detail design phase. Secondary controls could include the reselection of valves and fittings, design of pipe trains to reduce velocities and turbulence, lagging pipes and acoustic rated compound walls/mounds. Mitigation measures in respect of operational noise for the HDS are outlined in **Section 14.6.**

As part of the project design, development and assessment when final details of the plant and equipment are specified and the project noise goals confirmed, a more detailed noise assessment would be undertaken to establish and confirm the extent of noise mitigation required for the CPF and HDS. During the detailed project design phase, the acoustic investigations would assess for the need to adjust the source noise to account for tonality, impulsiveness, intermittency, irregularity or low-frequency content.

14.5.5 Summary of Predicted Impacts

Construction Noise

The findings of the assessment with respect to construction noise are summarised as follows:

- Noise modelling for the Stage 1 GFDA indicates that exceedances of the daytime target noise goal for construction would occur during some activities, depending on the distance to sensitive receptors. Consultation with affected landowners would be undertaken to ensure that impacts during this period are minimised.
- During evening and night time hours, drilling would be undertaken with the use of secondary noise controls such as portable acoustic screens. Where exceedances are unavoidable, drilling outside of typical construction hours should be undertaken only with the agreement of affected landowners.
- Fraccing would require the use of secondary noise controls such as portable acoustic screens to minimise noise impacts. Activities would be undertaken with the use of screens and other mitigation. Where exceedances are unavoidable, consultation would be undertaken with the landowner to ensure that the potential impacts are minimised. The short term nature of fraccing, limited to three to four hours per well site means that potential impacts resulting from this activity would be felt for a limited time only with no residual impact beyond completion of the works.
- It is not anticipated that the construction activities would generate vibration levels that would impact on existing residential dwellings.
- Noise from the HDS construction is predicted to satisfy the target daytime noise goal (54dBA) at the closest residential dwelling P17 on Old Maitland Road.
- Traffic noise would satisfy the daytime target noise assessment goals for local and collector roads, respectively.

Whilst there are noted exceedances and therefore potential noise impacts related to the construction phase of the project, it is important to note that these impacts would be temporary and generally short-term. Mitigation and management measures would be implemented to assist with the minimisation of these impacts and upon completion of the construction phase any such impacts would cease.

Operational Noise

Field audits undertaken at the existing pilot well sites identified that the main operation noise sources are associated with valves and the pump-motor. At 40 m from the well head the measured equivalent sound pressure level was less than 30dBA. At some well heads, 4 wells could be sunk; the equivalent noise level from 4 pumps at 100 m is predicted to be at 29-30dBA. Considering the approximate 600 m spacing between well heads, it is not anticipated that there would be measurable cumulative noise effects from multiple well systems.

The main operation noise sources associated with the CPF plant include generators, compressors, compressor cooler fans, pumps, fans and valves. The generators and compressors would be housed in individual acoustic enclosures and the compressor fin cooling fans selected on acoustic performance. The results of noise modelling show that with additional engineering noise controls and effective shielding from the site layout, the project noise goals are satisfied.

The main operational noise sources associated with the HDS include the gas heaters, valves, fittings and radiated noise from pipe trains. The noise predictions show that the project noise goals are exceeded at the closest residential properties to the HDS for calm and adverse meteorological conditions. Additional engineering noise controls would be required for the project noise goals to be satisfied which would be determined during detail design phase of the project.

The investigations have revealed that there would be no significant operational noise sources or noise impacts arising from the gas transmission pipeline.

Interpretation of Noise Impacts

In order to assist with understanding of the predicted noise levels resulting from the proposed project, **Table 14-16** relates sound pressure levels to typical noise sources and a subjective evaluation.

Table 14-16: Range of Typical Noise Sources

Sound Pressure Level (dBA)	Source Description	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Very noisy
110	Grinding on steel	Very noisy
100	Loud car horn at 3 m	Noisy
90	Construction site with pneumatic hammering	Noisy
80	Kerbside of busy street	Loud
70	Loud radio or TV	Loud
60	Department store	Moderate to quiet
50	General office	Moderate to quiet
40	Inside private office	Quiet to very quiet
30	Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

14.6 Environmental Safeguards

The design of the various project components, including the siting of the CPF, well site locations, gathering lines, access roads and the pipeline route has included extensive consultation with potentially affected landowners in order to establish landowner concerns and preferences and has been based upon detailed constraints analysis including a consideration of the potential for noise impacts. As such, the design and planning process itself represents a safeguard against significant noise impacts.

A constraints analysis and consultation with potentially affected landowners would also be undertaken when determining the location of the two construction workforce camps. A noise assessment may be incorporated into the construction workforce management plan to ensure that potential noise impacts to nearby residences are assessed and are acceptable.

However, it is recognised that there would be certain noise impacts as a result of the proposed project, largely related to the construction phase. As operational impacts in relation to noise are not expected to be significant, management during the operational phase would be limited to a noise monitoring program to validate the predicted noise levels from the CPF and Stage 1 GFDA and to ensure that noise levels remain within the relevant project noise goals.

The following safeguards are proposed in respect of the various components of the project to ensure that these impacts are minimised.

General

The following general safeguards would be implemented in relation to the potential noise impacts of the proposed project:

- A Noise Management Plan (NMP) would be prepared in respect of the project to address construction noise and vibration, and methods to minimise impacts. The NMP would be prepared in consultation with relevant authorities such as the DECCW and construction contractors. As part of the NMP, the following would be addressed:
  - selection of plant and equipment where practical on acoustic performance;
  - noise certification of all site plant and equipment prior to commencing site work and regular monitoring to ensure equipment noise emission levels do not deteriorate due to poor maintenance or damage;
  - work practices to minimise potential noise and vibration impacts;
  - a monitoring program to ensure that construction noise and vibration emissions are controlled and that the best possible practices are implemented;
  - noise and vibration monitoring shall be conducted in response to community complaints and at the request of the DECC. Reports of investigations shall be provided to the DECCW upon request;
  - site noise and vibration training and awareness program for all staff and contractors engaged during construction;
  - development and implementation of a public relations program to inform residents and the community of the progress of activities and potential noise and vibration impacts of each phase of the project; and
  - the establishment of procedures to address noise and vibration complaints received from the public during the construction period.

During the detailed project design phase of the project, the acoustic investigations would assess for the need to adjust the source noise to account for tonality, impulsiveness, intermittency, irregularity or low-frequency content.

14.6.1 Stage 1 GFDA

The following safeguards would be implemented in relation to the Stage 1 GFDA:

- Fraccing to be undertaken only during daytime hours, subject to geological conditions. Fraccing at times would be required to extend into the evening as the fracc process can not be interrupted once commenced. Scheduling of fraccing would be required to ensure that adequate daylight is remaining prior to commencing the frac process. Secondary noise controls such as portable acoustic screens would be utilised for fraccing activities where required;
- Drilling activities shall be undertaken during evening and night time hours only where project noise goals can be achieved or as otherwise agreed with affected landowners;
- Secondary noise controls such as portable acoustic screens would be installed for drilling activities as appropriate; and
- Activities associated with the construction of access tracks and the clearing of vegetation would be undertaken during daytime hours only.

14.6.2 CPF

The following safeguards would be implemented in relation to the CPF:

- The Proponent shall undertake a detailed assessment for the acoustic design measures required for the CPF plant to ensure that operational noise levels are maintained within the relevant project noise goals;
- Following final plant selection and detailed design, the Proponent shall commission a further detailed operational noise assessment of the CPF plant to establish and confirm expected operational noise levels and inform detailed design of noise mitigation for the plant;
- The Proponent shall undertake a program of noise monitoring once the CPF is operational in order to validate the design and mitigation measures applied to the facility. Details of the monitoring frequency would be detailed in the NMP, however it is anticipated that the Proponent would rigorously monitor noise at the commencement of the operation of the CPF followed by monitoring on a quarterly basis for a period of 12 – 24 months. If required, further mitigation may be recommended following the monitoring program to ensure that operational noise is maintained at an acceptable level. After 24 months of operation and when the CPF is operating consistently within the noise goals, external validations would be undertaken on a yearly basis; and
- Upgrading of acoustic enclosures for the power generators and compressors to achieve project noise goals if required.

14.6.3 Pipeline

The following safeguards would be implemented in relation to the pipeline:

- Construction activities to be limited to daytime hours only, with the exception of HDD where continuation of the process is necessary to ensure integrity of the borehole;
- Advanced notification of commencement of construction works to be provided to potentially affected landowners (generally those within 2 km of the pipeline construction works) indicating the length of time during which impacts may be experienced, the nature of potential impacts and a contact number for complaints to be recorded and responded to;
- No use of rock hammers within 20 m of a residence;
- No blasting to be undertaken within 200 m of a residence; and
- A noise impact would be undertaken to assess potential impacts associated with HDD and thrust boring techniques during construction of the pipeline.

14.6.4 HDS

The following safeguards would be implemented in relation to the HDS:

- The Proponent shall undertake a detailed assessment for the acoustic design measures required for the HDS plant to ensure that operational noise levels achieve relevant project noise goals. Secondary controls could include the reselection of valves and fittings, design of pipe trains to reduce velocities and turbulence, lagging pipes and acoustic rated compound walls or mounds;
- During construction, plant selections, temporary noise controls and work practices would be considered to minimise noise impacts; and

- The Proponent shall undertake a program of noise monitoring once the HDS is operational in order to validate the design and mitigation measures applied to the facility. Details of the frequency of monitoring would be detailed in the NMP, however these would likely be similar to those for the CPF as indicated above. If required, further mitigation may be recommended following the monitoring program to ensure that operational noise is maintained at an acceptable level.

14.7 Residual Impacts

As discussed previously in this chapter, the proposed project would result in some noise impact during the construction phase, with exceedances predicted for certain activities at certain distances from the location of construction. The implementation of recommended mitigation measures during the construction period would aim to minimise these impacts and maintain noise levels within the project noise goals as far as possible. Exceedances experienced during the construction period would be temporary and generally short-term, ceasing upon completion of construction activities. Given the generally low density of population in the area surrounding the Stage 1 GFDA, CPF, pipeline, and HDS residual impacts associated with the construction period would not be widespread and would likely be limited to isolated residences.

Operational noise impacts related to the Stage 1 GFDA and pipeline are expected to be minimal and manageable with no significant residual impacts. Operational noise impacts associated with the CPF and HDS would generally be managed through plant selection and site layout to be finalised during the detailed design phase and would be subject to a monitoring program to ensure that no significant residual impacts remain.

Decommissioning and rehabilitation of the Stage 1 GFDA may result in certain minor and temporary noise impacts, similar to those predicted for the site clean up activities during the construction phase and would be similarly managed to ensure no significant residual impacts.

14.8 Conclusion

The greatest potential for noise impacts arising from the project are related to the construction phase. These impacts would be temporary and generally short-term. To control environmental noise impacts during construction, a NMP would be prepared, including the development and implementation of a public consultation program to inform residents and the community of the progress of activities and potential noise and vibration impacts of each phase of the construction.

The potential noise impacts of the operational, decommissioning and final rehabilitation phases of the project are expected to be manageable through the implementation of appropriate mitigation measures and are not expected to result in significant adverse impacts.

Initial noise impacts associated with the future development of the Concept Area are expected to be similar to those predicted for the Stage 1 GFDA and would be managed through a similar process. Detailed noise assessment of future stages of the project would be undertaken as part of subsequent project applications, however the results of the noise assessment undertaken as part of this EA and any future monitoring undertaken in respect of the Stage 1 GFDA would be used to inform the design and siting of future stages within the Concept Area.

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15.0 Hazard and Risk

A Preliminary Hazard Analysis (PHA) was prepared in respect of the proposed project by Sherpa Consulting and is provided in ***Appendix I****. This chapter provides a summary of the PHA including a description of the study scope and methodology used, identification of hazards, consequence assessment and the findings of the quantitative risk assessment. The chapter also provides recommended mitigation measures in respect of hazard and risk and draws conclusions with regard to the residual risks of the Project in this regard.*

15.1 Concept Area

Potential hazards and risks associated with the Concept Area would be associated with development of gas wells to be constructed in future stages of the Concept Area. There would be a need for an update to the PHA to reflect the future stages of the Project and this would be undertaken as part of future project applications.

15.2 Study Scope and Methodology

As set out in **Chapter 6** of this EA, this project is defined as ‘petroleum production’, ‘petroleum production related works’ and ‘utility installation’ under relevant EPI’s. *Applying SEPP 33 – Hazardous and Offensive Development Application Guidelines* notes that SEPP 33 applies to developments that would be defined as ‘industry’ under the applicable EPI’s which this Project is not. As such, SEPP 33 may not strictly apply. However, a PHA has been prepared in accordance with the Director-General’s EARs for the proposed development, in order to adequately assess the potential hazards and risks in support of appropriate site location and management and mitigation protocols.

The PHA prepared by Sherpa Consulting assessed the following Project components:

- Above ground gas wellheads (in order to take account of potential future development within the Concept Area, the assessment considers up to 4 wells per well site location);
- Gas gathering lines;
- CPF at either CPF Site 1or CPF Site 7, including the eight compressor units;
- Gas transmission pipeline; and
- HDS.

The PHA was prepared in accordance with relevant NSW Department of Planning guidelines including *Hazardous Industry Planning Advisory Paper* (HIPAP) No. 6 – *Guidelines for Hazard Analysis*, HIPAP No. 4 – *Risk Criteria for Land Use Safety Planning* and *Multi Level Risk Assessment.* The following methodology was adopted for the purposes of the study:

- Establish the context, including level of assessment and risk tolerability criteria;
- Undertake hazard identification for the proposed development and identify a list of credible scenarios for carrying forward for quantification of consequences and likelihood;
- Undertake a consequence analysis for the identified credible scenarios. Where off-site impact is found to have the potential to occur, carry the scenario forward for frequency analysis;
- Undertake frequency analysis for the scenarios with the potential for off-site impact;

- Undertake quantitative risk assessment by combining the off-site scenario consequences and their associated frequency in order to generate risk contours for the well head, CPF and HDS and risk transects for the gas gathering system and the gas transmission pipeline;
- Assess the risk to neighbouring land uses against the NSW DoP Land-Use Safety Planning risk tolerability criteria; and
- Make recommendations for risk reduction, where the risk is found to be intolerable.

15.2.1 Level of Assessment

There are three levels of risk assessment set out in *Multi Level Risk Assessment* which may be appropriate for a PHA, as detailed in **Table 15-1** below:

Table 15-1: Level of Assessment - PHA

Level	Type of Analysis	Appropriate if:
1	Qualitative	No major offsite consequences and societal risk is negligible.
2	Partially Quantitative	Offsite consequences but with low frequency of occurrence.
3	Quantitative	Where level 1 and 2 are exceeded.

The PHA has been undertaken as a Level 2 assessment.

15.2.2 Risk Criteria

The risk criteria set out in the NSW DoP HIPAP No. 4 – *Risk Criteria for Land Use Safety Planning* were adopted for the purposes of the PHA in accordance with the Director-General's EAR's for the Project. The criteria are summarised in **Table 15-2** below.

Table 15-2: NSW Land-Use Planning Individual Fatality Risk Criteria

Risk Levels (per annum)	Land-Use	Limit of Exposure at the Following Locations
0.5×10^{-6}	Sensitive	Hospitals, child-care.
1.0×10^{-6}	Residential	Residential developments and places of continuous occupancy such as hotels and tourist resorts.
5×10^{-6}	Commercial	Commercial developments, including offices, retail centres, warehouses with showrooms, restaurants and entertainment centres.
10×10^{-6}	Active open space	Sporting complexes and active open space areas.
50×10^{-6}	Industrial	Site boundary.

15.3 Existing Environment

15.3.1 Concept Area

The land uses surrounding the Concept Area comprise mainly agricultural and rural residential land uses. The PHA has been undertaken in consideration of the surrounding land uses of the Project Area (refer below). However, future assessments to support project applications for additional well locations within the Concept Area would include the same locational principles as for the Stage 1 GFDA with regard to hazard and risk. Future project applications with respect to the Concept Area would include details that are broadly similar to the assessment set out below.

15.3.2 Project Area

Stage 1 GFDA

The land uses surrounding the proposed Stage 1 GFDA comprise mainly agricultural and rural residential land uses. Indicative well locations have been chosen in consideration of environmental constraints and in consultation with landowners with a minimum buffer of some 200m maintained between well heads and residences. This buffer distance has been developed specifically for this Project. The PHA was undertaken in respect of these surroundings.

CPF

The land uses surrounding each of the potential CPF sites (CPF Sites 1 and 7) comprise mainly agricultural, mining and rural residential land uses (refer to **Section 11.3.1**).

The CPF Site 1 is located on land that is currently owned by the Proponent and is known as the Tiedeman Property. CPF Site 1 is currently vacant, consisting of mainly grassland on relatively flat terrain with the nearest residence being some 1300 m to the north.

The CPF Site 7 is located on land currently owned by Gloucester Coal, on a parcel of land adjacent to a rail loop which currently services Stratford Colliery. The site is currently vacant and consists predominantly of grassland with some scattered sparse vegetation and with the nearest residence being some 460 m to the south-west.

The PHA was undertaken in respect of these surroundings.

Pipeline and HDS

The land uses surrounding the proposed gas transmission pipeline comprise mainly agricultural and rural residential land uses. The proposed pipeline runs in close proximity to certain residences along the route, including some within 30 m. In the far south, the proposed route runs through established industrial land in close proximity to a variety of industrial premises. The HDS is situated within this industrial context. The PHA was undertaken in respect of these surroundings.

15.4 Potential Impacts

The PHA identifies potential hazards which could arise from the different components of the proposed development. A comprehensive hazard identification table for the well sites, gathering lines, CPF, pipeline and HDS is provided as an appendix to the PHA, attached to this EA as **Appendix I**.

However, the major potential hazards are discussed in more detail in the following sections and are largely related to the potential for release of methane, a highly flammable (hydrocarbon) gas and simple asphyxiant.

15.4.1 Potential Releases from Well Sites, CPF and HDS

The potential exists for methane release from well sites, the CPF and the HDS under the following scenarios:

- Loss of containment during pigging operations;
- Loss of containment from pipework (from holes in pipework due to corrosion, impact, etc.);
- Loss of containment from flanged connections, valves, filters, meters, heaters due to flange leaks, instrument tapping point failures etc;
- Gas migration through geological faults, disused wells and coal holes; and
- External events such as bushfire, ground movement, lightning, flooding.

There is potential for bushfire or grassfire to impact on the operations of the Stage 1 GFDA (well site locations and CPF), however, the wellheads and the gas gathering lines would contain protective fire-safe ball valves and other fire-safe components, therefore, such an event would not compromise the integrity of the well infrastructure. Additionally, as part of the operational management measures, the area within the security fencing would be gravelled and controlled for weed and grass regrowth to minimise the incidence of fires and bushfire or grassfires in the general area.

15.4.2 Potential Releases from the Gas Gathering System and Gas Transmission Pipeline

There is potential during the operation of the gathering lines and gas transmission pipeline for a release of methane gas to the atmosphere and subsequent ignition. Based upon a literature review undertaken as part of the PHA, the main cause of pipeline leaks is due to external mechanical damage as a result of third party impact on the pipeline. There are over 21,000 km of major gas transmission pipelines in Australia and very few incidents have been reported for these pipelines. The main types of failure incident reported both in Australia and overseas are:

- External interference by heavy equipment (e.g. mechanical damage to pipe during excavation by third parties;
- Scour damage (e.g. river bed scouring, exposing and damaging pipes);
- Construction and material defects;
- Internal and external corrosion and stress corrosion cracking;
- Subsidence damage (e.g. banks and levees washing away, exposing and damaging pipes, mine subsidence, construction work near the pipeline);
- Faulty construction (e.g. welding defects, lack of weld testing);
- Ground movement (e.g. buckled pipework from excessive ground movement from earthquakes, slips and ground subsidence);
- Error during ‘hot tapping’ in which a pipeline is tied-in to another ‘live’ pipeline;
- Fracture failure due to fatigue from pressure cycling; and
- Stress corrosion cracking from pressure cycling.

Should such a methane release occur under one of the above scenarios from well sites, CPF, HDS, pipeline or gas gathering lines, the following may result:

- Jet fire, if ignited immediately. Heat radiation from the jet fire would impact people within the vicinity of the release;
- Flash fire, if ignition is delayed. If ignition is delayed a vapour cloud may form, however as natural gas is buoyant and would disperse easily, the potential for a significant cloud build up is low. Ignition of such a vapour cloud could result in a flash fire. In the event of a flash fire there is a high chance of fatality within the vapour cloud but due to the short duration of the flame there is a low chance of significant impact outside the vapour cloud radius;
- Vapour Cloud Explosion (VCE) if a flash fire occurs within a congested or confined plant area. The proposed well sites, CPF and HDS equipment layouts and the pipeline and gas gathering lines do not generate significant congestion and therefore, there is a very low likelihood of VCE. Further, the compressor enclosures would be mechanically ventilated and would be provided with a trip for ventilation failure, gas detection and fire detection, such that the potential for enclosure confined-space explosion is minimised. As such, the potential for explosion overpressure was not considered further in the PHA.

The design of gas gathering lines and the gas transmission pipeline (including pipe diameters and specifications and minimum depth of cover) are summarised in **Chapter 5** of this EA and **Appendix I.** Any construction occurring in class T1 areas (towns) would not use excavators larger than 30-40 tonnes. Larger equipment would only possibly be used for major industrial developments which are unlikely to be encountered along the majority of the pipeline route. In the case of such development occurring in the vicinity of the pipeline, additional procedural controls would be implemented to minimise the potential for impacts.

Similarly, the potential for impact upon the pipeline from high vehicle loads is considered to be negligible due to the inherent structural integrity of the transmission pipeline (which is much higher compared with typical vehicle loading). Gathering lines would not be exposed to significant roads and rail crossing loads. Overall, the design of the gathering lines and transmission pipeline is such that there would be a minimal likelihood of rupture due to external impact, however a range of mitigation measures has been recommended in **Section 15.5** to further minimise this risk.

Similarly, the likelihood of scour damage near watercourses is considered to be minimal due to the small catchment area available near the pipeline. There is potential for pipeline flotation near swampy land, encountered largely in the southern section of the pipeline route. The potential for pipe exposure due to scouring and flotation is however, considered to be low due to the structural integrity of the large-diameter, heavy walled transmission pipeline and the pipeline design measures emplaced at watercourse crossings (refer to **Section 5.6.4**). Regular pipeline patrols as recommended in **Section 15.5** would further reduce this risk.

In terms of construction and material defects, the gathering lines and transmission pipeline would be hydrostatically tested to a stress level equal to 100% of Specified Minimum Yield Strength (SMYS). This would provide assurance that the integrity is not compromised by residual flaws that could grow to failure as a result of fatigue.

The potential for pipeline corrosion is generally manageable through design and management measures such as pipeline coating and testing. Residual acid from acid-sulfate soils may result in pipeline corrosion, however this is generally managed by:

- Limiting excavation to minimise the length of open trenches and the time exposed in ASS affected areas;
- Lime neutralisation; and
- Spoil management, including segregated storage of acidic spoil stockpiles away from watercourses and appropriate treatment and disposal methods.

A detailed ASS Management Plan would be prepared in respect of the Project in order to adequately manage ASS in relation to pipeline construction, operation and maintenance. Further details on ASS are provided in **Chapter 17** of this EA.

The pipeline route at the northern end has been discussed with Gloucester Coal, owner of the Stratford Colliery and coal exploration leases in the centre of the Gloucester Basin. The pipeline route moves to the west and then travels south broadly over the central deep part of the Gloucester Basin. At this stage, the potential for underground mining, in the Gloucester Basin (giving rise to possible mine subsidence) is low with no commercial initiatives known to be under consideration at this time. Furthermore, if underground mining occurs, it is likely to commence in the shallow rather than the deepest parts of the basin. Accordingly, the detailed design of gathering lines and the transmission pipeline would not include specific allowance for the impact of potential future mine subsidence.

15.4.3 Location Specific Hazards

Other potential hazards specific to the locations where gathering lines and the transmission pipeline cross existing geographic features and civil-infrastructure include the following:

- Impact from vehicle loading or construction work near road and rail crossings;
- Alternating current (AC) induction effects from power lines near the transmission pipeline (not an issue for polyethylene gathering lines);
- Alternating current corrosion (not an issue for polyethylene gathering lines); and
- Stray currents from high voltage DC traction lines at the railway line (not an issue for polyethylene gathering lines).

These issues are commonly encountered in the design and construction of pipelines in Australia and as such, a range of proven mitigation measures exist which can be employed to manage the potential hazard. AC induction and corrosion are considered to be the most significant of these location-specific hazards and are discussed in more detail below.

AC Induction

The proposed pipeline route passes near 132 and 330 kV power lines and in certain locations the construction of the pipeline is to occur within the existing power line easement, adjacent to the power lines. This creates a potential hazard for construction and maintenance workers and requires specific mitigation and management measures.

AC Corrosion

AC corrosion occurs where there are exclusions or defects in the pipeline coating (known as ‘holidays’) as a result of the impact of AC induction near powerlines and may result in leaks in the pipeline in these locations. Whilst the process of AC corrosion is not fully understood, it is known to be more likely to occur under the presence of certain conditions such as high current density and low soil resistivity. The likelihood of AC corrosion occurring is considered to be low, however further assessment would be undertaken at the pipeline design stage and mitigation measures implemented to ensure that load current levels remain below the critical value which would significantly increase the risk of AC corrosion occurring.

15.5 Quantitative Risk Assessment

The partially quantitative risk assessment undertaken in respect of the Project considers the potential hazards associated with the proposed project activities, taking into account the consequences of such incidents and the predicted frequency of these events.

Quantitative risk levels were established for the proposed well site locations, the CPF and the HDS and are presented as contours indicating the risk level at any point around the facility (refer to **Figures 15.1**, **15.4**, **15.5** and **15.8** in **Appendix I**). The quantitative risk profile for the gas gathering system and gas transmission pipeline is presented as a risk transect showing the risk level that a receiver would be exposed to at any lateral distance from the pipe centreline (see **Figures 15.2**, **15.3**, **15.6** and **15.7** in **Appendix I**).

15.5.1 Risk Profile – Well Sites

A typical well site risk contour (based upon the collocation of up to 4 wells at each well site location) is shown in **Figure 15.1** of **Appendix I**. The risk assessment of the proposed well sites concluded that:

- The 0.5 x 10^{-6} per year individual fatality risk contour (sensitive land-use) was found to extend by about 40m from the centre of the well site and would therefore extend by about 12m off the boundary of the well site, assuming a 60m x 60m bounded well site area. This would not extend to any sensitive land-uses.
- The 1 x 10^{-6} per year individual fatality risk contour (residential areas) was found to extend by about 38m from the centre of the well site and would therefore extend by about 10m off the boundary of a typical well site. This would not extend to any residential areas as well sites would be located to provide a minimum exclusion zone
- The 5 x 10^{-6} per year individual fatality risk contour (commercial areas) was found to remain within the boundary of the proposed well sites and, therefore, would not have the potential to extend to any commercial land-uses.
- The 10 x 10^{-6} per year individual fatality risk contour (active open spaces) was found to remain within the boundary of the proposed well sites and, therefore, would not have the potential to extend to any active open spaces.
- The 50 x 10^{-6} per year individual fatality risk contour (industrial areas) was not generated by the well site hazard scenarios.
- Due to the negligible off-site risk, societal risk was not evaluated.
- The effects of an accidental emission of methane gas are unlikely to threaten the long-term viability of the ecosystem or any species within any sensitive natural environmental areas which may exist near the Project.

15.5.2 Risk Profile – Gas Gathering System

Risk transects were produced for the gas gathering system, showing the individual risk of fatality versus the distance from the centreline of the pipe (see **Figures 8.2** and **8.3** of **Appendix I**). The risk transects calculated for the gathering system showed that the risk of fatality would not be expected to exceed 2 x 10^{-7} per year and thus the risk tolerability criteria for fatality would not be exceeded at any:

- Sensitive land uses;
- Residential areas;
- Commercial areas;
- Active open spaces;
- Adjacent industrial facilities.

The analysis also found the fire frequencies to be low and, as such, the risk of injury and off-site accident propagation would not be exceeded at any lateral distance from the gathering system.

The effects of an accidental emission of methane gas are unlikely to threaten the long-term viability of the ecosystem or any species within any sensitive natural environmental areas which may exist near the proposed development.

15.5.3 Risk Profile – CPF

Risk contours were generated for both of the proposed CPF locations (see **Figures 15.4** and **15.5** of **Appendix I**) with the following results:

CPF Site 1

- The 0.5 x 10^{-6} per year individual fatality risk contour (sensitive land-use) was located within the boundary of the site and does not extend to sensitive land uses.
- The 1 x 10^{-6} per year individual fatality risk contour (residential areas) was located within the boundary of the site and does not extend to residential areas.
- Risk levels for other land use types (commercial, active open spaces, industrial) were located within the boundary of the site and do not extend to the relevant land use types.

CPF Site 7

- The 0.5 x 10^{-6} per year individual fatality risk contour (sensitive land-use) was located within the boundary of the site and does not extend to sensitive land uses.
- The 1 x 10^{-6} per year individual fatality risk contour (residential areas) was located within the boundary of the site and does not extend to residential areas.
- Risk levels for other land use types (commercial, active open spaces, industrial) were located within the boundary of the site and do not extend to the relevant land use types.
- Due to the remoteness of the CPF site and consequently low populations, societal risk was not evaluated.
- The effects of an accidental emission of methane gas are unlikely to threaten the long-term viability of the ecosystem or any species within any sensitive natural environmental areas which may exist near the Project.

15.5.4 Risk Profile – Gas Transmission Pipeline

Risk transects were produced for the proposed transmission pipeline (for both R1 rural and T1 town location class sections) showing the individual risk of fatality versus the distance from the centreline of the pipe (see **Figure 15.6** and **15.7** of **Appendix I**). Risk transects were produced for sections of the pipeline with marker tape and sections without marker tape.

The fatality risk contour level for sensitive land uses (5 x 10^{-7} per year) was found to extend up to 190 m from the centreline of the pipe (based upon no marker tape), however sensitive land uses (such as hospitals, schools, child care centres, aged care housing, etc) were not identified to exist within this distance.

The fatality risk contour for residential land uses (1 x 10^{-6} per year) was not generated for the pipeline sections that would be provided with marker tape and was found to extend up to 35 m from the centreline of the pipe for sections where marker tape would not be used. Residential land uses were identified to exist within 35 m, albeit at the sections of pipeline within road reserve, for which marker tape would be provided. The PHA recommended that additional measures such as an increased depth of cover and / or marker tape to be provided at all sections of pipeline that would be located within a 35 m distance of residential development.

The risk analysis (based upon no marker tape, i.e. conservative assessment) showed that the risk of fatality would meet the risk tolerability criterion at:

- Commercial areas;
- Active open spaces; and
- Industrial facilities.

The assessment found the fire frequencies to be low, therefore the risk of injury and off-site accident propagation (at a frequency of 50 x 10^{-6} per year) would not be exceeded at any lateral distance from the pipeline.

15.5.5 Risk Profile – HDS

The HDS would be located within the Hexham Port and Industry zone in which there are no sensitive, residential or commercial land uses. Risk contours generated (see **Figures 15.8** of **Appendix I**) showed the following:

- The 0.5 x 10^{-6} per year individual fatality risk contour (sensitive land-use) was found to extend off-site by a maximum of about 30m. The contour remains within the Zone 4a Industrial Area, and does not reach any sensitive land-uses;
- The 1 x 10^{-6} per year individual fatality risk contour (residential areas) was found to extend off-site by a maximum of about 20m to the southern boundary of the HDS site. The contour remains almost entirely within the Zone 4a Industrial Area and does not reach any residences;
- The 5 x 10^{-6} per year individual fatality risk contour (commercial) was found to be contained within the boundary of the HDS site and therefore does not extend to adjacent commercial zones (i.e. retail centres, office or entertainment centre);
- The risk levels for other land use types (active open spaces, industrial) were not generated for the site, i.e. risk levels at the HDS did not reach the criteria levels for these land use types at any point on the HDS site;
- The 50 x 10^{-6} per year injury risk contours and the 50 x 10^{-6} per year escalation (accident propagation) risk contours were not generated on the site; and
- Societal risk was not evaluated as there are no significant populations within the areas defined by the fatality contours.

15.6 Interpretation of Potential Impacts

The risk tolerability criteria set by the NSW DoP are chosen so as not to impose a risk that is significant when compared to the background risk to which people are normally exposed. The DoP publication *Risk Criteria for Land Use Safety Planning* provides statistical information relating to the level of risk that people may be exposed to due to a variety of day to day activities. A number of the activities listed are voluntary, for which one may accept a higher level of risk due to a perceived benefit, whilst others are involuntary. Generally, a lower level of involuntary risk is expected if a direct benefit is not perceived. A selection of these data are provided in **Table 15-3** below in order to provide perspective with respect to the land use safety planning risk criteria used to assess the potential risks associated with the proposed project.

Table 15-3: Risks to Individuals in NSW

Activity	Probability of Fatality (per annum)
Voluntary Risks (averaged over active participants)	
Smoking	5000×10^{-6}
Drinking alcohol	380×10^{-6}
Travelling by motor vehicle	145×10^{-6}
Swimming	50×10^{-6}
Playing rugby football	30×10^{-6}
Travelling by train	30×10^{-6}
Travelling by aeroplane	10×10^{-6}
Involuntary Risks (averaged over entire population of NSW)	
Cancer	1800×10^{-6}
Accidents at home	110×10^{-6}
Pedestrian struck by motor vehicle	35×10^{-6}
Homicide	20×10^{-6}
Electrocution (non-industrial)	3×10^{-6}
Cataclysmic storms and floods	0.2×10^{-6}

15.7 Environmental Safeguards

The following safeguards have been recommended to minimise the potential impacts of the proposal in relation to hazard and risk:

15.7.1 General

- The following are to be prepared/undertaken at the detailed design stage of the Project:
  - Hazard and Operability Study;
  - Final Hazard Analysis (comprising an update of the PHA prepared by Sherpa Consulting);
  - Fire Safety Study; and
  - Emergency Response Plan.
- A Construction Safety Study is to be undertaken prior to commencement of works, during the construction/commissioning stage of the Project.
- Prior to the commencement of operation of the various components of the Project, a Safety Management System would be developed in respect of the Project and an Independent Hazard Audit would be undertaken.

15.7.2 Stage 1 GFDA, CPF and HDS

The following specific mitigation measures are recommended in respect of the Stage 1 GFDA, CPF and HDS:

- Measures would be taken to ensure that no free oxygen is present in the natural gas produced by the Project;
- Hydrostatic testing of equipment would be undertaken as appropriate and in accordance with the Proponent's standard procedures;
- Security fencing would be installed around infrastructure as appropriate. This would include installation of a security fence around the HDS outside the hazardous area classified by AS 2430 to minimise risk of ignition sources;
- Vehicle barriers would be installed around infrastructure where appropriate;
- 100% radiography of circumferential welds to ensure minimal defects during construction;
- Aboveground pipework would be painted to ensure maximum visibility and for corrosion prevention;
- A regular program of maintenance/inspection of infrastructure would be adopted in accordance with the Proponent's standard procedure;
- Pressure regulating skid to be fitted with pressure control and slam-shut valve (slam-shut valve operates if pressure increases above the set point);
- Overpressure controls (such as pressure monitoring at the pressure regulating skid and control, pressure rating of equipment and pressure relief) and leak and fire protection (including instrumented protective features and fire detection) to minimise potential impacts to infrastructure from bushfires. All these measures would be controlled remotely from the CPF control room;
- Spiral wound gaskets to be fitted on high pressure flanged equipment;
- Gravel or hardstand area to be constructed inside the fenced site around gas filled equipment to minimise risk of grass fires;
- Lightning protection to be fitted as appropriate;
- Adoption of the Proponent's standard operating procedures in respect of the proposed facilities;
- Monitoring of pressure via SCADA system;
- Use of remotely operated ESD valves;
- Ignition control as per AS2430 Hazardous Area requirements;
- Appropriate separation distances to be maintained between release points and site boundary in accordance with the consequence impact distances reported in the PHA report; and
- Disused wells and coal holes encountered throughout the Stage 1 GFDA would be cemented to minimise the likelihood of gas migration. Field and aerial monitoring for vegetation dieback would also be done to identify any areas that may experience gas seepage / migration through natural faults in the geology. There has been no evidence to date of surface gas migration.

15.7.3 Gas Gathering Lines and Transmission Pipeline

The following specific mitigation measures are recommended in respect of the pipeline:

- The pipeline is to be provided with marker tape at all sections that would be located within a 35 m distance of residential development (as measured from the pipeline centreline) and or additional depth of cover in these areas;
- Appropriate safety measures to be designed and adopted for sections of the pipeline which are in close proximity to 132 and 330 kV power lines to ensure the safety of personnel and equipment. These measures may include:
  - Selective earthing at certain positions along the pipeline,
  - Installation of zinc ribbon in the pipeline trench,
  - Installation of inline isolation in the pipeline,
  - Restriction of access to the pipeline and its facilities,
  - Use of equi-potential grids or other similar safety equipment during maintenance of the pipeline, and
  - Use of lockable test points for the cathodic protection system.
- Preparation of a Construction Safety Study in respect of the pipeline. This study should address general construction safety requirements as well as specific locational hazards such as AC induction;
- The PHA would be updated when final design details are known, particularly for the operation of the flare;
- Once final design details are known, the design would be subject to a hazard and operability study (HAZOP), particularly to assess abnormal operating modes such as flare and blowdown operations;
- Pipeline to be designed and operated in accordance with AS 2885-2007. Pipeline design to meet the requirements for T1 locations, being rural areas developed for residential, commercial or industrial use, where allotments are less than 1 hectare in area and buildings do not exceed four floors;
- Regular maintenance/inspection of pipeline in accordance with the Proponent’s standard procedures;
- Relieving of stress where ground movement stresses pipework;
- Installation of marker signs and marker tape along the length of the pipeline to alert people to the presence and location of the pipeline. Signage to include details of ‘One-Call’/’Dial before-you-dig’ services;
- External surfaces of pipeline to be coated to protect against corrosion. Testing of the integrity of the coating (‘Holiday’ detection) to be carried out prior to burial of the pipeline;
- Use of sacrificial anode cathodic protection system to provide further protection against corrosion;
- Gas quality to be such that corrosion enhancing components are minimised;
- Intelligent pigging of the pipeline to be carried out to assess pipeline condition;

- Regular patrolling of pipeline by the Proponent to assess for damage or activities which have the potential to cause damage to the pipeline. Patrols would also facilitate detection of ground movement or land subsidence. Where significant ground movement is detected and stresses are determined to be high, the ground around the pipeline/gathering line would be dug up to relieve stresses;
- Pipeline design to make provision for current subsidence parameters for the location (as provided by the Mine Subsidence Board);
- Liaison with Mine Subsidence Board to determine likely future mining activity; and
- Gas gathering lines to meet the requirements of AS 2885-2007 for R1 locations.

15.8 Residual Risk

The components of the Project, including the gas wells and gathering lines, CPF, gas transmission pipeline and HDS carry the risk of certain hazards, largely related to the potential for release and ignition of methane gas. However, the PHA undertaken shows that these risks meet the relevant criteria established by the NSW DoP and can be adequately managed through the implementation of mitigation measures such that residual risks are minimal.

15.9 Conclusion

Potential hazards and risks associated with the Project were assessed in a PHA prepared by Sherpa Consulting. The PHA concludes that the off-site risk of fatality, injury, accident propagation and the risk to the biophysical environment posed by the various Project components meets the NSW DoP Land Use Safety risk tolerability criteria provided the environmental safeguards are implemented and the Project is therefore considered to be acceptable.

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16.0 Traffic and Transport

This chapter assesses the potential impacts of the Project on traffic and transport within the local and regional surrounds. Consideration is given to anticipated vehicle movements for the construction, operation and closure phases of the Project and the management of these movements to ensure the impact is minimised upon the surrounding road network. The chapter also discusses proposed access arrangements, both external and internal, for the various components of the Project.

16.1 Concept Area

The Concept Area is set within a largely agricultural / rural setting with several roadways forming the main transport routes (refer to **Section 16.2.1** below). The specific traffic and transport needs for the future development of the Concept Area would require the use of certain local and regional roads, many of which would overlap with those required for the development of the Stage 1 GFDA. However staging of the Concept Area development would be such that construction works for the proposed Stage 1 GFDA and CPF would largely be complete prior to the commencement of further development of the Concept Area. In this way, the potential impacts in terms of traffic resulting from the construction of future works within the Concept Area would not be cumulative with those predicted for the Stage 1 GFDA development.

Traffic volumes and road usage for future development of the Concept Area are anticipated to be similar to the requirements of the Project Area described below in relation to well field development and the future development and operation of the CPF and associated infrastructure. Specific details on predicted traffic volumes and an assessment of the potential traffic impacts of future development within the Concept Area would be undertaken as part of subsequent traffic assessments in support of future project applications.

16.2 Existing Road Network

16.2.1 Overview of the Existing Major Road Network

The Stage 1 GFDA (including either potential CPF site) is located some 100 km to the north of Newcastle in the Gloucester Region. The pipeline corridor begins at the CPF site and extends some 95km south to Hexham. Major roadways that service the Project Area including the Stage 1 GFDA, CPF, pipeline corridor and HDS (listed north to south) include:

- Maitland – Stroud (MR101);
- The Bucketts Way (MR90);
- Raymond Terrace – Wirragula (MR301);
- Williamtown – NR Hexham (MR302);
- Salt Ash – East Maitland (MR104);
- Pacific Highway (SH10);
- New England Highway (SH9); and
- Sydney to Newcastle Freeway (F3) (F6003).

Information on existing road usage and road capacity is provided in **Section 16.3.2.**

The Project Area lies approximately 40 km west of the Pacific Highway (SH10) with The Bucketts Way (MR90) running from Nabiac (on the Pacific Highway) to Gloucester, and then south to Karuah. It is anticipated that the majority of vehicles associated with the Project would utilise The Bucketts Way (MR90) to arrive at the Stage 1 GFDA.

16.2.2 Overview of the Existing Local Road Network

There are a range of smaller rural roadways that service the isolated residential and agricultural areas surrounding the Stage 1 GFDA and CPF site. The majority of the minor roadways in the vicinity of the Stage 1 GFDA comprise unsealed roads running in an east-west and north-south grid formation. No significant upgrades to local roads are anticipated in the Stage 1 GFDA as part of the Project, however roads would be maintained and gravelled as required to ensure suitability.

Stage 1 GFDA and CPF

The minor or local roads that are proposed for use within the Stage 1 GFDA include (refer to **Figure 16.1**):

- Jacks Road;
- Mckinleys Lane;
- Faukland Road;
- Tiedemans Lane;
- Fairbairns Roads;
- Wenham Cox Road;
- Crowthers Road;
- Avon Street;
- Wood Road;
- Bowen Road;
- Upper Avon Road;
- Woods Road; and
- Parkers Road.

The two CPF sites, Site 1 and Site 7 are both situated within the Stage 1 GFDA. Access to Site 1 to the Tiedeman's Property would be from The Bucketts Way via Wenham Cox Road. If the CPF is located at Site 1, a right hand turn slip lane for vehicles entering from the south of the site would be constructed on The Bucketts Way for access into Wenham Cox Road as shown in **Figure 16.2**.

Access to the CPF Site 7 would likely be through the adjacent property to the south of Parkers Road from The Bucketts Way as shown in **Figure 5.10**. This is due to the limited sight distances to access Parkers Road from The Bucketts Way (AECOM, 2009). An intersection upgrade may be required for access to CPF Site 7, which, if required, would include widening of the road at the proposed intersection on the The Bucketts Way, and the inclusion of a channelized right turn lane to provide a protected right hand turn onto the proposed access road for Site 7 as shown in **Figure 16.2**.

An internal road network would be constructed within the Stage 1 GFDA and CPF site to accommodate construction and operational traffic. Indicative details of internal access arrangements are provided in **Section 16.4**.

Pipeline

Access for pipeline construction would be largely over private land and would be negotiated with landowners. It is anticipated that the construction of the pipeline would commence in the northern section (near the CPF site) and would progress to the south in a sequential motion. Access for machinery and equipment to the pipeline would initially be via the same access point as for the CPF site with some access for machinery facilitated along the established ROW. Local roads would be utilised for access to the ROW along the pipeline route and some temporary access tracks would be constructed where required to facilitate access over private land. These access tracks would be sited and constructed in accordance with landowner agreements.

Access to the ROW and to laydown areas along the pipeline route would be primarily via the existing road network utilising the following roads:

- The Bucketts Way;
- The Maitland – Stroud Road;
- Raymond Terrace – Wirragula Road;
- Woodville Road;
- Salt Ash – East Maitland Road;
- New England Highway; and
- Pacific Highway.

Several minor and local roads would also be used for access to the laydown areas/construction sites off the major roadways identified above. The use of minor and local roads would be required to access various points along the pipeline route.

The following roads would be utilised during pipeline construction to access the pipeline ROW:

- Parker Road, Stratford;
- Woods Road, Craven;
- Spring Creek Road/ Berrico Road, Wards River;
- The Bucketts Way;
- Monkerai Road;
- Reidsdale Road, Stroud Road;
- Williams Road, Stroud Road;
- Stroud-Dungog Road, Stroud;
- Black Camp Road;
- Flat Tops Road;
- Black Camp Creek Road;
- Glen Martin Road;
- Limeburners Creek Road, Clarence Town;
- East Seaham Road, Clarence Town;
- Clarencetown Road, Seaham;
- Brandy Hill Dr, Brandy Hill;

- Noongah Road, Brandy Hill;
- Hinton Road;
- Duckenfield Road;
- Raymond Terrace Road;
- Turners Road;
- Woodberry Road, Woodberry;
- Nilands Lane, Woodberry;
- Old Punt Road, Tomago; and
- Old Maitland Road, Hexham.

16.2.3 Other Transport Routes

Other transport routes in the vicinity of the Project Area include the North Coast Railway Line, which provides rail transit to the NSW North Coast and Queensland, and rivers and waterways that are utilised by marine vehicles for local freight and materials movement. These routes are important to the local, regional and national transport system.

The potential impacts upon the railway network are anticipated to be negligible with rail crossings being thrust bored to allow for the continued operation of the railway during construction works. The North Coast Railway Line would be crossed in two locations. This is further discussed in **Section 16.6** and **16.7** below.

The proposed pipeline route would cross the Hunter, Williams and Karuah Rivers. These major water bodies would be crossed using HDD in order to minimise potential disturbances to the water body and allow the continued use of these waterways by commercial and recreational users. The crossing of rivers and creeks is not anticipated to impact on transport of marine vehicles given the constrcution methods and mitigations proposed (refer to **Chapter 12**).

16.3 Existing Roadway Capacity

The existing roadway capacity provides information on the construction of roadways and intended capacities for operation. The required specifications and road capacities are determined by the Projected usage of the road in relation to a State road hierarchy governed by the NSW RTA. This information can be used to assess the maximum vehicle capacity for the individual roadway and would determine limitations and restrictions for road usage.

16.3.1 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 16-1** below, indicating typical nominal volumes expressed in terms of average annual daily traffic (AADT) served by various classes of roads.

Table 16-1: Road Hierarchy Classification

Type of Road	Traffic Volume (AADT)	Peak Hour Volume (phv)
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)

16.3.2 Average Annual Daily Traffic (AADT)

The most current RTA Traffic data for the Hunter and Northern Region (2004) has been used to provide estimates of AADT for the abovementioned roadways. A summary of the data is provided in **Table 16-2** below.

Table 16-2: Average Annual Daily Traffic (AADT)

Project Area	Recording Location	2004 AADT	Road Classification
Gloucester	09.332 – The Bucketts Way	4095	Collector Road
South of Stratford	09.330 - The Bucketts Way	1555	Collector Road
Weismantles	09.919 - The Bucketts Way	1643	Collector Road
Washpool	09.929 – The Maitland – Stroud Road	399	Local Road
North of Stroud	09.916 - The Bucketts Way	2043	Collector Road
Clarencetown	05.586 – Raymond Terrace – Wirragula Road	2270	Collector Road
Seaham	05.845 – Raymond Terrace – Wirragula Road	2406	Collector Road
Raymond Terrace	05.993 – Raymond Terrace – Wirragula Road	6021	Collector Road
West of Raymond Terrace	05.150 – Salt Ash – East Maitland Road	7966	Sub-Arterial Road
North of Hexham	05.055 – New England Highway	48879	Arterial Road
South of Hexham	05.052 – Pacific Highway	52833	Arterial Road
Hexham	05.001 – Pacific Highway	37781	Arterial Road

Project Area	Recording Location	2004 AADT	Road Classification
East of Hexham	05.590 – Williamtown – NR Hexham Road	9343	Sub-Arterial Road
West of Hexham (F3)	05.018 – Sydney to Newcastle Freeway	32997	Arterial Road

Source: RTA Traffic Data for the Hunter and Northern Regions 2004

It should be noted that the RTA are currently in the process of upgrading the Sydney to Newcastle Freeway (F6003) and the Pacific Highway (SH10) to improve traffic conveyance and road services. These roadways have been identified as significant transport routes in the NSW State Strategy and capacities are being increased to accommodate projected future growth of the Sydney and Brisbane Regions. The Bucketts Way is also undergoing an upgrade funded by the Federal Government to improve road conditions along this route.

16.4 General Construction Traffic (Plant and Equipment)

The construction phase would result in the greatest increase in traffic in the vicinity of the Project Area. The construction period for the various project components is:

- Stage 1 GFDA – up to 18 months (based on the shortest and therefore most impact intense construction timeframe);
- CPF – 12 months;
- Pipeline – approximately 12 months; and
- HDS – approximately 6 months.

Later stages of the Project to be developed as part of the Concept Area are anticipated to require construction periods of a similar duration to that anticipated for the Stage 1 GFDA.

16.4.1 Stage 1 GFDA

Machinery and equipment required for the construction of the Stage 1 GFDA is set out in **Section 5.4.12** and includes:

- 2 x bulldozers;
- 2 x grading machines;
- 4 x excavators for trenching and pipe installation;
- 20 x tipping truck and dog combinations;
- 6 x articulated dump trucks (internal road use only);
- 2 x rollers (internal road use only);
- 2 x trenching machines (internal road use only);
- 1 x HDD rig;
- Hand held plant and machinery (compactors);
- Electric generators for fusion welding;
- Fusion welding machines; and
- Water trucks for dust control

The equipment would be delivered to the Stage 1 GFDA from The Bucketts Way via the local roadways identified in **Section 16.3.2** and shown in **Figure 16.1**. Internal roads/accessways within the Stage 1 GFDA would be subject to negotiation with landowners and locational principles as outlined in **Chapter 5** of this EA.

Earthmoving equipment and water trucks would be sourced locally and would therefore be transported to the site from within the Gloucester area. Specialist welding equipment would be sourced from elsewhere in the region from a source to be identified during the detailed design phase of the Project.

16.4.2 CPF

Machinery and equipment required for the construction of the CPF is set out in **Section 5.5.1** and includes:

- 1 x bulldozer;
- 2 x graders;
- 2 x rollers;
- 2 x excavators;
- 2 x bobcats;
- 1 x piling rig
- 2 x tip trucks (for transporting imported fill and base course material);
- Welding machinery;
- Electric generators for construction equipment;
- 4 x large cranes for heavy lifts;
- 1 x small cranes for small lifts;
- 1 x franner for pipe spool placement; and
- 1 x forklifts for moving equipment.

The delivery of these items to the CPF site would likely be via an access road on the adjacent property to the south of Parkers Road from the The Bucketts Way (refer to **Figure 5.10**) for CPF Site 7 and via The Bucketts Way and Wenham Cox Road for CPF Site 1. The earthmoving equipment would be delivered to the site at the start of construction to establish the hardstand areas and evaporation ponds. The cranes and forklifts would be delivered to assist with the installation of the compressors and associated infrastructure.

The grading machines, excavators, franners and forklifts would remain on the site for the duration of the construction period. The tip trucks would remain on site for up to four months, whilst the small cranes would remain for up to two months. The large cranes would be kept on site for approximately three weeks. Dispatch of equipment following use would therefore be staggered which would reduce impact upon the surrounding road network.

16.4.3 Pipeline

Machinery and equipment required for the construction of the pipeline is set out in **Section 5.6.6** and includes:

- 2 x Bulldozers;
- 3 x Grading machines;
- 2 x Trenching machines;
- 1 x Rock saw;
- 5 x Semi trailers (for pipe and materials movements);
- 5 x excavators for trenching and lifting;
- 2 x tip trucks for importing sand as padding material and soil removed;
- 2 x Mobile padding machines for backfill processing;
- 2 x Water trucks for dust control;
- 2 x Mobile welding units on trucks for pipeline welding;
- 4 x Lowering in machines or sidebooms;
- 1 x Thrust boring machine; and
- 1 x HDD rig.

The equipment would initially be delivered to a laydown area along the pipeline route where construction would commence. The construction activities would then progress along the pipeline route as described in **Section 5.6.**

16.4.4 HDS

Machinery and equipment required for the construction of the HDS is set out in **Section 5.6.6** and would include:

- Concrete delivery trucks (4-5 per day during civil construction);
- 1 x Light crane
- Equipment transport including:
    - 2 x Water bath heaters;
    - 2 x Filters;
    - 2 x Control dongers;
    - 1 x Pig receiver; and
    - 1 x Attenuator;
- 3 x Pipework skids;
- 6 - 8 x miscellaneous pipe / valve trucks; and
- Site preparation vehicles including:
    - Bobcat;
    - Grader;
    - Dozer;

- Piling Truck;
- Roller; and
- 5 x Water and Dump trucks.

The delivery of these items to the HDS site would via Old Maitland Road. The site preparation equipment would be delivered to the site at the start of construction to establish the hardstand areas.

16.5 Construction Activities

16.5.1 Stage 1 GFDA

The majority of movements associated with construction traffic in respect of the proposed Stage 1 GFDA would be related to the initial delivery of materials, plant and equipment and removal of equipment and machinery from the site upon completion of works. Plant and equipment would be kept on-site (within the Stage 1 GFDA) for the duration of the construction period.

Gravel Transport

The Project would require significant volumes of gravel material to be transported to the various construction sites within the Project Area for use in pad construction, hardstand areas and roadway upgrades.

During construction, each well site would initially require an area of approximately 8100m^2 (typically 90 m x 90 m), containing a gravel hardstand of typically 65 m x 65 m (4225 m^2) with a compacted depth of gravel of 0.3 m. This pad would be reduced to 15 m x 15 m (still with a depth of gravel of 0.3m) for the final hardstand area.

Truck movements on the external road network associated with the transport of gravel for well pad construction are predicted to be in the order of 896 movements per month over the first three months of construction, reducing to between 354 and 404 per month for the remaining fifteen months of construction period due to the recycling of gravel between pads. Truck movements associated with the transport of recycled gravel would be internal to the Stage 1 GFDA, moving gravel between well sites. The 18 month construction period for the Stage 1 GFDA represents the most intense construction period and so has been used in this EA as the basis for assessing potential impacts.

Taking account of these variations, truck movements associated with the transport of gravel for well pad construction are therefore predicted to be some 34 truck movements per day on average for the first three months of construction, reducing to an average of 13 movements per day (worst case) over the remaining construction period.

In addition, road construction would require the establishment of a 3 - 4 m wide road with a depth of gravel of 0.3 m, being 0.9 m^3 of gravel per metre of roadway. Some 25 km of roadway is required to be constructed within the Stage 1 GFDA over the construction period. It is anticipated that road construction would occur at an average rate of 1.5 km per month. This equates to an average of 159 truck loads of gravel or 160 truck movements per month associated with gravel transport for road construction (approximately 6 movements per day).

The total average truck movements per day associated with gravel transportation are therefore predicted to be in the order of 37 movements per day over the first three months of construction, reducing to approximately 19 movements per day for the remainder of construction.

Plant and Equipment

The equipment and plant required for the construction of the Stage 1 GFDA is specified in **Section 16.4.1** above. It is anticipated that much of this equipment would be sourced locally and would therefore be transported largely within the local road network described in **Section 16.2.** Delivery of the equipment to the site would be staggered in accordance with the construction program.

Earthmoving equipment would be delivered to the site first for construction of the well pads and access roads as required. This would include the bulldozers, excavators and grading machines as described above which would be delivered to the site in a single event over two to three days. Delivery of gravel would commence following earthworks to provide for the construction of well pads and access roads.

Vehicle movements associated with the initial delivery of plant and equipment for the drilling phase of the development are shown in **Table 16-3** and are expected to comprise up to 62 initial heavy vehicle movements to the site over a period of several days. Vehicle movements beyond the initial delivery of drill plant and equipment would largely occur within the Stage 1 GFDA with drill rigs and associated plant moving between well sites. Each mobilisation of drilling plant would require some 62 heavy vehicle movements. There may be a need for this equipment to travel off site onto the surrounding local road network in order to access other well sites within the Stage 1 GFDA, however this is expected to occur infrequently. Mobilisations of drilling equipment would predominantly occur on the internal Stage 1 GFDA road network.

Upon completion of drilling, plant and equipment would be removed from the site involving a further 62 movements. Removal of plant and equipment from the site is expected to take several days with vehicle movements being spread over this period. Where possible, deliveries would be made outside of peak transport times, and within the internal road network for the Project to minimise potential disturbances to local traffic.

Construction activities would also generate some light vehicle movements associated with construction personnel travelling to and from the site as well as certain deliveries and disposal activities. Light vehicle movements would remain generally consistent over the construction period and are expected to equate to some 6-8 movements per well location per day whilst under construction.

As previously mentioned, the equipment and machinery required for construction works would be maintained on site throughout construction to minimise potential impacts to local traffic. Ongoing daily traffic movements would be limited to water trucks and personnel vehicles with other vehicle movements undertaken relatively infrequently as required.

Predicted traffic movements related to the drilling of wells within the Stage 1 GFDA are provided in **Table 16-3** below.

Table 16-3: Estimated external vehicle movements during drilling phase

Item Description	Vehicle/s	Movements
Drilling rigs	Trucks	8-12
Frac equipment	Trucks	14
Frac tanks	Trucks	14
Production equipment	Trucks	4
Cementing equipment	Trucks	8
Water Tankers	Tankers	10

Item Description	Vehicle/s	Movements
Total Heavy Vehicle Movements*		
Personnel Transport	6 – 8 vehicles per well location	6-8

*During the drilling process, drill rigs and associated equipment may be required to leave the Stage 1 GFDA and move along the local road network to access other well sites within the Stage 1 GFDA however these movements would be minimised wherever possible and are expected to occur infrequently.

Anticipated internal movements would not impact on traffic flows on the surrounding local or regional road network and impacts would be limited to the internal road network which would be managed in accordance with a Traffic Management Plan (TMP) to be prepared as part of the broader CEMP for the Project. Potential amenity impacts associated with the movement of vehicles within the Stage 1 GFDA area (such as air quality and noise) are addressed in **Chapters 9** and **14** of this EA.

External vehicle movements associated with the construction phase of the Stage 1 GFDA would be largely undertaken as a single event with materials, equipment and plant stored onsite during the construction period. Impacts upon the local and regional road network would therefore largely be temporary and short-term.

Regular and ongoing vehicle movements associated with construction would include the transportation of gravel for construction of well pads and roads, refilling and delivery of water tankers and other infrequent deliveries and disposals and personnel vehicles as detailed above. The impacts of these movements upon the local and regional road networks are considered to be minimal and manageable through the preparation and implementation of a TMP for the Project. These impacts would also be temporary, with a maximum duration of approximately 18 months to 5 years depending on the development scenario (refer to **Section 4.2**). The 18 month timeframe represents the most intense construction period and therefore the worst case scenario.

16.5.2 CPF

The two proposed CPF locations, Site 1 and Site 7, are situated in the vicinity of Stratford, a small township with a low residential density surrounded by largely rural/agricultural land. Based upon the nature and density of surrounding land uses, traffic movements in the local area are relatively low off the main regional transit roadways.

The construction of the proposed CPF would require delivery of construction equipment (as detailed in **Section 16.4)** and various plant and construction materials (see **Table 16-4**) to the site prior to construction. The delivery of these plant and materials would be undertaken prior to commencement of works and represents the largest impact in terms of traffic in respect of the CPF facility. Where possible, deliveries would be made outside of peak transport times to minimise potential disturbances to local traffic.

Table 16-4: Vehicle Movements - CPF Plant and Materials

Description	Item Information	Delivery Vehicle	Movements to Site	Movements from Site
Compressor Skids (8 Units)	Central Skid (per unit)	1 low loader per unit with escorts	8	8
	Wing skids x 2 (per unit)	2 low loaders with escorts	16	16
	Cooler skid (per unit)	One Truck	8	8

Description	Item Information	Delivery Vehicle	Movements to Site	Movements from Site
	40 ft containers (per unit)	One Truck	8	8
Dehydration Skids	Contactor weight	One Truck	2	2
	Regeneration Skid	One Truck	2	2
	Container	One Truck	2	2
Miscellaneous containers and Equipment	Up to 3 deliveries per week	One Truck per delivery	3 per week	3 per week
Concrete Delivery	Approximately 1100m^3 average load is 4m^3	275 Truck deliveries	9 per day	9 per day
Equipment transport	Approximately 2 per day	2 trucks	2 per day	2 per day
Personnel transport	Transport for personnel	18 light vehicles	18 per day	18 per day

Delivery of construction plant and equipment would be staggered to reflect the construction program with the earthmoving equipment described above delivered to the CPF site first. Concrete would then be delivered, followed by the compressor units and other plant. The staggering of these vehicle movements would assist in reducing impacts upon the surrounding road network.

Construction materials, including gravel and concrete, would be sourced from local suppliers wherever possible, with delivery occurring along major routes from the north, south, east and west as appropriate. Equipment and plant required for the construction of the CPF would be sourced from Newcastle and delivery would therefore occur from the Pacific Highway, then along The Bucketts Way and onto an access road on the adjacent property to the south of Parkers Road from The Bucketts Way for CPF Site 7 or via Wenham Cox Road for CPF Site 1 (refer to **Section 16.2.2**). Further details of the access to the CPF site would be provided in the TMP for the Project, once the final CPF site is determined.

Delivery of construction plant, equipment and materials would be undertaken over a period of 30 days, outside of peak traffic times where possible in order to minimise impacts upon the surrounding road network.

The CPF construction would also generate light vehicle movements associated with construction and contractor personnel equating to some 36 vehicle movements per day over the anticipated construction period of 12 months.

It is anticipated that the delivery of equipment and machinery to the CPF site would result in an increase in the number of vehicle movements in the vicinity of the CPF, however the majority of these movements would occur over an initial period of some 30 days and would therefore represent temporary and short-term impacts upon the road network. These impacts would be managed through the preparation and implementation of a TMP as part of a broader CEMP for the Project. The TMP would include measures such as the timing of these movements outside of peak periods in order to further minimise potential impacts upon surrounding roads. As such, it is not anticipated that the additional vehicles would result in significant adverse impacts upon traffic flows. The Bucketts Way has capacity to accommodate the increased vehicle numbers (see **Table 16-2**) and the nature of the construction traffic (being a single event over a short period) is not expected to generate additional congestion or traffic issues.

Access to CPF Site 1 would be via the upgraded intersection at Wenham Cox Road (refer to **Section 16.2.2**) and The Bucketts Way, with an access road constructed from Wenham Cox Road to CPF Site 1 through land owned by the Proponent.

An intersection upgrade would be required for access to CPF Site 7, which would include widening of the road at the proposed intersection on the The Bucketts Way, and the inclusion of a channelized right turn lane to provide a protected right hand turn onto the proposed access road for the Site 7 (refer to **Figure 16.2**). The intersection upgrade may result in temporary disruptions to traffic along The Bucketts Way during the works, however these would managed as part of the TMP and would be temporary, therefore no significant impact is anticipated.

16.5.3 Pipeline

Similar to the Stage 1 GFDA and CPF, vehicle movements on public roads associated with the construction of the pipeline would be largely generated through the initial delivery of plant, equipment and materials. In relation to the pipeline construction, there are expected to be three laydown areas along the pipeline route, spaced at roughly equal intervals. Construction materials, including the pipeline itself would be delivered to these laydown areas and stored until required for use. Laydown areas would be located on private land in consultation with relevant landowners, subject to a range of locational principles as specified in **Section 5.2**. Each laydown area would be used for a period of some 10 weeks before pipeline construction would progress to the next location.

Materials (including sections of pipe) would be transported along the appropriate major route dependent upon the section of the pipeline under construction, with local and private roads utilised to gain access to the laydown area. The use/construction upgrade of private access roads would be subject to agreement with relevant landowners. Where possible, delivery of materials, plant and equipment for pipeline construction would be made outside of peak transport times to minimise potential disturbances to local traffic.

Vehicle movements associated with the initial delivery of materials to laydown areas are summarised in the table below.

Table 16-5: Pipeline Construction Material Delivery

Description	Item Information	Delivery Vehicle
Pipe Delivery	Approximately 10 per day	Five trucks per day over a stringing period of 70 days delivering to two of three laydown areas.
Equipment transport	Approximately 2 per day	Two low loaders per day transporting equipment from one work front to the next.

Description	Item Information	Delivery Vehicle
Water	Two trucks continuously during construction	Two water trucks per day travelling along the ROW/work front.

Materials would be collected from the appropriate laydown area and moved to the pipeline construction location on a daily basis. Traffic movements from laydown areas to the construction site would be via local roads where required and along the established pipeline ROW which would therefore reduce the impact upon the public road network.

Light vehicle movements associated with construction personnel are predicted to be in the order of 50-100 light vehicle movements per day. Personnel would be accommodated in local establishments along the pipeline route and in a construction workforce camp (refer to **Section 5.6.7**), therefore this light vehicle traffic would be from local townships, taking the most direct route to the construction site. Construction personnel would be transported from the construction workforce camp to the work site by minibus or equivalent in order to minimise light vehicle movements.

16.5.4 Construction Personnel / Workforce

The construction phase of the Project would also generate a number of light vehicle movements used for the transport of the workforce to and from the construction sites. Personnel numbers anticipated for each of project components are detailed in **Table 16-6** below.

Table 16-6: Personnel Numbers

Activity	Number of Personnel
Stage 1 GFDA (construction and drilling)	50 – 100
CPF construction	40 – 50
Pipeline construction	200 – 300
Management and office staff	10 – 15
Total Construction Personnel	**465**

Assuming that some transport would involve car pooling, the potential number of additional daily vehicle movements resulting from the transport of construction personnel is approximately 400 movements, (being 200 vehicles daily). This provides a conservative view of additional daily traffic movements as these movements would be spread out over the distance of the Project Area (which is some 100 km) and so would not occur in the same location and potentially not at the same time. Additionally, the traffic generated from the construction of the Stage 1 GFDA may be reduced and spread over a longer period of time, depending on the development scenario (refer to **Section 4.2**).

Personnel movements would be largely focussed during two peak times – at the beginning of the day and at the end of the day. Where possible the movement of personnel would be timed outside of peak traffic periods. The workforce would be located in construction workforce camps in proximity to the worksite and some in rental accommodation. The majority of the workforce from the construction workforce camps would be transported to the work site by minibus and carpooling would be encouraged for the duration of the construction period to minimise traffic impacts. The addition of up to 200 vehicles over a 100km area is unlikely to significantly influence the existing traffic flows in the local area.

16.6 Summary of Potential Construction Impacts

16.6.1 Stage 1 GFDA and CPF

As discussed in the previous sections, the majority of construction traffic movements for the various project components would occur over a limited period (approximately 30 days) during the initial delivery of plant, equipment and materials to the construction site. Once initial delivery has taken place, additional traffic movements generated on the external road network would be temporary for a period of 18 months to 5 years during the construction phase of the Project (refer to **Section 4.2**), with 18 months representing the most intense construction period and therefore a worst case scenario.

Additional traffic movements on public roadways would be primarily related to the transportation of gravel associated with well pad and road construction, in addition to deliveries required on a daily basis and personnel travel. The regional and local roadways that are anticipated to experience the greatest impacts as a result of the Project are The Bucketts Way (MR90) and the various local roads (identified in **Section 16.2.2**) which would be the primary access routes for these deliveries. As shown in **Table 16-2** the existing traffic volumes for the identified roads are within operational criteria, and capacity is available for the proposed temporary increase. Impacts would however require management through the implementation of a TMP for the Project. Details of the TMP to be prepared are provided in **Section 16.9** and **Chapter 25** of this EA.

Access to either of the potential CPF Sites would require the construction of an intersection along The Bucketts Way at the proposed access point (refer to **Section 16.2.2**). These works would be undertaken in accordance with relevant standards and guidelines and would be subject to consultation with the RTA and other stakeholders as appropriate. Impacts upon the operation of Gloucester Coal are not anticipated, however works with the potential to affect the operation of Gloucester Coal would be subject to negotiation and consultation with Gloucester Coal. The majority of the workforce for the Stage 1 GFDA and CPF would be accommodated in a construction workforce camp (refer to **Section 5.4.15**) and would be transported to the worksite by minibus, thereby minimising traffic impacts.

16.6.2 Pipeline

The impacts of the construction of the proposed pipeline in terms of traffic and transport are heavily focused on the construction period, in particular the initial delivery of plant and materials to the various laydown areas along the pipeline route. Impacts in this regard would be short-term and temporary and would be further reduced through the timing of deliveries.

The pipeline would cross roads at approximately 30 locations along the proposed route. The roadways to be crossed are detailed in **Section 5.6.4**, and include the following significant roadways:

- The Bucketts Way;
- Pacific Highway; and
- Maitland Road.

The preferred method for major road crossings would be under boring, which would be undertaken in accordance with relevant guidelines, standards and statutory requirements. Certain minor, private access roads and tracks would be crossed using open trench construction in consultation with relevant local authorities.

Some of the existing roads and tracks along the proposed pipeline route would require upgrade works in order for construction vehicles and plant to safely access the construction site. Additionally, in areas where existing roads and tracks do not currently exist, access tracks may need to be constructed. Some access tracks may be required to be retained during the operation of the pipeline for maintenance purposes, while others would be remediated upon completion of construction of the pipeline. Routes to be used for construction activities would be capable of conveying traffic as detailed in the Project description. Permits and licences required for oversized loads would be obtained by the contractor prior to transporting.

Where possible, construction activities would be structured to maintain access to residential and farming properties at all times throughout the Project works. In any event that access to a property is temporarily blocked, suitable notification and consultation would be undertaken with the landholder to minimise potential disruption to services. Agreements and consultation would be undertaken prior to access over private or public property and the construction workforce would be transported by minibus or carpooling to minimise traffic impacts.

The proposed pipeline route also traverses the North Coast Railway Line, crossing at two locations. The North Coast Railway Line services the Sydney to Brisbane XPT service with three trains per day. It is proposed that the pipeline be bored below the railway line at each of these locations to a suitable depth to avoid impacts on the use and operation of the railway. It is not anticipated that the under-boring of the railway line would impact on the operation or result in any damage or alteration to the railway infrastructure. Initial consultation with relevant authorities associated with the operation and management of the railway has been undertaken and would be ongoing for the duration of the construction phase of the Project.

Construction traffic for the HDS would be minimal (refer to **Section 16.4.4**) and is not anticipated to result in significant impacts.

16.7 Operational Traffic

Operational traffic associated with the Project would vary across the Project components but would generally include staff movements, drill rig relocations and salt removal from the CPF site. The majority of these movements would be confined to the internal network of the Stage 1 GFDA, with some minor movements for transport to and from site, waste material disposal and pipeline maintenance. A summary of the anticipated operational vehicle movements is provided below.

16.7.1 Operational Staff

During operation, additional traffic impacts are expected to be negligible with vehicles limited to the Stage 1 GFDA for monitoring and maintenance. Likely traffic sources during the operation phase of the Project would include:

Table 16-7: Operation Personnel

Personnel	Anticipated vehicle numbers	Usage information
Stage 1 GFDA		
6 field operators for field monitoring	Up to six light vehicles	Daily usage to check the wells. Movements internal to Stage 1 GFDA.
6 workover crew operating the workover rig and support vehicles	One workover rig, one truck and two light vehicles	Monthly usage for work-over operations internal to the Stage 1 GFDA.

Personnel	Anticipated vehicle numbers	Usage information
CPF		
Field Operations management and administration	Ten light vehicles	20 external movements per day.
Two Plant Operators (one per day and night shift)	Two light vehicles	Four external movements per day.
One Plant Supervisor	One light vehicle	Two external movements per day
One Electrical & Instrumentation technician	One light vehicle	Two external movements per day.
Four Workshop and maintenance staff	Four light vehicles	Eight external movements per day.
Six CPF contractors (compression, E&I and environmental license compliance)	Four light vehicles	Eight external movements per day. Anticipated onsite every three months.
Pipeline		
One Pipeline technicians based in Gloucester	One light vehicle	Routine inspections of the pipeline route requiring movements on the external road network along the pipeline route. Additional support from plant operators where required
HDS		
One Operator	One light vehicle	Two external movements per day
During maintenance: Eight Contractors on-site	Three light vehicles and one heavy vehicle	Once or twice a year in the early stages

Based upon the above predicted external traffic movements it is unlikely that additional vehicle movements from the operation phase of the Project would result in an adverse impact to traffic flows.

16.7.2 Salt Removal

The drilling operation would recover a quantity of saline water that would be evaporated at the on-site water treatment facility creating a salt precipitate. It is anticipated that the rate of salt accumulation from the processing could be in the order of 3 tonnes per day. Given this rate, the salt would be transported from the site on a weekly basis to an appropriately licensed facility for reuse or disposal, equating to one truck movement per week on average.

Investigations are underway for the salt to be either transported to a salt producer for further processing, or processed locally into saleable products (refer to **Section 5.5.4**). In the event that the salt cannot be utilised, it would be disposed of in an appropriately licensed landfill facility. The location of the facility would be dependant on the classification of the salt precipitate. Should the salt be classified as a restricted solid waste, it would need to be disposed of at a licensed facility in Sydney. Should it be classified as non-restricted material, disposal would be to a facility in Taree.

Should the anticipated rate of salt production be higher than expected, an additional truck load may be required on a periodic basis to remove the additional quantity of salt.

The disposal of salt from the Project Area is unlikely to result in congestion or adversely impact the existing road network given the available capacity and the intermittent nature of the vehicle movements.

16.8 Cumulative Impacts

The cumulative impacts of the Project in terms of traffic must be considered in relation to existing surrounding development and future development proposed in the area which has the potential to increase traffic volumes on local and regional roads.

As previously discussed, existing land use in the area surrounding the Stage 1 GFDA and CPF site is low density and largely for agricultural/rural purposes expected to generate little traffic on the local and regional road network. The potential CPF Site 7 is located adjacent to an existing coal mine, however as coal is transported to domestic power stations via a rail network, vehicle movements associated with the mine are limited to personnel and some transport of mining consumables (Resource Strategies, February 2001). Access to the Bowens Road North mine is off Bowens Road, north of the proposed CPF site and would therefore not result in an accumulation of traffic on any one local road.

A number of future growth areas are identified in relevant strategic planning documents, such as The Lower Hunter Regional Strategy (LHRS) which earmarks a number of areas for growth in the surrounds of Newcastle to the south east of the southern section of the pipeline route. The LHRS identifies 115,000 new dwellings over the 25 year period (2006-2031), with 60% anticipated to be in new release areas. The major priority release areas, and therefore the areas likely to undergo development during the life of the proposed project are:

- Thornton North (7,000);
- Cooranbong (3,000);
- Bellbird (4,000); and
- North Raymond Terrace (5,000).

Other areas of development identified in the LHRS are; Lochinvar, Anambah, Wyee and Branxton-Huntlee.

These areas are located in the far south of the Project Area and the predicted timing of their release and development indicate that significant cumulative traffic impacts are unlikely.

Further, to accommodate the planned growth in this area, the RTA is upgrading the Sydney to Newcastle Freeway (F6003) and Pacific Highway (SH10). The Sydney to Newcastle Freeway is being upgraded along its length to accommodate predicted increase in traffic flows. The section of greatest relevance to the Project is the Heatherbrae extension. These works would be in proximity to the southern section of the pipeline, although would not be affected or crossed by the Project. The pipeline would cross the Pacific Highway in the vicinity of Hexham, however HDD would be used to avoid surface impacts to the Pacific Highway. Therefore it is not expected that the proposed pipeline route for the Project would affect the upgrade of the Pacific Highway or any other proposed road upgrade.

The proposed pipeline for this EA would intersect the QHGP Project Pipeline approximately two kilometres north of Woodberry (i.e. approximately 7 km from the Hexham Delivery Station) and would run parallel to each other approximately 80 m apart for approximately 1.5 km (from approximately the 86 to 87.5 KP mark). There is the potential for cumulative traffic impacts if the construction of each pipeline in this area occurred concurrently (refer to **Chapter 16**) and safeguards are provided in **Section 16.9**.

The Federal Government has also committed to an upgrade of The Bucketts Way (MR90) with a contribution of $20 million towards a 158 km upgrade of the road from Raymond Terrace to Gloucester. This upgrade would also result in an improvement to road services for the region.

These roadways (MR90, SH10 and F6003) are considered to be the most relevant to the growth areas and planned expansion of the region. There are no significant development areas identified in the immediate vicinity of the Project Area and the proposed works would not impact directly upon the identified growth areas. The region as a whole may experience an increase in traffic associated with the development of growth areas however it is proposed that the majority of the traffic generated by the Project would be related to construction and would therefore be temporary and largely ceased by the time these identified growth areas are developed.

It is not anticipated that the Project would result in significant traffic congestion issues related to urban growth areas, nor would the works inhibit the planned expansion of residential development in the vicinity of Newcastle.

16.9 Environmental Safeguards

The following safeguards would be implemented to minimise potential impacts to the surrounding road network:

- A TMP would be prepared to form part of the broader CEMP and OEMP to be developed for the Project. The TMP would include detail on:
  - A Transport Code of Conduct which would outline and manage the transportation routes to the sites for heavy vehicles;
  - Heavy vehicle access to the various laydown areas and construction sites;
  - Deliveries and dispatch during construction and operation;
  - Heavy vehicle parking during construction and operation;
  - Internal speed limits;
  - Use of truck turnaround areas;
  - Access to laydown and temporary work areas; and
  - Details of road/intersection upgrades.
- Consultation to be undertaken with potentially affected landowners and relevant road authorities with regard to the timing of plant and equipment delivery campaigns and potential localised impacts on the road network;
- Consultation would be undertaken with the proponent of the Queensland Hunter Gas Pipeline (QHGP) Project (MP06-0286) to manage potential interaction and cumulative impacts when working in close proximity;
- Where oversized vehicles are used, suitable controls and management would be put into place and heavy vehicle permits would be obtained as required. Oversized loads would be transported in accordance with relevant RTA guidelines;
- Heavy vehicle movements would be timed wherever possible to avoid or minimise localised impacts such as avoiding peak traffic zones and school zones between the hours of 7am - 9am and 2pm - 4pm;
- Traffic direction control would be used where appropriate for open trenching of road crossings. Available measures would be taken to minimise disruption during open trench crossings to no more than one to two days;

- Multi-passenger vehicles and car pooling would be used wherever possible for the transportation of construction personnel to the construction site/s in order to minimise the number of vehicle movements;
- Once the location of laydown areas has been established, the potential impacts of vehicle movements would be more accurately assessed and appropriate mitigation measures developed as part of the TMP;
- The internal Stage 1 GFDA road network and pipeline ROW would be used to facilitate access and accommodate vehicle movements wherever possible;
- AGL would prepare pre and post dilapidation reports for major access roads affected by the Project. Impacts considered to be attributable to the Project, as determined by the dilapidation reports, following the construction phase of the Project would be remediated by AGL;
- Vehicle movements would be minimised wherever possible;
- Materials would be sourced from local suppliers where possible;
- Nominated transport routes would be clearly identified in the TMP and contractors would be made aware of the requirements to use these routes when travelling to and from the Project Area; and
- Access to residential and farming properties would be maintained where possible.

16.10 Residual Impacts

It is anticipated that there would be an increase in local traffic during the construction phase of the Project as a result of deliveries of plant, equipment and materials, personnel transport and construction activities. Much of this would be limited to single events occurring over a period of 30 days for initial delivery and would be mitigated through the implementation of traffic management measures as described above and further detailed in the TMP to be prepared for the Project.

Permanent, ongoing traffic movements associated with the operation of the various project components are expected to be minimal.

16.11 Conclusion

It is not expected that the Project would adversely impact on the current operation of the local and regional transport network. Although the works would involve additional vehicle movements required for deliveries, works and personnel, these would be largely limited to a short time at the beginning of the construction period and would be spread along the approximately 95 km length of the Project.

Further, construction works would be staged to minimise congestion. Deliveries of major plant, equipment and materials would be undertaken outside of peak transport times, and would be carried out as required throughout the Project. Where possible, construction and operational movements would be restricted to the internal road network created for the Stage 1 GFDA and the pipeline ROW, reducing potential impacts upon the surrounding road network in terms of congestion and use of public roads. There are not anticipated to be construction or operational traffic impacts for the HDS.

Therefore, the impact of the Project on traffic and transport of the local and regional surrounds is not considered to be significant.

17.0 Soils and Geology

This Chapter assesses the potential impacts of the Project on the soil and geology of the locality. The assessment covers the proposed Concept Area, Stage 1 GFDA, CPF and pipeline construction from Stratford to Hexham.

17.1 Landform – Concept Area

Due to the regional scale of landform and geology, the characteristics of the Concept Area in this regard are as described for the Gloucester Basin region detailed below.

17.2 Landform – Project Area

The Stage 1 GFDA is located approximately 100 km north of Newcastle near Stratford in the Gloucester geological basin. The proposed pipeline extends from the Stage 1 GFDA, south to Hexham in the Newcastle area. The landform of the locality is characterised by two regions being the Gloucester Basin Region to the north and the Hunter Valley Region to the south.

The Gloucester Basin Region can be further divided into twelve physiographic subregions, with the three regions relevant to the proposal described below:

- Gloucester Basin
  - Containing the Stage 1 GFDA and CPF sites, dominated by mainly undulating to rolling Permian sediments with occasional steep hills. The basin boundaries comprise basic and acidic volcanics and Carboniferous sediments.
- Monkerai Hills
  - Containing the western area of the Stage 1 GFDA and pipeline corridor, dominated by rolling to steep hills on Carboniferous sediments and volcanics to the west of the Stroud Gloucester Basin.
- Clarencetown Hills
  - Rolling to steep hills composed of Carboniferous sediments and acid volcanics to the south of Monkerai Hills.

The original vegetation of the Gloucester Basin Region was open-forest which covered most of this landscape and has since been cleared and replaced with improved pasture mining and urban practices. Remaining vegetation is extremely diverse across the region with soil types playing an important factor in determining vegetation composition. Valley floor is often highly fragmented and affected by weeds, feral animals and altered fire regimes. Vegetation structures range from sub tropical forests to cleared tall open forests with the majority of remnant vegetation on steep slopes and in riparian areas. Remnant native mature trees on the plains and flats being Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus. moluccana*) are common but isolated.

The Lower Hunter region forms a transition zone for many plant and animal species between the sub-tropical influences of the north and the cooler, less fertile conditions to the south. Flora is remarkably diverse, with approximately 2000 species of vascular plants (DECC, 2006).

The existing land use of the Gloucester Basin is predominantly improved and semi-improved pasture accommodating a variety of agricultural activities including dairying, beef cattle production, orchards, horse stud, turf farming and some cultivation. The raising of beef cattle is the main industry for the area, with dairy, and orchards occupying the alluvial plains and gentle inclined slopes and horse studs and turf farming occupying pockets of floodplain areas. Traditional and hobby farms are common in the vicinity of towns and the Barrington Tops National Park is present in the upper catchment providing an important area for the preservation of wilderness and being widely used for recreational and educational purposes.

The Hunter Valley Region has three physiographic regions of relevance to the proposal, being the Clarencetown Hills (continuing from the Gloucester Basin Region described above), Medowie Lowlands and The Lower Hunter Plains, described below:

- Medowie Lowlands – Occurring to the south east of the Clarencetown Hills the lowlands are formed predominantly on Carboniferous sediments and volcanics.
- The Lower Hunter Plains - Extending from Seaham to Newcastle Harbour, these low plains occupy the southern area of the pipeline.

The landscape of the Hunter Valley has great diversity with sub-alpine areas in the highlands to broad coastal heathlands near the ocean. The lower Hunter Valley is relatively flat, with a large flood plain, which narrows in width in the upper reaches. An important area of the Lower Hunter Plains is the Hunter estuary, an important site for migratory shorebirds, fish and crustaceans, many of which are commercial and recreational significant. The Lower Hunter Estuary contains wetland areas listed internationally under the Ramsar Convention due to their unique mix of wetland types, important for maintaining biological diversity and conservation of migratory shorebirds.

The catchment covers a diverse area with the dominant non-agricultural land uses including urban and rural residential development, coal mining, power generation, heavy industry, shipping, tourism, manufacturing and fisheries. The major agricultural industries include table and wine grapes, cereal cropping, grazing, dairying, and beef, pork and poultry production. As with the Gloucester Basin Region traditional and hobby farms are concentrated around townships.

17.3 Gloucester Basin Geology

The Gloucester Basin is a sequence of Early Carboniferous to Late Permian sedimentary and volcanic units that are part of the New England Fold Belt. The Gloucester Basin displays steep dips of up to 90 degrees on its flanks declining to relatively flat along the north south trending basin axis. To the northern part of the Gloucester Basin, a prominent circular feature is evident in the regional magnetics and the surface geological mapping. SRK Consulting (2005) identifies two major basement structural domains. A northern domain has been defined over the circular basement anomaly, where shortening has been predominantly by folding. A southern domain over the remainder of the Basin has been defined, where shortening has been predominantly by thrusting along NNW-striking fault zones.

The Gloucester Basin contains around 13 coal seams thicker than 2.5m, with an average net coal thickness of around 40m at depths of 200m to 700m. Measured average gas contents range from 12 m^3/t to 20 m^3/t (daf), with methane contents of 95-99% (SRK Consulting, 2005).

The basin can be divided into six stratigraphic phases, each of which has a distinctive structural and tectonic association. These are listed below and shown in **Figure 17.1**.

- Early Carboniferous;
- Late Carboniferous;
- Early Permian - Bimodal volcanism;

- Early Permian - Dewrang Group;
- Middle Permian - Avon Sub-Group & Speldon Formation;
- Middle – Late Permian - Craven Sub-Group Marine regression.

These stratigraphic phases identified in SRK Consulting (2005) as being representative of the Gloucester Basin geology are summarised below.

17.3.1 Early Carboniferous sequences

The Early Carboniferous sequences of the New England Fold Belt form the 'basement' of the Gloucester Basin geology and is comprised of six formations as described below.

- **Wootton Beds** – fossiliferous dark gray mudstone and siliceous siltstone;
- **Conger Formation** – fine to coarse lithic sandstone;
- **Boolambayte Formation** – (facies equivalent of the Wootton Beds and Conger Formation). Lithic sandstone and boulder conglomerate overlain by siltstone, mudstone, sandstone and minor conglomerate;
- **Nerong Volcanics** – rhyodacitic and andesitic ignimbrite interbedded with lesser tuffaceous sandstone and conglomerate;
- **Copeland Road Formation** – (facies equivalent of Nerong Volcanics) – lithic reddish brown (terrestrial) sandstone and shallow marine siltstone; and
- **Berrico Creek Formation** – (facies equivalent of Nerong Volcanics). Gray and brown lithic sandstone and ignimbrite.

17.3.2 Late Carboniferous sequences

The Late Carboniferous sequences overly the Early Carboniferous sequences and comprise of five layers as defined below:

- **Karuah Formation** – conglomerate and lithic sandstone overlying the Nerong Volcanics;
- **Faulkland Formation** (facies equivalent of the Karuah Formation). Red to gray lithic sandstone;
- **Booral Formation** – siliceous siltstone and mudstone, medium to coarse grained lithic sandstone;
- **McInnes Formation** – lithic sandstone with minor conglomerate and mudstone; and
- **Johnsons Creek Conglomerate** – coarse, massive pebble and cobble conglomerate clasts, predominantly of silicic volcanics.

17.3.3 Early Permian (Bimodal volcanism) Sequences

Alum Mountain Volcanics (& Stroud Volcanics) – a 2040 m thick coal barren Early Permian sequence of bimodal volcanics and interbedded sedimentary rocks. Flows are occasionally separated by thin siltstone layers and thin coal seams. The volcanics are unconformable on the Late Carboniferous conglomerate. This sequence has been correlated with the Greta Coal Measures of the Sydney Basin.

17.3.4 Early Permian Sequences

The Early Permian sequences are comprised of the **Dewrang Group** formation lying unconformable on the Alum Mountain Volcanics. The sequence may represent a marginal marine facies of the Maitland Group of the Sydney Basin, consisting of the following:

- **Durallie Road Formation** – a 250 m thick fluvial sandstone and conglomerate grading to a well sorted marine sandstone in the south. Has been correlated with the Branxton Formation of the Sydney Basin;
- **Weismantel Formation** – a 20 m thick sequence with coal at the base, grading up to shale and sandstone deposited in a marine environment. Has been correlated with the Muree Sandstone of the Sydney Basin; and
- **Mammy Johnson Formation** – a 300 m thick near shore, high energy lithic sandstone sequence with an intra Mammy Johnson coal seem central to the sandstone sequences.

17.3.5 Middle Permian Sequences

Comprising the **Avon Sub-Group** and the **Speldon Formation** the sequence forms the basal sub-group of the **Gloucester Coal measures**, consisting of:

- **Waukivory Creek Formation** – a regressive sequence, probably deposited during the Mt Range Uplift which occurred to the west of the present Gloucester Basin, beginning at the end of the Dewrang Group with deposition of fluvial sandstone in an upper delta plain environment.
  - The sequence contains a number of coal seams, including Parkers Road, Valley View, Glen Road, Rombo, Triple, Avon Lower and Avon coal seams (in ascending order).
  - The Parkers Road Coal Seam and the Avon Coal Seam are widespread, thick seams of approximately 5m that may represent depositional hiatuses when much of the trough was covered by coalforming swamps.
- **Dog Trap Creek Formation** – a sequence that represents a marine transgression after deposition of the Avon Coal Seam. A middle sequence of fluvial deposition may represent further uplift. The later sequence indicates continuation of the marine transgression.
  - The Glenview Coal Seam at the top of the Dog Trap Creek Formation has increasing sulphur values in the upper parts of the seam indicating increasing marine input. A number of growth faults have been reported in the Dog Trap Creek Formation.
- **Speldon Formation** – the upper part of a marine transgressive sequence that started with the Dog Trap Creek Formation. The Speldon Formation is approximately 100m thick and separates the Avon Sub-Group from the overlying Craven Sub-Group.
  - As with the Dog Trap Creek Formation, there are a number of growth faults reported in the Speldon Formation, creating a variety of local depositional environments.
  - Subsidence during deposition of the Speldon Formation precluded the deposition of significant coal at that time.
  - The Speldon Formation is considered the equivalent of the Archerfield Sandstone in the Sydney Basin.

17.3.6 Middle-Late Permian Sequences

Comprising the **Craven Sub-Group** the Middle – Late Permian sequence is a series of five formations of 800m thickness that make up the upper part of the **Gloucester Coal measures**. The Craven Sub-Group has significantly less marine input than the Avon Sub-Group or the Speldon Formation. The lower part of the Sub-Group indicates the beginning of a regressive cycle. Basin subsidence has slowed and / or there is period of regional uplift, possibly correlating with the early stages of the Hunter Bowen Orogeny.

- Wenham Formation – approximately 25 m thick sequence of coal (Bowens Road Lower Coal Seam), fine grained sandstone and the Bowens Road Coal Seam. The Wenham Formation is considered to represent a depositional hiatus following regression, equivalent to the Bayswater Coal Seam in the Sydney Basin and the Hoskissons Coal Seam of the Gunnedah Basin.
- Wards River Conglomerate – a widespread alluvial fan conglomerate with minor sandstone, shale and rare carbonaceous shale. The Wards River Conglomerate occupies the entire Gloucester Coal Measures (Avon Sub-Group, Speldon Formation and Craven subgroup) in the western part of the Basin. It is very much reduced in thickness along the eastern margin where it occurs stratigraphically above the Wenham Formation.
- Jilleon Formation (Bucketts Way Formation) – is a fine grained sandstone, shale and mudstone sequence. The Formation contains the Cloverdale Coal Seam (with numerous seam splits) at its base and the Roseville Coal Seam near the top.
- Leloma Formation (Woods Road Formation) – contains siltstone, sandstone and numerous thin coal seams. The Formation onlaps basement in the western part of the Basin and grades into the Wards River Conglomerate elsewhere. The formation contains numerous claystone bands, including the Jo Doth Tuff Member.
- Crowthers Road Conglomerate has been deposited in a series of alluvial fans and occurs in the western part of the Basin.

17.4 Soils

The Concept Area and Project Areas extend from Gloucester in the north to Hexham in the South. The area occupies two soil landscape sheets, being the Newcastle 1:100 000 Soil Landscape Sheet and the Dungog 1:100 000 Soil Landscape Sheet. A review of these landscape sheets has identified several soil landscapes that the Project is likely to encounter during construction and operation of the proposed project. **Appendix J** details the likely soil landscapes for both the Stage 1 GFDA (including both CPF sites) and Pipeline with a summary of the potential limitations provided below.

The soil landscapes likely to be encountered have been separated into two sections to assess the potential impacts the soil classification may have on the construction phase of the Project. These two sections are Stage 1 GFDA and the pipeline corridor.

17.4.1 Stage 1 GFDA

The Stage 1 GFDA covers an area of approximately 50 km^2 and includes the proposed well site locations and both CPF Site 1 and Site 7. Soils are predominantly alluvial, high in compounds and dark in colour. Potential soil landscapes limitations related to the Stage 1 GFDA include:

- High erosion potential;
- Dispersible soils; and
- Seasonal water logging.

Other limitations that have the potential to influence the construction activities are the presence of acid soils and poor soil drainage, including swamps. These limitations are likely to increase water content of the drilling process and may impact on the suitability of well locations and manoeuvrability of vehicles around the well field area. Consideration of these factors was included in the site selection study for well location to reduce the likelihood of bogging and excessive water. These factors would also be integral to future well site locations within the Concept Area.

The management of these issues would be through stringent erosion and sedimentation controls, clearly identified drill locations and avoidance of water logged and swamp lands. Should excessive water be encountered during field operations, an additional assessment of site suitability would be undertaken to determine continued use of individual well sites.

17.4.2 Pipeline

The 100 m wide pipeline corridor is approximately 95 km from the CPF Site 7 to the HDS, and an additional 5.1 km from CPF Site 1. The pipeline construction would involve clearing, grading and excavation works over a nominally 30 m wide area, which would disturb surface and subsurface soils. It is proposed that the trench for the pipeline is constructed between one and 3 meters in depth to achieve the required cover.

The northern section (Stratford area) of the pipeline is likely to encounter alluvial plains and drainage depressions extending into low to steep rolling hills. Limitations to the construction of the pipeline include:

- Water logging;
- Swamps;
- Erosion hazards;
- Acid soils;
- Localised rock outcropping; and
- Potential aluminium toxicity.

These limitations may have an impact on the engineering and construction of the pipeline through excessive water, reactivity of soils and the potential to encounter rock material during excavation. Planning for the construction activities has considered these limitations and an appropriate route has been identified through the pipeline corridor selection study to minimise the incidence of these limitations. Should additional factors / limitations be identified during the works, the proposed route of the pipeline could be varied (within the approved corridor) where possible to a location of higher suitability.

The central section of the pipeline (Clarencetown / Monkerai Hills) encroaches into rolling to steep hills with some narrow alluvial plains and low level terraces. The limitations encountered in these areas include:

- Steep slopes;
- Water erosion hazard;
- Stony soils;
- Rock outcropping; and
- Foundation hazard (predominantly around waterways and terraces).

These areas present the only hilly area of the proposed route with likely issues mainly associated with the excavation of the trench for the pipe. It is anticipated that the limitations of the central pipeline areas would be mitigated through stringent erosion and sedimentation controls, careful selection of the pipeline route and minimisation of works in proximity to waterways. Should factors / limitation not identified in the planning stage arise during works, the relocation of the 30 m ROW within the assessed pipeline corridor would be considered to reduce the impact of these limitations.

The southern section of the pipeline (Hexham area) lies within the Lower Hunter Plains which is dominated by extensive alluvial plains and terraces, with some tidal creeks and swamps / estuarine backplains. Potential limitations for the southern section of the pipeline route include:

- High water tables;
- Water logging;
- Flooding;
- Localised foundation hazard; and
- Acid sulfate soil (ASS).

The presence of high groundwater levels and estuarine landscape features (such as tidal creeks and swamps) along with the presence of acid sulfate soils makes the management of works in this area a primary issue for the Project. Management of these limitations would be through management plans and erosion and sedimentation controls to limit the impacts of the works to the landform. Additionally, an ASS Management Plan (ASSMP) would be created to mitigate potential sulfuric acid impacts and leaching during the construction works. ASS management is further detailed in **Section 17.6**.

17.5 Potential Impacts

Impacts to soils and geology are likely to occur during the construction and rehabilitation phases through excavation, site setup, drilling, and clearing activities. Operational impacts are considered to be less likely to affect soils. Disturbances during this phase would primarily be related to vehicle movements and minor maintenance works.

Other factors potentially affecting soils and geology include:

- Remnant impacts from historical land use;
- Interception of ASS; and
- Potential contamination through fuel and oil spills.

17.5.1 Stage 1 GFDA

Impacts associated with the development of the Stage 1 GFDA are related to the excavation and clearing of well sites and gathering lines as well as access roads required for the drilling activities. These activities are likely to result in direct disturbance of soils within the Stage 1 GFDA.

As described in **Chapter 5**, each well site would require the clearing of an area up to 90 x 90 m (with a 65 x 65 m hardstand area) in preparation for drilling activities. This would remove groundcover and topsoil materials to a depth of approximately 100 – 150 mm, which would be stockpiled for use in rehabilitation. The site would be prepared with imported gravel creating a hardstand area prior to well site establishment using a truck mounted drill. On completion of well site establishment the hardstand area would be reduced to 15 x 15m with the area rehabilitated to original condition utilising stockpiled material.

Gas and water gathering pipelines would be constructed to transport water and gas away from the well sites to be collected at the CPF facility. These pipelines would consist of polyethylene pipes of 50-1000mm diameter which would be buried to a minimum depth 750mm below ground surface. This would require trenching activities to install the pipes which would remain in place for the lifespan of the well field area.

Construction workforce camps commissioned during the drilling phase and during the pipeline construction may require some grading and/or disturbance to soils in these locations. These areas would be rehabilitated upon decommissioning as outlined in **Chapter 22**.

The removal of topsoil materials through clearing and grading of well sites has the potential to increase erosion and sedimentation on the site through wind and surface runoff although this would be mitigated in part by the establishment of a hardstand area to cover exposed soils. It is anticipated that the period of exposure for disturbed soil is likely to be for a short period of time with negligible effects from water and wind once the site is covered with the gravel material. The management of erosion and sedimentation would be guided by a Soil and Water Management Plan (SWMP), which would provide guidelines for works that would result in soil disturbance.

The stockpiling of soil materials has the potential to result in sediment laden runoff and dust if not managed appropriately. It is not anticipated that the impacts from stockpiling would adversely impact soils of the locality given the rehabilitation of the site as soon as practical after construction activities and the potential mitigation measures proposed, including management in accordance with best practice guidelines and confinement within bunded areas.

The creation of additional roadways and access ways for the Stage 1 GFDA would be required to transport drill and well site equipment to the individual well sites. The roadway construction would require grading which has the potential to disturb topsoils and to increase the potential for erosion and sedimentation during construction. To minimise the exposure of disturbed soils, roadbase materials (such as gravel) would be placed over graded areas as soon as possible during construction works. This would reduce the potential for erosion impacts to occur. Roadways would be inspected on a routine basis to identify potential areas of erosion during operation to reduce the likelihood of degradation and sedimentation. The roadways would be maintained for the productive life of the well with rehabilitation planned upon the decommissioning of each well site.

Given the Stage 1 GFDA is located on land which has historically been utilised for agricultural practices, the potential exists for contamination and disturbance of materials associated with previous agricultural practices. This issue has been addressed in **Section 17.5.5** below as it applies to the development of the Project.

17.5.2 CPF

Construction of the CPF (at either CPF Site 1 or CPF Site 7) would involve clearing and grading activities for site establishment and infrastructure construction. The CPF would include the excavation (cut and fill) of three 25 ML storage ponds for the treatment of water. The CPF would also include bunded areas for the storage of oils and chemicals for the operation phase of the Project. These activities have the potential to result in erosion and sedimentation impacts to local areas and would require the stockpiling of excavated soil materials. The storage of oils and chemicals has the potential to result in leaks and spills that may contaminate soils.

The excavation and stockpiling of soils for the CPF would be governed by management practices in the SWMP and are not anticipated to adversely impact the locality. Excavated material would be stockpiled for reuse in the rehabilitation phase of the Project, with disturbed areas rehabilitated as soon as practical after construction activities.

The storage areas for oil and chemicals would be within a bunded area to minimise the potential for leaks and spills to escape from the site. This would be managed through the OEMP and would conform to regulatory requirements for bunding size and rainwater capacities.

17.5.3 Pipeline

The pipeline would require significant excavation along the 95 km length to CPF Site 7 (or approximately 100 km length to CPF Site 1) for installation prior to operation. This would involve the clearing and grading of a 25-30 m ROW along the length of the pipeline. The clearing of the ROW would remove the top 100-150 mm of soil and stockpile the material for reuse in the rehabilitation of the area. The impact width of approximately 25-30 m would enable construction activities including trenching, access roads, stockpiling of removed soil and vegetation and storage. In environmentally sensitive areas along the pipeline, the ROW may be reduced to minimise impacts to vegetation or habitat along the pipe

The pipe installation would involve trenching to allow for a minimum depth of cover to 750 mm depth for installation of the high pressure steel pipe which would be anodised for protection. The pipe would be lowered into the trench using cranes and machinery, before cleaning and testing. The installation would be undertaken in sections of up to 20 km to maintain access for agricultural and farming practices and to minimise quantities of soil exposed or stockpiled at any one time.

As detailed in **Chapter 5** the pipeline is likely to cross three main rivers, with a total of 178 rivers, creeks and drainage lines traversed over the 95 km length to CPF Site 7 (or 183 watercourse crossing over the 100 km length to CPF Site 1). In order to minimise potential impacts to creeks, habitat and biodiversity, works in the vicinity of creek lines would be undertaken in accordance with the DWE guidelines for laying pipes and cables in watercourses. The use of HDD techniques for crossing sensitive watercourses would avoid potential impacts as the drill would operate at a minimum of 2 m below the depth of the watercourse.

HDD cuttings would contain natural water based additives. The cuttings would be de-watered with the water removed and disposed on if an appropriate facility as detailed in **Section 5.6.4**. The cuttings would be re-buried at the site as they would be essentially what came out of the sub-surface sediments and soils. If the materials are located in an area of potential ASS, the mitigations and management practices of the ASSMP would be actioned to ensure that no potential impacts occur within the locality or offsite/downstream.

The construction works would involve extensive excavation and stockpiling activities. As such a SWMP would be prepared to manage potential impacts arising from these activities. The plan would include mitigation measures for stockpiling and would be consistent with the publication "*Managing Urban Stormwater- soils and construction (the Bluebook)*" (Landcom 2004).

The installation of the pipeline has the potential to disturb contaminated soils and ASS along its length. There is potential for contaminated materials or historical soil impacts to be disturbed along the length of the pipeline, with the potential for ASS disturbance limited to the southern section of the pipeline near Hexham. These issues are further discussed in **Sections 17.5.4** and **17.5.5** below in further detail. The extent of ASS in this area is shown on **Figure 17.2**.

17.5.4 Acid Sulfate Soil Management

Estuarine sediments from coastal NSW of the Holocene geological age may contain iron pyrite, the main constituent of ASS. These sediments naturally occur over low-lying coastal areas and are generally found below 5 m Australian Height Datum (AHD), typically in coastal and floodplain areas. Pyritic sediments can be divided into classes based on their oxidised state. If the pyritic material is being oxidised it would generally have a pH of less than 4.0 and is called actual acid sulfate soil (AASS). If the pyrite material is below the water table and has not been oxidised, it is termed potential acid sulfate soil (PASS) and generally has a pH of greater than 4.0. The pH has the potential to become much lower when the PASS is exposed to oxygen. Sediment which, after the addition of hydrogen peroxide, has a pH of less than 2.5 strongly indicates the presence of AASS (ASSMAC, 1998). As long as the sulfidic soils remain below the water table, oxidation cannot occur and the soils are quite harmless and can remain so indefinitely.

The pipeline is likely to encounter ASS in the southern section of the pipeline (refer to **Figure 17.2**) in the vicinity of Hexham. The higher potential occurrence has an obvious relationship to elevation and proximity to coastal water bodies. The proposed works in this area include the excavation and trenching for pipeline construction and installation of the HDS at Hexham in the vicinity of Hexham Swamp. The extent and probability of ASS occurring in the vicinity of the pipeline (based on mapping provided by DECCW) is shown on **Figure 17.2**. The probability of ASS occurrence is related to elevation and landform.

Changes to historical land use on floodplains such as grazing cattle and wetland drainage, have led to the oxidation of sulfidic soils, resulting in acid leaching from the soil causing water quality problems. The Hunter Estuary has undergone significant changes resulting from extensive flood mitigation and drainage schemes constructed to prevent tidal exchange and to remove surface water from reclaimed farmland on the floodplain.

Numerous other wetlands in the Lower Hunter Estuary have been modified for farming and other human activities. The detailed distribution of ASS in the Lower Hunter River estuary is largely unknown, as is the impact these soils are having on the estuary and Ramsar wetlands of international importance. Analysis of soil chemistry (DPI 2008) indicates that while ASS occur in the Lower Hunter Region, there are significant differences in the degree of oxidation and consequently the risk of acid discharge.

Disturbance or poor management and use of ASS can generate sulfuric acid and salts through oxidation which can change the soil chemical properties. The pH of the soil and water can be lowered and salinity increased along with the exchangeable aluminium, reducing or precluding vegetation growth and producing soil conditions which may be detrimental to concrete and steel components of structures. The movement out of the soil depends on the hydraulic properties of the soil, as well as movements in the water table. In estuarine areas these movements are affected by the tidal action, rainfall, movement of surface runoff, flooding and evapo-transpiration by plants growing in the soil.

Elevated concentrations of such elements in site runoff may result in changes which are potentially detrimental to receiving water bodies and associated aquatic organisms. Acidification affects both soil and water, and can result in negative impacts on water quality, estuarine habitat, commercial and recreational fisheries, engineering structures, community infrastructure, agricultural productivity, real estate values, scenic amenity and tourism (DPI 2008).

The area of potential impact for this Project is in the vicinity of Hexham Swamp, which ranges in its ASS risk from low through to high. A sulfide layer of variable elevation is present in the southern part of the swamp, and high risk areas were found adjacent to Ironbark and Fishery Creeks (DPI 2008). The proximity of the Hexham Swamp area to the southern section of the pipeline route means that this area would be at direct risk from discharge resultant from the pipeline installation if not appropriately managed. Potential acidic discharge or seepages from the pipeline installation may result in mortality of aquatic and amphibious species of which some are threatened in the swamplands through altered water chemistry.

The proponent is aware of the significance of this issue and as such a suite of mitigations, including soil testing / monitoring prior to and during construction and stringent ASS controls actioned through an ASSMP are proposed to ameliorate potential impacts. Further discussion regarding the potential impacts of ASS on flora and fauna is provided in **Chapter 10.** Generally, the pipeline corridor has been designed to avoid sensitive wetland areas or to use HDD to avoid or minimise impacts (refer to **Chapter 10**).

As previously mentioned, undisturbed ASS pose little problem for the environment. Accordingly, drainage or excavation of ASS affected areas should be avoided, where possible. Trenching or excavating within areas where the potential for ASS exists, particularly in the vicinity of Hexham for the pipeline route, would require to be undertaken in accordance with an ASSMP.

17.5.5 Historical Land use and Contaminated Land

While the majority of contaminated land is associated with industrial land use, there is the potential for historical land uses, such as livestock intensive industries, to result in soil contamination. The Project Area, in particular the Pipeline corridor, would cross large areas of agricultural and feedstock lands that may have involved activities with the potential to result in contaminated materials. In order to manage the risk of unidentified contaminated soils and materials, routine sampling would be undertaken during excavation activities to determine the presence of potential contamination and to determine appropriate management measures.

An investigation of DECCW Contaminated Land records for the six LGA's concerned revealed the following:

- Gloucester, Great Lakes, and Dungog:
    - – No records registered with DECC.
- Port Stephens - 1 record registered, (current):
    - Remediation order located in Tomago, Genkem Pty Ltd (lot 1411 DP 582135)
- Maitland – 4 records registered, (2 current, 2 former):
    - East Maitland, East Maitland Gas Works (1 former revocation, 1 former remediation order; and
    - Maitland, Maitland Gas Works (2 current remediation orders)
- Newcastle – 38 records registered to 17 sites:
    - Hamilton (1), Hamilton North (3), Hexham (2), Kooragang (2), Mayfield (5), Newcastle (1), Sandgate (1), Shortland (1), Tarro (1);
    - Hexham – Engineering Fabrication Plant, FORGACS Dockyard, (current - Voluntary investigation Proposal); and
    - Hexham – Trojay Pty Ltd, 64 old Maitland Road, (current – remediation order).

The proposed Project Area does not traverse any of the above mentioned properties and therefore it is unlikely that the works would disturb identified contaminated lands.

17.5.6 Rehabilitation

Initial rehabilitation would be undertaken after the construction phase and final rehabilitation would occur at the decommissioning phase of the Project as further detailed in **Chapter 22**. Some initial rehabilitation would be undertaken during construction, such as revegetation of well site locations and constructed access ways as described above. However, upon the completion of the Project, affected areas would be returned to as close as possible to pre construction condition. This would include the removal of infrastructure and materials for well sites and pipelines and decommissioning of all CSG extraction facilities.

The potential issues related to the rehabilitation phase are largely the same as those for construction, being erosion and sedimentation, excavation, ASS and contamination. These issues would be managed as per construction with best management principles of the time implemented to minimise impacts.

On completion of the rehabilitation works it is anticipated that the Project Area would be returned to pre construction condition with no lasting effects. It is not anticipated that the Project would impact or limit the potential for future activities on the land or permanently alter the landscape.

17.6 Mitigation Measures

Mitigation measures proposed to ameliorate potential impacts to the soils and geology of the Project Area are:

- Preparation of a SWMP to manage erosion and sedimentation impacts and stockpiling activities. The plan would include mitigation measures for stockpiling and would be constant with the publication "*managing urban stormwater (the Bluebook)*" (Landcom 2004);
- During excavation soils would be tested for the presence of potential contamination, especially from historical land use activities such as intensive animal agriculture. This would determine the requirements for potential contaminated soil management during the Project construction;
- Drill locations would be clearly identified and works undertaken according to the Project CEMP and standard operating procedures. Should soil limitations, (such as water logged and swamp lands), require relocation of any individual site, additional investigation would be required to determine the suitability of the new location;
- Disturbed areas would be rehabilitated as soon as practical after construction;
- Pipeline works, including construction operation and decommissioning, would be undertaken in accordance with the recommendations in The Australian Pipeline Industry Association Limited – *Code of Environmental Practice – Onshore Pipeline (2005);*
- Preparation of an ASSMP for the Project, in consultation with relevant authorities, to mitigate potential impacts from the disturbance of PASS in the vicinity of Hexham. As a minimum this would include the following:
  - A detailed account of the geology, hydrology, physical characteristics and environmental receptors within the locality;
  - Measures to manage ASS in order to be protective of fauna species and preventative of off-site and downstream effects, particularly in the vicinity of freshwater wetlands;
  - Pre-construction monitoring program to establish baseline water quality conditions prior to excavation where the potential for ASS exists;

- Management options considered for the Project, including construction, operation and decommissioning. DPI (2008) identifies four main strategic options exist for the management of acid in the environment:
  - **Containment** within the soil profile in natural depressions, ponds or drains;
  - **Neutralisation** typically either lime ($CaCO_3$) or the bicarbonate (HCO_3) in seawater;
  - **Dilution** use of freshwater to raise the pH; and
  - **Transformation** reduction into stable compounds.
- Treatment measures proposed – including bunding, testing, application of lime or bicarbonate, sampling and any other relevant measures;
- Leachate controls;
- Monitoring requirements and frequencies;
- Requirements and application for disposal of ASS materials; and
- Responsibilities of individual members – including reporting requirements, authorities, and training requirements.

• The ASSMP would also consider measures suggested by the National Strategy for the Management of Coastal Acid Sulfate Soils (NWPASS, 2000) to prevent ASS problems becoming worse including:
  - **Awareness**: be aware of the nature and distribution of ASS as well as its potential adverse impacts;
  - **Education**: to achieve healthier environmental outcomes; and
  - **Planning and development controls**: tailored to minimise the risk of disturbing ASS.

17.7 Residual Impacts

The works would involve drilling, excavation, clearing and installation of infrastructure which would impact the soils and geology in the short to medium term, however the decommissioning phase would include regeneration and rehabilitation activities which would return disturbed areas to their original state. On completion of the decommissioning phase it is not anticipated that there would be lasting impacts to the soils or the landscape resultant from these works.

17.8 Conclusion

Minor disturbances to the soils and geology are likely during the construction phase from clearing, grading and trenching activities. The impacts of these activities are likely to be locally confined and would be mitigated through the use of appropriate erosion and sediment controls and safeguards including the ASSMP and through rehabilitation of disturbed areas to their original state.

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18.0 Visual

This chapter considers the existing landscape and visual aspects of the Concept Area and Project Areas and provides an assessment of the likely effect of the Project on the visual and landscape characteristics.

18.1 Concept Area

Concept and concurrent Project Approval is sought for the development of well sites and associated infrastructure to produce CSG within the Concept Area. The initial construction and well site development is likely to include the development of up to 300 well sites in the Concept Area with a CSG production life extending to 2040 and potentially beyond.

The Concept Area is centred on the Gloucester Basin, with a majority of the Concept Area located in the Gloucester Shire LGA. The Gloucester Shire is characterised by mountain ranges and escarpments typified by open forests in the west, which provide a visual contrast to the cleared alluvial plains of the Gloucester Basin which comprise agricultural and pastoral land uses. The major landscape feature of the area is the mountain range known as the Bucketts, which is located to the west of Gloucester.

The Gloucester area is situated at the headwaters of the Manning River Catchment. The majority of the Concept Area is located in the lowlands and floodplains of the Avon and Gloucester Rivers, which provide fertile alluvial plains characterised by agricultural and pastoral land uses such as cattle farming. The southern portion of the Concept Area extends into the Great Lakes LGA along the floodplains of the Karuah and Wards Rivers, with the landscape becoming slightly more undulating than the areas in the north.

An area known as the Vale of Gloucester, comprising approximately 25,000 ha between Faulkland and Gloucester is listed as an Indicative Place on the Register of the National Estate. The Vale of Gloucester comprises generally the upper Avon River catchment south of Gloucester, and part of the Gloucester River catchment. The heavily forested Bucketts and other mountain ranges of the area are recognised for their granite and volcanic characteristics which provide a marked contrast to the cleared pastoral low hills and undulating topography of the shale-derived valley floor. One of the key values identified on the indicative listing is:

> *"Scenic value: the town of Gloucester is surrounded by a series of low hill ranges which dominate the valley floor and provide a spectacular backdrop to the agricultural activity that takes place in the valley." (Place ID 1357)*

The heritage values of the Vale of Gloucester are discussed in **Chapter 19**. It is noted that the Vale of Gloucester is listed as an Indicative Place, and a decision has not been made as to whether the place will be listed on the Register of the National Estate. Data has been either provided to, or obtained by the Australian Heritage Council or the former Australian Heritage Commission, entered into the database, and the place is at some stage in the assessment process.

The Concept Area is dissected in a north-south orientation by The Bucketts Way and the North Coast Railway, which form the major infrastructure feature in the area. Townships within the Concept Area include Gloucester, Stratford and Craven. Mining is also a characteristic land use of the area, with mining operations at Stratford and Duralie, operated by Gloucester Coal.

The Concept Plan would involve the development of well sites in a manner consistent with that proposed for the Stage 1 GFDA, as discussed below in **Section 18.5**. The period with the greatest potential to impact the visual landscape would be during construction, with a construction phase at each well site of 6 to 8 weeks. The development of well sites within the Concept Area is not considered to be inconsistent with the visual characteristics of current land uses in the area. Furthermore, given the temporary nature of construction works and relatively minimal visual impact of well sites once operational, the development of the Concept Area is not anticipated to significantly affect the visual character of the area.

18.2 Project Area

18.2.1 Stage 1 GFDA

The Stage 1 GFDA is situated in the Gloucester Basin, and is bounded to the east and west by predominantly north-south oriented linear ridges. The landscape is characterised by undulating lowlands and floodplains of the Avon River and tributaries. The topography is gently undulating, comprising grassy flats and gentle rises.

The Avon River, which rises to the south west of Gloucester, runs along the western boundary of the Stage 1 GFDA, with a number of smaller tributaries dissecting the Stage 1 GFDA. Two major tributaries dissect the Project Area and flow into the Avon River. The eastern boundary of the Stage 1 GFDA runs along the foothills of a linear north-south oriented mountain range rising up to 400 m AHD.

The visual landscape of the area is predominately influenced by existing land uses. Agricultural land uses are dominant, with cleared pastoral lands for cattle farming comprising a majority of the Stage 1 GFDA. Visual features comprise agricultural structures such as fencing, dividing the land into regular shaped blocks, sheds and other structures, and networks of access tracks throughout properties. Scattered remnant trees are located throughout the area, and are particularly prominent along roads, near homesteads and along creeklines. Riparian vegetation is present along Waukivory Creek, and parts of other minor tributaries flowing into the Avon River. Other scattered vegetation is present throughout the Stage 1 GFDA.

Rural residential properties and homesteads are located throughout the Stage 1 GFDA, with a majority of properties situated in the northern portion of the Stage 1 GFDA. Landscape features of rural residential properties situated in the Stage 1 GFDA are dominated by homesteads, sheds, and tree planting. The townships of Stratford and Gloucester, which comprise clusters of residential and rural residential properties, are located to the west and north west of the Stage 1 GFDA, respectively. Residential receptor locations for the Stage 1 GFDA are shown in **Figure 18.1**.

Open cut coal mining activities are also present in the Stage 1 GFDA. Stratford Colliery, an open cut mine operated by Gloucester Coal, represents a prominent visual feature in the southern portion of the Stage 1 GFDA.

Infrastructure proximate to the Project Area includes the North Coast Railway and The Bucketts Way, which run generally in a north-south direction, roughly parallel to the western boundary of the Stage 1 GFDA. The Bucketts Way extends north from the Pacific Highway south of Karuah through to Gloucester, where it extends eastwards and rejoins the Pacific Highway at Taree. The Bucketts Way is a scenic alternative route to the Pacific Highway, and provides access to Barrington Tops National Park.

The Vale of Gloucester and its associated scenic and landscape qualities cover the northern portion of the Stage 1 GFDA and surrounding areas. The visual and landscape character of the Vale of Gloucester provides a base for tourism in the area. This is discussed further in relation to socio-economic impacts in **Chapter 20**.

18.2.2 CPF Site 1 and Site 7

CPF Site 1 is situated on land owned by the Proponent, which is currently used for operations forming part of the Stratford Pilot Project. As such, CSG exploration activities are already an existing land use at this site including a number of well sites and other associated infrastructure.

CPF Site 7 is situated on land owned by Gloucester Coal adjacent to the Stratford Colliery Coal Preparation Plant. In this respect the visual characteristics of the proposed CPF Site 7 are heavily influenced by the industrial nature of Stratford Colliery operations.

18.2.3 Pipeline and HDS

The 100 m wide pipeline corridor and 30m ROW traverses approximately 95 km extending from near Stratford in the north to Hexham in the outer suburbs of Newcastle in the south. The landscape traversed by the pipeline is predominantly rural, agricultural and pastoral with visual and landscape characteristics similar to the Stage 1 GFDA and Field Area.

The pipeline corridor avoids traversing towns for a majority of its length, until it reaches Duckenfield and Woodberry north of Hexham.

18.3 Visual Assessment Methodology

An assessment of the visibility of project components within the Stage 1 GFDA and the visual absorption capacity of the surrounding landscape has been undertaken to assess the potential visual impacts of the Project on sensitive visual receptors. The methodology is described in **Sections 18.3.1** and **18.3.2** below.

Visual impacts along the pipeline corridor have been assessed qualitatively based on the type of activities and potential receptors. A discussion on the potential visual impacts of the pipeline corridor is provided in **Section 18.5.3**.

18.3.1 Visual Receptors

Visual receptors are those receptors such as residential dwellings with potential views of project components including well site locations and the CPF and other infrastructure. Visual receptors within and surrounding the Stage 1 GFDA have been identified, which are those areas from where project components are likely to be within the viewshed of the receptor.

Visual receptors were identified as part of the visibility assessment undertaken for the site suitability assessment. These include residential dwellings within and surrounding the Stage 1 GFDA, as well as location points along The Bucketts Way. Visibility is a measure of the extent to which the Project components are visible from the surrounding visual catchment. Visibility is dependent on a number of factors, including the extent of visibility and viewing distance:

- **Extent of visibility:** extent to which project components are visible from a point, i.e. whether the view is interrupted by other landscape features such as vegetation, buildings, or the horizon. Also includes the view duration i.e. residents would be considered to have a permanent view, while motorists driving past would have a transient view.
- **Viewing distance:** the distance from which the Project components are viewed. Distance acts to attenuate visibility of project components from view points.
- **Number of Viewers:** the number of people with views of project components. The greater the number of viewers, the greater the potential impact.

Visibility Assessment – Stage 1 GFDA

To assess the visual impact of the Stage 1 GFDA, the viewsheds of the proposed well sites were modelled to determine visibility from residential receptors. Topographic data were input to a computer modelling program known as Vertical Mapper to produce a visibility map. Local topography was mapped and a visibility assessment undertaken to determine the visibility of the well sites in relation to surrounding receivers. This analysis enabled the potential visual impacts of the proposal to be identified and assessed. This visibility assessment is solely based on topography and distance and does not take into account the screening effect of vegetation or other built infrastructure on the landscape. Screening effects are considered in the discussion of potential impacts in **Section 18.5**.

The visibility assessment calculated the number of well sites that could be seen from a single visual receptor within a viewshed with a radius of 600 m. Based on observations of existing well sites in the Stratford Pilot Project, at this distance, the visibility of the operational infrastructure is only slight, with other elements of landscape dominating the observer's field of view. The visual impact of well site infrastructure further than 600 m away is therefore considered negligible.

Visibility Assessment – CPF Site 1 and Site 7

A visibility assessment was undertaken for the proposed CPF Site 1 and Site 7 locations using Vertical Mapper and topographic data. A visibility map was generated for each of the CPF locations with a radius of 2 km, identifying receptors within the 2 km radius which would potentially have views of the CPF. The visibility of the CPF from distances of greater than 2 km is considered to be minimal in the context of the surrounding land use as it would not be a dominant feature of the landscape.

Two structure heights were considered for the visibility assessment:

- **Lightning diverter poles – height of 30 m.** Two lightening diverter poles would be located at the CPF (at both sites). The visibility of the lightning diverter poles is considered to be insignificant at distances greater than approximately 1km, and visual impacts are considered to be minimal in the context of the surrounding landscape.
- **Compressor engine stacks – height of 12 m.** The compressor engine stacks would represent the tallest solid structures besides the lightning diverter poles. Up to 13 stacks would be located at the CPF site locations.

The majority of the remaining CPF infrastructure would be less than 10m in height. As such, the visibility assessment provides a relatively conservative assessment of potential visual impacts.

The visibility assessment does not take into consideration the effects of built structures and vegetated areas that may act to screen views of the CPF. Aerial photography and ground reconnaissance indicated that there are a number of vegetated areas and built structures that would screen views of each of the CPF locations from visual receivers. To provide a conservative assessment, the model does not consider screening effects, however a qualitative assessment of screening effects is considered in **Section 18.5**.

18.3.2 Visual Absorption Capacity

The visual absorption capacity, defined as the ability of the surrounding landscape to absorb the Project, is also a measure of the potential visual impact that may result from the proposal. The visual absorption capacity of the surrounding landscape is dependent on the appearance of the Project component and the interaction between landscape features such as vegetation cover, existing built structures and topographic landforms. An assessment of the visual absorption capacity is provided in **Section 18.4.4** below.

18.4 Visual Assessment

18.4.1 Visibility Assessment – Well Sites

The results of the visibility assessment for well site locations are summarised in **Figure 18.1** and **Table 18-1** below.

Table 18-1: Well sites visible from sensitive receptors with the Stage 1 GFDA

Number of Well Sites Visible (600 m radius)	Number of Receptors with Well Site Visible in Viewshed
4	2
3	7
2	19
1	30
0	60
Total	**118**

The visibility assessment indicates there are two receptors which have four well sites visible, seven receptors with three well sites visible, 19 receptors with two well sites visible within their viewshed, and a further 30 receptors have one well site located within their respective viewsheds. Visibility of these well sites would be greatest during the construction period when drill rigs and other equipment are present at these sites.

Sixty of the 118 identified receptors would not have a well site located within their respective viewsheds, therefore potential visual impacts would be negligible at these receptors.

18.4.2 Visibility Assessment – CPF Site 1

The results of the visibility assessment for CPF Site 1 are provided in **Figures 18.2** and **18.3** for heights of 12 m and 30 m respectively.

Table 18-2: Visibility Assessment - CPF Site 1

CPF Structure	Number of Receptors from which Structure is Visible within 2 km radius	Number of Receptors from which CPF Structure is not Visible within 2 km radius
Compressor Engine Stacks - 12 m	9	3
Lightning Diverter Poles - 30 m	9	3

The visibility assessment indicates that nine receptors within a 2 km radius would potentially have views of the tallest component of the CPF, the lightening diverter poles. The lightning diverter poles are considered insignificant in terms of visibility at distances of 1km and greater. No receptors are located within a 1 km radius of CPF Site 1, and as such, the lightening diverter poles are not considered to be visible at the receptor locations within 2 km of CPF Site 1 due to the effects of distance attenuation.

The compressor engine stacks would be potentially visible at some nine receptor locations within a 2 km radius of the site. A majority of these receptors are located on the periphery of the viewshed, greater than 1.5 km from the nearest CPF Site 1 boundary. Aerial photography indicates that there are a number of vegetated areas and built structures that would screen views to the CPF from some locations. These receptors are considered to have limited views of the site. When the potential effects of screening vegetation and other obstructions are taken in into account, as well as distance attenuation, the visual impact of CPF Site 1 is not anticipated to be significant.

The majority of the CPF infrastructure is less than 10m in height and would not be visible from some of the locations identified above. As such, the visibility assessment provides a conservative assessment of potential visual impacts.

18.4.3 Visibility Assessment – CPF Site 7

The results of the visibility assessment for CPF Site 7 are provided in **Figures 18.4** and **18.5** for heights of 12 m and 30 m respectively.

Table 18-3: Visibility Assessment - CPF Site 7

CPF Structure	Number of Receptors from which Structure is Visible within 2 km radius	Number of Receptors from which CPF Structure is not Visible within 2km radius
Compressor Engine Stacks - 12 m	10	9
Lightning Diverter Poles - 30 m	18	1

The visibility assessment indicates that 18 receptors within a 2 km radius would potentially have views of the tallest component of the CPF, the lightening diverter poles. Of these, only one receptor is located within 1 km of the site, some 400 m from the closest boundary of the CPF. As such, this is the only receptor at which the lightening diverter poles are likely to be visible.

The visibility assessment indicates that the compressor engine stacks would be visible from some 10 receptors within the 2 km radius of the site. Of these, one receptor is located some 400 m from the closest boundary of the site. The remaining nine receptors are located at distances greater than 1.5 km from the site. In addition, aerial photography indicates that there are a number of vegetated areas and built structures that would screen views to the CPF from some locations. These receptors are considered to have limited views of the site. When the potential effects of screening vegetation and other obstructions are taken into account, as well as distance attenuation, the visual impact of CPF Site 7 is not anticipated to be significant.

18.4.4 Visual Absorption Capacity

Representative viewpoints were selected within the Stage 1 GFDA to provide an indication of the existing landscape in order to determine the visual absorption capacity. Photographs were taken at each of these viewpoints to demonstrate the existing landscape character as discussed in **Section 18.2.1** (refer **Photographs 1-9, Figure 18.6**). **Photographs 1-9** of **Figure 18.6** demonstrate the rural landscape character of the surrounding environment. The industrial influences of the Stratford Colliery are visible in **Plates 5, 6** and **7**.

The operational infrastructure proposed at the well sites is not considered to be visually intrusive in the context of the existing land uses, and is minimal in scale. **Figure 22.1** (**Photographs 10 and 11**) provides an indication of the visual nature of the well sites during construction, and during operation. Given the gently undulating topography of the landscape, the existing CSG extraction within the Stage 1 GFDA, and the existing industrial land use at the Stratford Colliery in the vicinity of Site 7, the landscape is considered to provide a good level of absorption capacity for the proposed development.

18.5 Potential Impacts

18.5.1 Stage 1 Gas Field Development Area

The project components in the Stage 1 GFDA would include up to 110 well sites, as well as gas and water gathering lines, and access roads. Visual impacts are likely to be associated with the preparation and construction of the well sites, gas and water gathering lines, and access roads, as well as the visual impacts associated with the operational infrastructure at well sites.

As discussed in **Section 18.4.1** above, the viewshed analysis for the well site locations (refer **Figure 18.1**) indicates the greatest number of proposed well sites visible from a single location would be no greater than four, which would be the case at two receptor locations. A further 7 receptors would have three proposed well sites visible, 19 receptors will have two proposed well sites visible, and 30 receptors would have one proposed well site visible within their respective viewsheds.

Construction

The construction phase of the Project would involve plant and equipment of a substantial scale operating for periods of up to 8 weeks at each well site if 24 hour drilling is undertaken (or up to 10 weeks if daytime drilling only is undertaken). The entire Stage 1 GFDA is expected to be developed over a period of 18 months, therefore not all well sites would be developed at once. Plant and equipment located at well sites during construction would include drilling rigs, earth movers and graders, excavators and electricity generators. The initial well site construction footprint would be approximately 90 x 90 m with a hardstand area of some 65 x 65 m, but would be reduced to approximately 15 x 15 m once well completion has been undertaken. **Photograph 10** of **Figure 22.1** shows an aerial view of the Stratford Pilot wells during construction and **Photograph 11** of **Figure 22.1** shows the reduced well sites, after rehabilitation.

Construction of the CPF would be undertaken over a period of twelve months. Plant and equipment required would be similar to that required during the construction of well sites. Plant and equipment would be delivered to the site at the commencement of construction, and would generally remain on site for the duration of construction works. Works would generally be limited to daytime hours.

Construction of gas and water gathering lines and access roads would be ongoing throughout the construction period, staged to suit the requirements of the staging of well site locations. Construction of gas and water gathering lines would require trenchers, as well as earth movers, excavators and graders. Construction vehicles would be predominantly mobile, and would not remain at a fixed location for a significant duration. Gas and water gathering lines would be laid in the same trench and where possible, trenching would be undertaken along fence lines and existing access roads to minimise ground disturbance and associated visual impacts.

Given the substantial scale of plant equipment required during the construction of well sites and the CPF, visual impact is anticipated to be greatest during the construction period. However given the temporary nature of construction works, potential visual impacts would be limited to a finite period, and are likely to be significantly reduced during operation.

Operation

Once the entire Stage 1 GFDA has been developed, there would be up to 110 well sites present. Operational well site locations would be reduced to a 15 x 15 m operational footprint following the initial rehabilitation of the construction footprint. Initial rehabilitation would be undertaken in consultation with relevant landowners, and may include replanting of native vegetation or crop cover according to surrounding land uses.

Operational well head plant and equipment is described in **Chapter 5** and shown in **Photograph 1** of **Figure 5.15**. The scale of operational plant and equipment that would remain on site is not considered to be substantial, and would be designed to be sympathetic to the surrounding environment in terms of materials, colour schemes and landscaping, and is not considered to be visually intrusive. **Photograph 10** of **Figure 18.6** depicts an existing well site on the Tiedemans property, photographed from approximately 400 m distance. The scale of the infrastructure from this distance is minimal, with other elements of the landscape dominating the field of view.

Given this, the scenic value for which the Vale of Gloucester was nominated for formal listing (but which is not fully listed currently), would not be impacted by the Project. The scenic value would not be detrimentally affected by the Project given the minor nature of the visual impacts and the ongoing agricultural activity as the predominant activity within the Vale of Gloucester. As a result, it is also not considered that related tourism activities would be impacted. However, this is discussed in greater detail in **Chapter 20**.

The visual impacts are not considered significant as the aboveground infrastructure associated with the operation of the Stage 1 GFDA is minimal. Potential visual impacts would be further minimised through the use of appropriate materials and landscaping. Materials used would be consistent with the existing landscape character and would be selected following landowner consultation.

18.5.2 Central Processing Facility

Construction

The construction of the CPF and associated site works would generate short term visual impacts for a period of some 12 months. These activities would potentially be visible from receptors within the viewshed of both CPF Site 1 and Site 7, as well as motorists and passengers passing through along The Bucketts Way.

During construction works, machinery and equipment required for construction would be present on the site, however these impacts would be temporary and present only for the duration of construction. The field of view of motorists and passengers from The Bucketts Way would be transient and constantly changing, therefore potential visual impacts are likely to be minimal.

Residential receptors with views of both CPF Site 1 and Site 7 would be screened to a certain extent by existing vegetation and the built environment. This will assist in screening either CPF site and therefore views are likely to be partially or fully obscured.

Given the existing industrial nature of the existing visual landscape, including the Stratford Colliery and rail loop adjacent the proposed CPF Site 7, and the relative remoteness of CPF Site 1, visual impacts associated with the construction period are not likely to be significant.

Operation

Both CPF Sites 1 and 7 would be visible from the adjacent road network and sensitive residential receptors shown on **Figures 18.2**, **18.3, 18.4** and **18.5**. Potential motorist receptors from The Bucketts Way would have a transient view of the site, as discussed above, and therefore potential impacts are likely to be minimal.

Views to CPF Site 1 would be partially obstructed at most receivers by existing vegetation and the built environment.

Given the industrial nature of the existing activities at Stratford Colliery located immediately to the east of the proposed CPF Site 7, the visual impact of the proposal in the context of these substantial operations is considered to be minimal. Given the presence of these industrial operations in the existing landscape, it is considered that the proposed CPF would integrate relatively well into the landscape without being visually intrusive.

As the proposed CPF would operate 24 hours per day, exterior lighting would be required in accordance with relevant safety standards. As such, there is a potential for light spill from the site to affect the visual amenity of the surrounding residential receptors during evening and night time periods. Notwithstanding functional and safety requirements, exterior lighting would be designed in accordance with relevant standards, including *Australian Standard 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting*.

18.5.3 Pipeline

Construction

The construction of the pipeline would be through predominantly rural, agricultural and pastoral areas with visual and landscape characteristics similar to the Stage 1 GFDA and Concept Area. As the pipeline corridor avoids traversing towns for a majority of its length, potential visual impacts are likely to be limited to temporary, short term impacts at rural homesteads associated with vegetation clearing, the presence of heavy vehicles along existing roads and access tracks, temporary storage facilities and communications systems, machinery, plant and equipment, and vehicle movements.

Given the transient nature of construction of the pipeline, potential visual impacts at particular points along the route would be temporary, thereby minimising potential visual impacts.

Operation

Operation of the pipeline is not anticipated to result in significant visual impacts. Surface infrastructure would be minimal, and generally limited to surface markers spaced at bends and fencelines, but not more than 250m apart to delineate the location of the pipeline. Significant portions of the pipeline corridor would be located within existing easements, therefore potential visual impacts at these locations during operation would be minimal as there would not be significant visual change.

The remainder of the pipeline would be located in areas dominated by cleared agricultural and pastoral land uses. Given that surface infrastructure would be limited to surface markers, once the pipeline corridor has been rehabilitated following construction, the visual characteristics of the affected areas are anticipated to be similar to pre-construction. Rehabilitation of the pipeline corridor is discussed in **Chapter 22**.

18.6 Environmental Safeguards

Potential visual impacts associated with the proposed development have been considered throughout the design of the Project. Consultation has been undertaken with landowners within the Stage 1 GFDA to identify suitable locations for well sites which minimise visual impacts. The CPF locations have been selected with regard to the visual characteristics of the surrounding area, and are proposed to be located proximate to existing industrial land uses in order to minimise potential impacts.

The pipeline route selection considered the location of townships along the pipeline route, with townships avoided for most of the pipeline length, thereby minimising receptors and the potential for visual impacts. Significant portions of the pipeline corridor would be located within existing easements to minimise potential visual impacts.

Environmental safeguards to further minimise potential visual impacts for the construction and operation of the Project are described below.

Construction

The following safeguards are proposed to minimise visual impacts during construction of well site locations, the CPF and the pipeline corridor:

- Implementation of a Traffic Management Plan as discussed in **Chapter 16** to minimise traffic flows, identify haulage routes and utilise internal purpose built construction access roads to minimise visual traffic impacts;
- Directional lighting would be employed to minimise light spill from construction footprints particularly for night time drilling.

Operation

The following safeguards would be implemented during operation of the Project to minimise potential visual impacts:

- Preparation of a Landscape and Rehabilitation Management Plan (LRMP) as part of the OEMP which would identify appropriate landscaping and rehabilitation treatments which would provide or retain screening vegetation to obscure views of project components;
- Monitoring and maintenance of landscaping and rehabilitation planting;
- Ongoing consultation with landowners on the operation and maintenance of well site infrastructure and other above ground infrastructure and facilities would be taken into consideration to minimise visual impacts; and
- Exterior lighting at the CPF would be designed to minimise light spill, and would be generally in accordance with *Australian Standard 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting,* notwithstanding functional and safety requirements.

18.7 Residual Impacts

The project may potentially result in temporary visual impacts to the visual characteristics of the surrounding landscape during the construction period, however following initial rehabilitation, the Project will integrate with the existing visual character of the surrounding landscape. The visual impacts of the Project following implementation of environmental safeguards and management measures are therefore not anticipated to be significant.

18.8 Conclusion

The proposal is likely to result in short term visual impacts associated with construction of project components including well site locations, the CPF(either Site 1 or Site 7) and the pipeline corridor. Additionally, construction impacts are minimised through the staging of activities throughout the Stage 1 GFDA, and the transient nature of activities during construction of the pipeline corridor.

Following construction, the scale and nature of operational infrastrcuture is likely to be significantly reduced, thereby minimising potential impacts. Operation of the Project is not likely to significantly affect the visual characteristics of the landscape.

Environmental safeguards have been recommended to minimise potential impacts. Provided these are implemented, the proposal is not anticipated to result in significant visual impacts to the existing environment.

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19.0 Heritage

This chapter investigates Aboriginal and Historic Heritage issues associated with the Concept Area and Project Area, including the Stage 1 GFDA, the CPF Sites 1 and 7 and the pipeline. Potential impacts and mitigations during the construction, operation and rehabilitation phases of the Project are investigated in this Section. This Section is based on the specialist Heritage Assessment provided in ***Appendix K****.*

19.1 Regional Context

An analysis of the natural resources available in a region are used to aid investigations of Aboriginal heritage to gain an understanding of the environmental conditions faced by hunter-gather societies, and consequently, the range of cultural remains that may be expected. Natural resources include the flora and fauna that may have provided food and material resources, and are linked to the hydrology, geology and soil types in a region, as detailed in **Appendix K**.

Prior to European settlement, the study area was inhabited by people of three Aboriginal language groups including the Birpai language group in the far northern section of the study area (around Gloucester), the Worimi language group in the majority of the study area and the Awabakal language group in the far southern section of the study area (south of the Hunter River) as further described in **Appendix K**.

Europeans first settled the Newcastle region in 1804 when a convict settlement was established. By 1818 European settlement extended as far north as the Hunter Valley and brought a period of decline in Aboriginal population numbers, largely due to the smallpox pandemic that caused an unknown number of deaths between 1830 and 1832. The traditional life of the Awabakal and Worimi were also affected by the creation of the port of Newcastle on the Hunter River in the late 18th century, while the Biripai were affected more by the arrival of the cedar cutters and farmers in the early 19th century.

19.1.1 Concept Area

There have been relatively few archaeological surveys carried out in the lowlands of the Gloucester region. Artefact scatters and isolated finds have been the most frequently recorded site types.

The predominant archaeological site type is the stone artefact scatter, typically buried within the upper soil horizon, with stone artefacts made mostly from silcrete or mudstone. Smaller proportions of stone artefact assemblages are of quartz, petrified wood and other igneous material.

The greater Hunter Valley, including the Concept Area, was closed to free settlement up until 1825 because of its close proximity to the Newcastle penal colony. Europeans first arrived in the Gloucester valley in 1826, when early settlement was encouraged in the area due to its ideal appearance for grazing and agriculture. By 1903, subdivision and good promotion by Gloucester Estate Limited resulted in rapid growth in the Gloucester area as further described in **Appendix K.**

The AHIMS search for the Concept Area revealed that there are five sites recorded within the Concept Area. The location of these sites is shown on **Figure 19.1**.

Potential impacts associated with future development within the Concept Area would be similar to those identified for the Stage 1 GFDA including:

- Ground disturbances at well site locations (initially 90 x 90 m at each well site location), construction camp locations, along access tracks and water and gas gathering lines;
- Indirect impacts or accidental impacts such as equipment being located or placed outside the areas

Watercourses present within the Concept Area, which may require to be crossed for the water and gas gathering system include:

- Avon River;
- Gloucester River; and
- Other creeks and unnamed watercourses.

Potential impacts associated with future development within the Concept Area would be assessed in a similar manner. Fieldwork relating to potential Aboriginal and historic heritage and artefacts within the Concept Area was not undertaken as part of this EA and further investigation would be required for future developments as part of subsequent Project applications.

19.1.2 Project Area

Stage 1 GFDA

The AHIMS search revealed that there are two sites recorded within the Stage 1 GFDA. One located south east of the Wenham Cox Road and Avondale Creek junction (38-1-0031) and the other located to the south east of Stratford Colliery (38-1-0008) (refer to **Figure 19.2**), however, neither were relocated during this survey due to access restrictions on the Stratford Colliery.

In addition to the sites registered in AHIMS, there are several other known sites within the Stage 1 GFDA, which were identified during an Aboriginal heritage assessment for the Stratford Pilot Project (FLALC 2007). Three stone artefacts (isolated finds) were identified, however, these sites have not yet been recorded in AHIMS. The FLALC report does not provide a specific location for any of the sites they found; however, it appears that the sites were found in the vicinity of Dog Trap Creek, probably on the property known as the Tiedeman Property.

CPF Site 1 and Site 7

The CPF Site 1 is located within the Tiedeman Property and is currently vacant, consisting of mainly grassland on relatively flat terrain. The FLALC report has identified three stone artefacts (isolated finds) likely to be located within the Tiedeman Property although their specific locations were not identified.

The CPF Site 7 is located on land currently owned by Gloucester Coal, on a parcel of land adjacent to a rail loop which currently services Stratford Colliery. The site is currently vacant and consists predominantly of grassland with some scattered sparse vegetation (refer to **Section 3.3.2**). There were no Aboriginal or historic heritage sites identified within CPF Site 7.

Pipeline

In the Lower Hunter Valley, there have been many salvage excavations on land that has been impacted by open cut mining, predominantly consisting of open sites with artefact scatters. A test excavation program was undertaken by Silcox and Ruig (1995: 36) around the margins of the Hexham Wetlands, which demonstrated that archaeological material was widespread and occurred in silcrete concentrations of varying sizes and density, separated by stretches of ground where much lower artefact numbers were present.

The AHIMS search revealed that there were four Aboriginal sites located within a 1,000 m buffer corridor of the pipeline as shown in **Figures 19.2 – 19.16** and further described in **Appendix K**. Two of the sites within the pipeline buffer zone (DECC 37-2-0336 and 37-2-0337) have erroneous positions recorded in AHIMS. These sites were recorded within the Mt Arthur Coal Mine Lease Area in the Hunter Valley; they are not within this study area. Furthermore, they have since been destroyed during a previous development pursuant to a Section 90 consent under the *National Parks and Wildlife Act 1974*. One of the sites within the pipeline corridor, a bora ring (DECC 38-1-0006) was identified during the field survey although an error in coordinate recording shows the site to be further south than it actually is (**Figures 19.1** to **19.16**). Further south, an isolated stone artefact site (AHIMS #38-4-0010) is recorded on the banks of Little Black Camp Creek. This site is recorded in AHIMS as where a massacre took place. It was formerly recorded as an "Aboriginal Place", but this reference was removed on 6 November 1997 because the site is not a formally declared Aboriginal Place. This site was not re-identified during the survey, except for the general locality.

19.2 Summary Methodology

An Aboriginal heritage survey was conducted, according to the EARs, which consisted of identifying known Aboriginal sites, places, issues and values, together with a predictive model (**Section 3** of **Appendix K**) to define target sample areas for intensive survey. Aboriginal community consultation was undertaken in accordance with the DEC (2004) *Interim Community Consultation Requirements for Applicants* (ICCRs). Details of the Aboriginal Consultation process, including the groups involved, their contribution, responses and fieldwork are provided in Section 4 of **Appendix K**. The fieldwork results are provided below in **Section 19.3**.

The Aboriginal heritage assessment for the initial study area was sent out to the Aboriginal stakeholders involved in the consultation process for this project allowing an opportunity to provide comments regarding the assessment. Subsequent amendments to the Project including changes to the CPF site location and some minor adjustments to the pipeline corridor, required additional field work and consultation with Aboriginal stakeholders. The amended Aboriginal heritage assessment was sent to the Aboriginal stakeholders involved. Comments were received for each of the reports sent to the Aboriginal stakeholders and these have been addressed in **Appendix K**.

Predictive modelling was utilised to draw predictions regarding the likelihood of finding sites in the study area. The predictive modelling in this project used a combination of desktop reviews of previous surveys in the region with existing Aboriginal site data, followed by a physical inspection of the study area to verify those sites and to locate and record any new sites.

The potential for finding Aboriginal sites in the study area is detailed in **Appendix K,** however, in summary, the predictive modelling in conjunction with findings from previous Aboriginal assessments (e.g. Gay, 2000) indicated that isolated finds of stone artefacts are considered to be the main site type likely to be found for the immediate area around Gloucester (i.e. Concept Area) and these were predicted to most likely occur within 100 m of larger creeks with reliable water. Along the pipeline route, the most likely site type to be encountered is the 'open camp site' consisting of an artefact scatter.

For the historic heritage survey, the methodology used for identifying the historic heritage values of the study area comprised a desktop review of previous heritage reports associated with the study area in conjunction with a review of relevant heritage databases to identify heritage sites currently listed in and around the study area. Databases searched included the NSW Heritage Office's (DoP) Heritage Database for the Gloucester, Great Lakes, Dungog, Port Stephens, Maitland and Newcastle Local Government Areas (LGAs), including the State Heritage Register (SHR), relevant government agency section 170 registers and relevant Regional Environmental Plans (REPs) and Local Environmental Plans (LEPs). Searches were also made of the Australian Heritage Database encompassing the Register of the National Estate (RNE), the National Heritage List (NHL), the Commonwealth Heritage List (CHL) and World Heritage List (WHL). Further details are provided in **Appendix K**.

19.3 Fieldwork Results

A total of nine Aboriginal sites with artefactual evidence were located in the field area or along the approximately 100 km of the pipeline route (total length of potential pipeline route considering either CPF location) and their significance assessed as shown in **Figures 19.1 – 19.16** and further described in **Appendix K**. A Bora ground (DECC # 38-1-0006) is recorded adjacent to the pipeline route, and was identified during the field survey although an error in coordinate recording shows the site to be further south than it actually is (**Figure 19.7**). In addition, 14 potential archaeological deposits (PADs) were also identified (one PAD in the Stage 1 GFDA and 13 along the pipeline corridor).

19.3.1 Stage 1 GFDA

Outlined below are the fieldwork results for Stage 1 GFDA. The identifier numbers relate to LEA (Archaeology), PAD (Potential Archaeological Deposit) or LEH (Historic).

The significance assessment or the Aboriginal sites is based on scientific and educational potential. The Aboriginal groups have been provided with a draft of the full assessment report. Some general recommendations were provided by the Aboriginal stakeholders, however, specific details regarding cultural and social significance for identified sites were not received (refer to Section 4.6 of **Appendix K**).

Table 19-1: Significance Assessment for Aboriginal and Historic Sites Identified in Stage 1 GFDA

Site ID	Site Type	Scientific Assessment	Educational Assessment	Social/Cultural Assessment	Significance
LEA1	Scarred Tree	The poor condition of the tree provides some doubt as to whether the scar is culturally formed: *Low*	Of limited educational value: *Low*	Not Given	Low
LEA2	Isolated Find	Two stone artefacts of similar style to artefacts found elsewhere: *Low*	Of limited educational value: *Low*	Not Given	Low

Site ID	Site Type	Scientific Assessment	Educational Assessment	Social/Cultural Assessment	Significance
LEA3	Artefact Scatter	Single stone artefact of similar style to artefacts found elsewhere: *Low*	Of limited educational value: *Low*	Not Given	Low
Vale of Gloucester	Historic	Not assessed	Not assessed	Not assessed	Listed as 'Indicative Place' on Register of National Estate

19.3.2 CPF

As noted above, no sites have been identified in relation to either of the potential CPF sites.

The FLALC report has indicated three stone artefacts (isolated finds) likely to be located within the Tiedeman Property (CPF Site 1) although their specific locations were not identified.

19.3.3 Pipeline Corridor

Outlined below in **Table 19-2** and **Table 19-3** is the significance assessment of sites identified within the pipeline corridor or in the vicinity (refer to **Figures 19.2** to **19.16**). One item – LEH11 – is already listed on a heritage instrument and was not reassessed here.

Table 19-2: Significance Assessment of Aboriginal Sites Identified Along the Pipeline Corridor during the Field Survey

Site ID	Site Type	Scientific Assessment	Educational Assessment	Social/Cultural Assessment	Significance
LEA4	Isolated Find	Single stone artefact that exhibited very few diagnostic features: Low	Of limited educational value: Low	Not Given	Low
LEA5	Isolated Find	Single stone artefact of similar style to artefacts found elsewhere: Low	Of limited educational value: Low	Not Given	Low
LEA6	Artefact Scatter	Two stone artefacts of similar style to artefacts found elsewhere: Low	Of limited educational value: Low	Not Given	Low
LEA7	Scarred Tree	The shape of the scar on this tree is unusual and makes identification as a cultural scar doubtful: Low	Of limited educational value: Low	Not Given	Low
LEA8	Artefact Scatter	Two stone artefacts of similar style to artefacts found elsewhere: Low	Of limited educational value: Low	Not Given	Low

Site ID	Site Type	Scientific Assessment	Educational Assessment	Social/Cultural Assessment	Significance
LEA9	Artefact Scatter	Two stone artefacts of similar style to artefacts found elsewhere: Low	Of limited educational value: Low	Not Given	Low
AHIMS #38-1-0006	Bora ground	Re-identified during survey and is probably of high scientific value.	Unsuitable for educational use: Low	Not Given	High

Table 19-3: Significance Assessment of Historic Sites Identified Along the Pipeline Corridor during the Field Survey

Site ID	Name	Significance Criteria	Significance Assessment	Significance
LEH1	Cobb and Co Hut	-	Not assessed as situated approximately 500 m outside pipeline corridor and not to be impacted.	*Unknown*
LEH2	Unnamed Tree	-	Not assessed as situated approximately 800 m outside pipeline corridor and not to be impacted.	*Unknown*
LEH3	Hut and Stockyard	g	An interesting pastoral hut dating from the late 19th century that retains many relics of former pastoral life.	*Local*
LEH4	Stockyard	-	This stockyard is similar to any one of hundreds of similar items still extant.	*None*
LEH5	Brick Pile	-	This site does not display any evidence of historic heritage value.	*None*
LEH6	Hut	-	An interesting hut that exhibits some features of early construction but is largely obscured by subsequent additions. Not assessed as situated approximately 100 m west of the pipeline corridor.	*Unknown*
LEH7	Stockyard	-	This stockyard is similar to any one of hundreds of similar items still extant.	*None*
LEH8	Bridge	-	The bridge is similar to many existing farm-track bridges still evident in the Gloucester region.	*None*

Site ID	Name	Significance Criteria	Significance Assessment	Significance
LEH9	Bridge	-	The bridge is similar to many existing farm-track bridges still evident in the Gloucester region.	*None*
LEH10	Mound	-	This site is not considered to have any heritage value.	*None*
LEH11	Bridge	-	This site is not considered to have any heritage value.	*None*

19.4 Potential Impacts

19.4.1 Stage 1 GFDA

The Stage 1 GFDA would be impacted by the construction of up to 110 wells. The wells would have an initial impact area of typically 90 x 90 m (8,100 m^2) during drilling and the hardstand for each well would be reduced to 15 x 15 m (225 m^2) during production, with the remaining land restored. The gas gathering system would be constructed to convey the gas from the well heads to the CPF. Access tracks would also be required for the construction and maintenance of well sites and gas gathering lines, however, existing farm tracks would typically be utilised where possible.

Activities associated with the construction, operation and rehabilitation of the Stage 1 GFDA may potentially have direct impacts 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.

Table 19-4 below provides details on the likely impacts of the proposed works within the Stage 1 GFDA and the final management requirements.

Table 19-4: Management Commitments for Aboriginal Sites and Historic Sites within Stage 1 GFDA

Site ID	Within Study Area?	Final Impact?	Final Management Requirement
LEA1	Yes. Field Area	No	Nil. This site is considered to be too close to the creek bank to be affected.
LEA2	Yes. Field Area	No	Nil. It is understood that the proponent is not considering any further development in this area.
LEA3	Yes. Field Area	No	Avoid any ground-breaking activities within 100 m of this location.
AHIMS #38-1-0008	Yes. Field Area	No	Nil. Gas field infrastructure is not expected to impact this site.
AHIMS #38-1-0031	Yes. Field Area	No	Nil. Gas field infrastructure is not expected to impact this site.

Site ID	Within Study Area?	Final Impact?	Final Management Requirement
Three unrecorded sites on the Tiedeman Property (FLALC 2006)	Yes. Field Area	Potential	Existence of these sites not verified. Should CPF Facility 1 be chosen as the CPF site, then consultation with FLALC should be conducted and if the sites are within the proposed footprint, they should be salvaged under AHMP procedures.
PAD1	Yes. Field Area	No	Nil required. The pipeline route was moved approximately 20 m westwards to climb the ridge via a shallow re-entrant between two spurs to avoid the PAD.
Vale of Gloucester	Field Area	No detrimental impact	Nil required. Some effect due to introduction of new industry within the Vale of Gloucester agricultural area, however, the impacts are not considered to be detrimental or significant (refer below for further discussion)

The Vale of Gloucester was nominated for listing on the Register of National Estate due to the outstanding visual amenity afforded by the Avon Valley floor bordered by the spectacular ranges to the east and west. The nomination's current status as an Indicative Place indicates that the nomination has not yet been accepted by the Australian Heritage Council (the status simply means that it somewhere in the assessment process).

The Vale of Gloucester covers a vast area (250 km^2) which consists of townships, farms and agricultural lands, roads, open cut mines and other infrastructure.

The RNE Indicative listing notes the key heritage values as being:

- Scenic: the town of Gloucester is surrounded by a series of low hill ranges which dominate the valley floor and provide a spectacular backdrop to the agricultural activity that takes place in the valley.
- Historical: The nomination listed its historic value as being based on the fact that the Vale was discovered in 1826 by the (then) chief agent of the Australian Agricultural Company, Robert Dawson, and that a homestead was built while the area was being developed for sheep-raising.

It is not believed that the scenic value of the Vale of Gloucester would be detrimentally affected by the Project and this is discussed further in **Chapter 18**.

The project would introduce a new industry to a part of the Vale of Gloucester. However, agriculture (the reason for which historically the area expanded under Robert Dawson) would remain the predominant industry within the Vale.

The Stage 1 GFDA covers approximately 16% of the Vale, however the gas wells are not considered to 'detract from the essentially rural nature of the area' and the Project would not have an impact on the 'more outstanding features of the landscape' (i.e. The Bucketts Way to the west and the ranges to the east) as indicated in the condition and integrity for the listing (see **Appendix K**). The majority of the development would be subsurface and is not considered to be detrimental to the rural nature of the area. Except in the immediate vicinity of the CPF, which is located adjacent to the existing rail loop to the Stratford Colliery or within the Tiedeman Property, all lands associated with the development would retain their existing (rural/agricultural) uses.

It is considered that there would be no detrimental impacts to the Vale of Gloucester on a historic heritage basis.

19.4.2 CPF

The CPF Site 1 would cover an area of approximately 0.064 km^2 or the CPF Site 7 would cover an area of approximately 0.072 km^2 which would be impacted through construction of the site. No sites or archaeological potential has been identified within this area and so no impacts are anticipated.

The CPF site is not anticipated to detrimentally impact the Vale of Gloucester on a historic heritage basis as detailed above in **Section 19.4.1** and in **Appendix K**.

19.4.3 Pipeline

Construction of the pipeline would consist of clearing and grading a temporary construction corridor within a 30 m ROW along the entire route. This would involve minor vegetation clearance. The survey sampled a corridor up to 100 m wide to allow for minor alterations to the intended route.

It is intended that, where possible, existing infrastructure corridors/easements such as the transmission line easements or Telstra telephone cable corridors, would be used to site the pipeline. Many of these areas have already received a high level of disturbance, particularly those where cable burial has occurred. Access tracks would also be required for the construction and maintenance of the pipeline corridor, however, existing farm tracks and roads would typically be utilised where possible.

Activities associated with the construction, operation and rehabilitation of the pipeline may potentially have direct impacts to archaeological sites through the movement of topsoil and subsoil during construction and rehabilitation of the pipeline corridor. Indirect or unintentional impacts may also occur with the potential for equipment being located or placed outside the areas previously investigated.

Table 19-5 below provides details on the likely impacts of the proposed works within the Stage 1 GFDA and the final management requirements. The proponent has minimised the potential for impacts to Aboriginal and Historic sites through the design and re-design of the pipeline route in the initial stages of the Project based on earlier recommendations provided by the 'Heritage consultant' (AECOM).

Table 19-5: Management Commitments for Aboriginal and Historic Sites and PADs along the Pipeline Alignment and within the Pipeline Buffer Zone

Site ID	Within Study Area?	Final Impact?	Final Management Requirement
LEA4	Yes. Within the pipeline corridor	No	Nil. A subsequent inspection of the site on 10 October 2008 failed to relocate the object, despite it being located in a prominent position.
LEA5	Yes. Within the pipeline corridor	No	Pipeline alignment should be approximately 20 m further west (i.e. 30 m from the site) to avoid impacts from trenching and spoil deposition. Should realignment be unfeasible and damage to the site unavoidable, surface artefact collection should be conducted.
LEA6	Yes. Within the pipeline corridor	No	Nil. Alignment of the pipeline is within the disturbed road easement and would avoid this site.
LEA7	Yes. Within the pipeline corridor	No	Nil. Alignment of the pipeline is within the disturbed road easement and would avoid this site.

Site ID	Within Study Area?	Final Impact?	Final Management Requirement
LEA8	Yes. Within the pipeline corridor	Potential	Recommend test excavation along the western bank of Deadmans Creek and collection of surface artefacts.
LEA9	Yes. Within the pipeline corridor	Potential	Recommend test excavation along the western bank of Deadmans Creek and collection of surface artefacts (Mitigation to be reviewed depending upon distance of HDD (as applicable) from Creek bank).
AHIMS #38-1-0006 *(This site was re-identified during the survey and was not given a new site ID).*	Yes. Within the pipeline corridor	Potential	Ensure pipeline alignment remains in road easement on the eastern side of Black Camp Road. Recommend retaining archaeologist and Aboriginal community representative to monitor construction in this area, under AHMP procedures.
AHIMS #38-4-0010	Yes. Buffer Zone	Potential	Ensure pipeline alignment remains in road easement on eastern side of Black Camp Road. Recommend retaining archaeologist and Aboriginal community representative to monitor construction in this area, under AHMP procedures.
LEH1	Yes. Within the pipeline corridor	No	Nil required. This building is located greater than 100 m outside the proposed alignment (and on the opposite side of the highway) and is therefore not considered to be under threat from the pipeline.
LEH2	Yes. Within the pipeline corridor	No	Nil required. The current alignment of the pipeline is approximately 490 m east of the item.
LEH3	Yes. Within the pipeline corridor	No	Nil required. This item is located more than 100 m west of the proposed alignment and is not considered to be under any threat from the development. Should realignment be considered in the vicinity of this site any ground-breaking activities should not be conducted within 50 m of the building with preference given to the eastern side of Black Camp Road or within the road easement.
LEH4	Yes. Within the pipeline corridor	Potential	The pipeline is located within the disturbed road easement and would pass to the east of this site; however the site is adjacent to the road side and impacts may occur during construction.

Site ID	Within Study Area?	Final Impact?	Final Management Requirement
LEH5	Yes. Within the pipeline corridor	No	The pipeline is located within the disturbed road easement and would pass to the east of this site; however the site is adjacent to the road side and impacts may occur during construction.
LEH6	Yes. Within the pipeline corridor	No	Nil required. The pipeline would pass 100 m west of this site. No impacts expected.
LEH7	Yes. Within the pipeline corridor	No	Nil required. The pipeline passes 100 m north of the site. No impacts expected.
LEH8	Yes.	Possible	Nil required. This item is not considered to have heritage significance.
LEH9	Yes.	Possible	Nil required. This item is not considered to have heritage significance.
LEH10	Yes. Within the pipeline corridor	No	Nil required. Pipeline passes 100 m west of this site. No impacts expected.
LEH11	Yes. Within the pipeline corridor	No	Nil required. Pipeline passes 100 m west of this site. No impacts expected.
PAD2	Yes. Within the pipeline corridor	Yes	PAD unavoidable. Provisions of AHMP apply.
PAD3	Yes. Within the pipeline corridor	No	Nil. Proposed alignment does not impact PAD.
PAD4	Yes. Within the pipeline corridor	Yes	PAD unavoidable. Provisions of AHMP apply.
PAD5	Yes. Within the pipeline corridor	Yes	PAD unavoidable. Provisions of AHMP apply.
PAD6	Yes. Within the pipeline corridor	No	Nil. It is recommended that the gas pipeline remains within the road easement. Recommend retaining archaeologist and Aboriginal community representatives to monitor excavation works in this area of Black Camp Road, under the provisions of an AHMP.
PAD7	Yes. Within the pipeline corridor	No	Nil. Alignment of the gas pipeline remains within the road easement.
PAD8	Yes. Within the pipeline corridor	No	Nil. Alignment of the gas pipeline remains within the road easement.
PAD9	Yes. Within the pipeline corridor	No	Nil. The pipe line is located within the disturbed road easement and would pass to the south of this PAD; impact is unlikely.
PAD10	Yes. Within the pipeline corridor	No	Nil. The pipe line is located within the disturbed road easement and would pass to the east of this PAD; impact is unlikely.

Site ID	Within Study Area?	Final Impact?	Final Management Requirement
PAD11	Yes. Within the pipeline corridor	Yes	PAD unavoidable. Provisions of AHMP apply.
PAD12	Yes. Within the pipeline corridor	Yes	PAD unavoidable. Provisions of AHMP apply.
PAD13	Yes. Within the pipeline corridor	No	Nil. The present alignment along the fence line is considered to be sufficient to minimise impact to this area.
PAD14	Yes. Within the pipeline corridor	No	Nil. Current alignment of pipeline would pass to the north of this PAD; no impacts are expected.

19.5 Residual Impact

The proposed development has been designed to have minimal impacts to Aboriginal or heritage sites identified within this EA (**Table 19-4** and **Table 19-5**). Additionally, the environmental envelope assessment approach allows for the location of infrastructure to be altered slightly should an adverse impact to heritage items be identified.

However there is potential for impacts to occur to some identified Aboriginal and historic sites and PADs where realignment of the pipeline is unfeasible, particularly where the pipeline crosses creeks at near right angles and any realignment would carry the same risk. These areas are identified in **Table 19-4** and **Table 19-5**.

Management options identified in **Section 19.6** would be adhered to and implemented in order to minimise impacts as far as possible.

19.6 Safeguards

General mitigation measures applicable to all sites within the Stage 1 GFDA, CPF and pipeline corridor would include:

- Aboriginal sites/objects and historic heritage places/items within 100 m of the pipeline would need to be identified and flagged so that construction crews would not accidentally damage them (the exception to this is if they are on neighbouring property that would not be impacted by construction work).
- An Aboriginal Heritage Management Plan (AHMP) should be developed with provisions for dealing with any Aboriginal object or site that may be encountered in the course of construction. The AHMP would detail procedures for management of existing Aboriginal heritage sites and procedures for management of objects that are encountered during the construction phase of the development (e.g. procedures for construction in the vicinity of known sites and PADs, procedures for the discovery of skeletal remains, procedures for the discovery of unrecorded Aboriginal objects). The Awabakal Descendants Traditional Owners Aboriginal Corporation have requested they be consulted during the development of the AHMP. Management commitments in the AHMP would include, but not limited to, the management commitments outlined in this section and **Appendix K**.
- All standing archaeological structures would be avoided by the pipeline construction footprint.

- Should historical archaeological sites be encountered during the excavation process, then work would cease at that location and a qualified historical archaeologist consulted.
- Should Aboriginal archaeological sites be encountered during the excavation process, then work would cease at that location and DECCW and the relevant Aboriginal stakeholders notified.
- Construction crews would be made aware of the potential for cultural heritage values to occur in the Project Area. Training and induction would be provided and reinforced during regular toolbox talks.

A series of specific mitigation recommendations have been provided to the proponent regarding the Aboriginal, historic and PAD sites recorded throughout the Stage 1 GFDA, CPF and pipeline corridor as detailed in **Appendix K**.

19.7 Conclusion

The Aboriginal and historic heritage assessment indicated that the potential for impacts to heritage items would be minimal due to the recommended mitigation measures which have already been incorporated into the design of the Project. Furthermore, potential impacts would be minimised through the implementation of the general environmental safeguards and management options for Aboriginal and historic heritage sites and artefacts.

Upon implementation of environmental safeguards and management measures identified, the impacts associated with Aboriginal heritage are not expected to be significant.

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20.0 Socio Economic

A socio economic assessment of the Project has been undertaken. This chapter details the demographics of the Gloucester Shire LGA, the local and regional economy and workforce trends, and details potential impacts on the local area, the Hunter Region, and NSW.

The Project involves the development of CSG resources within the Concept Area, which is predominantly located within the Gloucester LGA to the north and the Great Lakes LGA to the south. The Stage 1 GFDA is entirely contained within the Gloucester LGA. The Project also includes construction and operation of the pipeline in a corridor from Stratford to the HDS at Hexham. This assessment of socio economic impacts has focused on the local socio economic impacts upon the Gloucester Shire LGA, as the Project is considered to have the greatest potential socio economic impact in this region due to the concentration and duration of activities in the Stage 1 GFDA. Furthermore, socio economic impacts associated with construction of the pipeline are likely to be temporary and transient in nature. Following construction, potential impacts would be negligible as there would be minimal activity associated with the pipeline therefore amenity is unlikely to impacted.

20.1 Concept Area

The existing socio economic environment of the broader Gloucester Shire LGA is considered below, and incorporates the Concept Area which includes the Stage 1 GFDA. Potential impacts would be similar for both the Stage 1 GFDA and the Concept Area. It should be noted however that the CPF and pipeline would be of sufficient capacity to cater for the additional wells constructed within the broader Concept Area. As such, the only development within the Concept Area would be the wells and gas and water gathering lines. Given that the Stage 1 GFDA and Concept Area effects would be largely the same, the assessment below considers both the Concept Area and Project Area. Potential impacts include:

- Beneficial impacts to the local economy;
- Potential impacts to local infrastructure and services; and
- Potential amenity impacts to sensitive receivers.

The majority of the Concept Area lies within the Gloucester LGA, with the southern portion of the Concept Area lying within the northern portion of the Great Lakes LGA. The potential socio-economic impacts to the Great Lakes LGA would be considered when Project Approval is sought for further development within the Concept Area, however potential impacts would be considered to be similar to the Stage 1 GFDA. The characteristics of that area and the potential impacts are likely to be similar to those discussed in detail in relation to the Project Area as outlined below.

20.2 Project Area

20.2.1 Gloucester Shire Demographics

Current Population

The population of the Gloucester LGA recorded a total population at the 2006 census of 4,800 persons. Between the 1996 and 2006 census, a total decline in growth rate of -0.2% occurred. This is compared to a total population in the Hunter Region of 589,240 persons, approximately 9% of the NSW State total population of 6.5 million. The Hunter Region experienced a growth rate of 0.8%, only slightly below the average for NSW of 0.9% (HVRF, 2008).

Gloucester LGA is considered part of the Hunter Region. Analysis undertaken by the Hunter Valley Research Foundation (HVRF) has characterised the Hunter Region into three sub-regions:

- Lower Hunter comprising Maitland, Port Stephens, Newcastle, Lake Macquarie, and Cessnock LGAs;
- Upper Hunter comprising Singleton and Muswellbrook LGAs; and
- Other Hunter comprising Great Lakes, Dungog, and Gloucester LGAs.

These sub-regions are referred to in the following sections.

Age Structure

The age structure of the Other Hunter region experienced a decline in the growth rate of persons aged between 15 and 39 year olds. Overall, the population in this region under 40 years old declined by an average of 0.8%. Within the Gloucester LGA, this rate of decline in persons under 40 years old was greater at 2.7%, which also represents the greatest rate of decline in the whole Hunter Region.

The ratio of old-age dependency i.e. persons aged greater than 65 years old compared to the average working age population 15-64 years old, has been increasing in both the Hunter Region and the State over the past 10 years, however the Hunter Region has demonstrated a higher growth rate of 25%, compared to the State with an average of 21%. The ageing demographic and falling proportion of younger workers indicates the need to provide services and infrastructure as well as incentives to retain and attract young people to the region, in particular Gloucester, to maintain the economic viability of the region.

Workforce

Total employment in the Hunter Region has experienced a 16.9% growth between the 1996 and 2006 census surveys, with the total persons employed increasing from 209,930 in 1996 to 245,351 in 2006. The employment growth has been attributed to continued expansion and diversification of the regional economy, increased female participation in the labour force, and falling unemployment (HVRF, 2008). The unemployment rate in the State as well as the Hunter Region has shown a steady decline, although the decline has been more pronounced in the Hunter Region.

Compared to the State, employment change in the Hunter Region is considered to be both more cyclical and more volatile, with increases and declines proportionally more pronounced in the Hunter than in the State as a whole. Since 2005, although employment growth has continued to be more volatile than in NSW, the overall pattern of employment growth is more consistent with NSW patterns. This has been partially attributed to the increased stability in employment that has occurred as a result of demands of the resource sector in the last three years, as well as the regional economy being increasingly diversified and robust (HVRF, 2008).

Compared with the State, in 2006 the Hunter Region demonstrated proportionally higher employment of technicians and trade workers; machinery operators and drivers and labourers, reflecting the higher proportion of people with trade and vocational qualifications, as well as higher employment in industries such as manufacturing and mining. Gloucester LGA had the second greatest proportion (19.6%) of persons employed in the agriculture, forestry and fishing industry sector than other LGAs in the Hunter Region besides the Upper Hunter Shire (20.2%). This industry sector was the greatest employer in the Gloucester LGA, with health care and social assistance (10.5%), retail trade (9.9%) and manufacturing (8.3%) the other major employers.

Beef and dairy cattle farming accounted for 16% of all employed residents. Gloucester LGA has recorded job losses in the years leading to 2006, attributed to reforms to the timber and dairying industries (Hunter Development Brokerage, 2006).

Coal mining accounted for 1.9% of employment in the Gloucester LGA, and was recorded as one of the top 10 industries in the LGA.

Local Economy

Census data indicates that the four largest employers in the Hunter Region are retail trade, healthcare and social assistance, construction and manufacturing. The first three sectors experienced increased growth at the 2006 census and contributed to 60% of all regional jobs growth from 1996 to 2006, while the latter (manufacturing) experienced a slight decline. The professional, scientific and technical services, and public administration and safety sectors also experienced relative growth. Employment requirements continue to be reduced in the agriculture and mining sectors, with drought and farm amalgamations also having an impact (HVRF, 2008).

The top 10 employment industries in the Gloucester LGA in 2006 included the following:

- Beef Cattle Farming (Specialised);
- Hospitals (except Psychiatric Hospitals);
- Local Government Administration;
- Dairy Cattle Farming;
- Supermarket and Grocery Stores;
- Primary Education;
- Road Freight Transport;
- Secondary Education;
- Coal Mining; and
- Cafes and Restaurants.

Gloucester was the most dependent of all the Hunter LGAs on its ten major industries, with these industries employing 40% of the workforce, compared to 22% employment in the top 10 industries in the Hunter Region as a whole. Gloucester LGA therefore is the least economically diverse in the region, with potentially the greatest susceptibility to jobs losses by sector (HVRF, 2008).

Gloucester Shire Council has developed a Strategic Plan for the Economic Development of the Gloucester District (Gloucester Shire Council, 2006) which identifies markets for potential future economic growth. Tourism is recognised as having significant potential into the future to fuel economic growth within the Shire. The Hunter Region is the fourth most visited region by tourists in NSW behind Sydney, and the North and South Coasts, respectively.

The key strengths of the Gloucester Shire which form the basis of the tourism industry are centred on the cultural and landscape values of the Shire, including the agricultural and pastoral lands which characterise the Gloucester Basin, and natural heritage values of the surrounding areas, including Barrington Tops National Park. The scenic values of the area near Gloucester along The Bucketts Way are also nominated on the Register of the National Estate as the Vale of Gloucester, although heritage values of the area have not been formally listed. These scenic values contribute to the appeal of the area to tourists. The tourist industry is supported by a range of boutique accommodation in the LGA including farmstays and bed and breakfast lodges, as well as motels, caravan parks and camping areas.

Community Infrastructure and Services

A range of community infrastructure and services are available in the Gloucester LGA, primarily located within the town of Gloucester. The *Gloucester Shire Community Plan 2003-2008* outlines a range of infrastructure and services including health services, education, sport and leisure and aged care support services which are detailed below:

- **Health Services:** the Mid North Coast Area Health Service operates the Gloucester Community Health Centre which offers a range of services including mental health, social worker, welfare officer, pathology and child and family services. Gloucester Medical Centre also offers 24 hr on-call doctor service. Dental and other general health services are also available through private practitioners.
- **Education:** St Joseph's Primary and Gloucester Primary Schools, Gloucester High School, as well as a number of other small rural schools are located in the LGA.
- **Sport and Leisure:** Gloucester Swimming Pool Complex and Gloucester District Park offer a range of facilities including gymnasium, sporting fields, netball courts and cricket ovals.
- **Aged Care Services:** a range of services including aged care units, self contained housing, nursing home facilities, hostel and a proposed retirement village.

20.3 Potential Impacts

Potential socio economic impacts of the Project are discussed below for both construction and operation.

20.3.1 Construction

Economic Impacts

The presence of the construction workforce along the length of the pipeline is anticipated to have short term positive impacts for local economies of the affected LGAs due to the demand for goods and services by the construction workforce. The Project is likely to result in direct positive impacts associated with temporary construction employment generation, with up to 465 temporary construction jobs, some of which would likely be sourced from the local area (refer to **Section 16.5.4**).

The Project, including the Stage 1 GFDA, CPF and pipeline would also result in indirect benefits to the Gloucester Shire associated with expenditure on local goods and services, food, fuel, infrastructure and other supplies, which would potentially be beneficial to a range of industries including hospitality, accommodation, rental, hiring and real estate services, construction and retail trade. These benefits would also be realised at other townships along the pipeline as construction moves along the length of the pipeline. Construction workers camps would be established as part of the Project to accommodate workers within the Stage 1 GFDA and mid way along the pipeline. These camps would be located and designed to be self-sufficient such that they are close enough to townships to support local retail and hospitality economies.

Camps would be subject to further detailed design, and would be constructed and operated in accordance with the CEMP to be prepared for the Project. Additionally, a site specific Construction Workforce Management Plan would be contained within the CEMP to address site management principles which would be designed to consider both construction personnel and the local population, while not stifling the potential economic benefits that the presence of the temporary construction workforce may have on local communities.

Community Infrastructure and Services

There is potential for the Project to temporarily increase the demand for public health facilities in the region such as hospitals and general practitioner medical services via the potential increase in population as a result of increased flow-on employment associated with the Project.

Construction workforce camps would likely be required for both construction of the Stage 1 GFDA and pipeline. Two construction workforce camps are proposed; one camp for up to 100 construction personnel to accommodate the workforce for the Stage 1 GFDA and CPF, and one camp for up to 300 people located approximately half way along the pipeline corridor to accommodate the construction workforce for the pipeline. A construction workforce camp would be required for the construction of the Stage 1 GFDA to reduce the impact on the existing accommodation facilities within Gloucester, as it is a tourist destination and would not be sufficient to accommodate all the construction personnel. Camps would be located proximate to construction areas in order to minimise commuting distances and use of road networks. In this respect, construction personnel would generally be transported to and from construction sites via bus, to minimise strain during the construction period.

Camps would include all required infrastructure including water and sewage management, electricity, ablutions facilities, wet mess, recreation facilities and sleeping quarters. Camps would be designed to be relatively self-sufficient to avoid reliance on public infrastructure and amenities, but would be located within reasonable proximity to townships to allow use of amenities and opportunities to access local retail and hospitality economies. Management principles would be applied to the construction workforce camp to minimise mass migration of workers to local towns on a regular basis, for example the construction workforce camps would be “wet” sites to prevent workers travelling to towns to utilise pubs, clubs and hotels.

The presence of the construction workforce and construction workforce camps would be temporary during the construction period, and as such there is not anticipated to be a permanent significant demand on other infrastructure and services in areas affected by construction within the Stage 1 GFDA or along the pipeline corridor.

Sensitive Receivers

The proposed Stage 1 GFDA would be developed over 18 months or longer, depending on the development scenario (refer to **Section 4.2**), whilst the CPF and pipeline would likely be constructed over a period of some 12 months. While impacts are not anticipated to be significant, the construction phase may temporarily result in minor impacts to the socio economic environment of townships and other sensitive receivers. Potential impacts to sensitive receivers are primarily related to amenity and include noise, air quality, traffic, visual and hazard and risk. These issues have been assessed in this EA and are summarised as follows:

- **Noise –** the proposed construction of project components may exceed identified noise assessment criteria, however, impacts would be of a temporary nature. With the implementation of appropriate mitigation and management, potential amenity impacts associated with noise are unlikely. Sensitive receivers along the pipeline corridor may experience short term exceedences of noise criteria during the day time, however are not anticipated to be significantly affected by construction noise. Pipeline construction and associated noise would be transient along the length of the pipeline, and noise impacts at any particular point would be temporary and limited from as little as several days to several weeks. Mitigation measures would be implemented to minimise potential impacts (refer **Section 14.6**).

  Construction workforce camps could potentially have adverse impacts on local sensitive receptors, however the siting of workforce camps would consider the proximity to receivers. Noise impacts associated with construction workforce camps are not anticipated to be significant.

- **Air Quality –** the air quality assessment concluded that air quality would not be significantly affected provided recommended mitigation measures are implemented during the construction and operation of project components (refer **Section 9.5**).
- **Traffic –** traffic movements on local and regional roads would be generated by the delivery of plant, equipments and materials throughout the construction period, however there is not likely to be significant amenity impacts to existing traffic conditions. A Traffic Management Plan would be implemented, which would include measures to minimise local road congestion around sensitive receivers such as schools during peak hour periods. Where possible, traffic movements would utilise internal access routes (refer **Section 16.9**).

  The use of construction workforce camps would minimise traffic movements to and from construction sites, as the majority of the workforce would be transported via bus from the construction workforce camp which would minimise the daily use of personal vehicles to and from the construction site.
- **Hazard and Risk –** the PHA prepared in respect of the Project assessed potential risks to human health and land uses surrounding the Project infrastructure, and concluded that the Project meets the relevant land use safety risk tolerability criteria (refer **Chapter 15**).
- **Visual –** the Project may result in minor and temporary visual impacts during the construction phase of the gas field development, however visual impacts are not expected to affect to the overall existing landscape character or scenic values of the area. The potential CPF sites have been located proximate to existing CSG infrastructure associated with the Stratford Pilot Project and industry such as the Stratford Colliery with existing industrial landscape characteristics. The well site locations have been located such that generally there is significant spacing between well sites and from any particular location, the number of well site visible is usually fewer than four sites. Furthermore, construction and development of well sites would be staged between 18 months up to 5 years and as such the number of visible well sites under construction would generally be limited to no greater than two (refer **Section 18.6**).

Given the temporary nature of the construction period and transient nature of construction works, potential amenity impacts to sensitive receivers are likely to be minimal. Upon implementation of mitigation measures, amenity of sensitive receivers and tourists in the Gloucester area is not likely to be affected.

20.3.2 Operation

Economy

The Project has been assessed in terms of potential effects on the local economy of the Gloucester Shire, as well as the impact of the Project on the regional and State economies.

The Strategic Plan for the Economic Development of the Gloucester District (Gloucester Shire Council, 2006) identifies key opportunities for economic development in the LGA which includes the development of the Shire as a centre for commercial and industrial opportunities, as well as key threats to the local economy which includes the foreseen closure of the Gloucester Coal operations and associated loss of employment. The project is considered to be consistent with these initiatives, and it is considered that the Project would potentially offset, to a certain extent, jobs lost in other declining industries in the Shire such as agriculture and forestry.

The agriculture, forestry and fish aquaculture industries accounts for the greatest proportion of employment in the Gloucester Shire, approximately 19.6%. The Project is not anticipated to have a significant effect on this industry in terms of the availability of land as a result of operation. Landowners that would be directly affected by the Project, as well as surrounding landowners, have been consulted throughout the development and design of the Project. A majority of the land affected within the Stage 1 GFDA is pastoral freehold land, and would generally be returned to a land use consistent with the pre-construction land use once the operation phase of the Project commences. Productive land affected by the construction of pipeline corridor would similarly be returned to pre-construction land uses where possible, and would be managed through ongoing consultation with landowners. **Chapter 22** details methods for rehabilitation following construction. **Photographs 10** and **11** on **Figure 22.1** provide photos of a well site location before and after initial rehabilitation.

At a regional and State level, securing a cost effective energy supply with reduced carbon emissions (compared to other fossil fuel energy generation) is considered vital to the economic growth of the State. NSW has the largest energy market in Australia, however currently only produces approximately 10% of its total natural gas requirements. The Project would result in a number of overall beneficial impacts to the region and State, primarily as a result of the provision of an indigenous gas supply for NSW. The Project would also have the potential to support industrial and economic growth in the Hunter Region, particularly Newcastle and the Lower Hunter.

Community Infrastructure and Services

Up to some 40 personnel would likely be associated with operation of the Project. As such, the operation of the Project is not likely to result in additional demand on community infrastructure and services. Once the Project is operational, the workforce would be significantly reduced and additional investment in community infrastructure and services would not be required.

The Project may result in some benefits to the community in terms of a possible supply of treated water which could potentially be used for irrigation, however investigations into reuse of treated water are ongoing. The Project may also result in benefits to local landowners where opportunities exist to upgrade internal access tracks and roads, as well as other road upgrades and improvements, such as Black Camp Road.

20.4 Environmental Safeguards

To minimise potential impacts to the socio economic environment of the Gloucester LGA and other LGAs affected by the Project, a Construction Workforce Management Plan would be prepared as part of the CEMP to manage impacts. In addition, the siting of construction workforce camps would consider relative proximities to towns in order to maximise indirect economic benefits to local service providers and the hospitality industry.

20.5 Conclusion

The Project is not anticipated to result in significant negative impacts to the socio economics of the local Gloucester Shire, Hunter Region or NSW. The Project is likely to have a positive impact on regional and State economies due to the provision of an indigenous gas supply, while the Gloucester Shire also may experience positive impacts associated with demand for local goods and services during both the construction and operation phases of the Project.

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21.0 Greenhouse Gas and Climate Change

This section addresses the issue of climate change, including ways the Project may be affected by climate change in coming years. A greenhouse gas assessment is also provided for the components of the Project.

21.1 Concept Area

Future developments within the Concept Area would involve the construction of further gas field developments. The CPF has been designed with adequate capacity (approximately 30 PJ per year) to accommodate treatment of gas produced from the Concept Area. Potential impacts of the development of the Concept Area relating to greenhouse gas emissions and climate change would be assessed in future project applications.

21.2 Overview

The Hunter Region experiences relatively elevated temperatures during summer, with average maximum January temperatures of approximately 29–32°C. Winters are mild, with average maximum July temperatures of 17–18°C. Annual rainfall varies across the Hunter region with about 650 mm/year. The average rainfall at Gloucester is higher than the regional average, at around 981 mm/year (Gloucester Shire Council, 2006). Peak precipitation typically occurs between January and March, while the driest months are typically from July to December, however, the variability in rainfall from one year to the next is high.

A recent report (CSIRO, 2004) released on behalf of the NSW Government found that between 1950 and 2003, NSW became 0.9°C warmer, with more hot days/nights and fewer cold days/nights. Annual total rainfall reduced by an average of 14 mm per decade, with the largest declines in rainfall near the coast since the mid-1970s. Extreme daily rainfall intensity and frequency have also decreased throughout much of the state.

21.3 Sea Level Rise

The Stage 1 GFDA, including the CPF, is located at an elevation of approximately 100 – 150 m Australian Height Datum (AHD), according to topographic mapping (Gloucester 1:25 000). The pipeline would traverse terrain with an elevation of approximately 150 m in the northern section of the pipeline and would decrease to approximately 3 m AHD near Hexham, according to the Digital Elevation Model (DEM) of Newcastle LGA (NSW DoP, 2008). Whilst the extent and rate of climate change occurring on the east coast of Australia is a matter of some debate, there currently appears to be a technical consensus that the climate is now changing at an increasing rate. Consequently, the coastal zone would experience the most direct physical impacts of climate change and significant sea level rise (SLR) is anticipated along the east coast of Australia. The most authoritative and most recent (at the time of writing) report on climate change (IPCC, 2007) predicts a global average SLR of between 0.2 and 0.8 m by 2100, compared with 1980 levels. In addition to SLR, climate change is also likely to result in changes in wave heights and direction, coastal wind strengths and rainfall intensity, all of which have the capacity to impact adversely on development. Mean relative SLR (including land movement) around Australia of about 1.2mm/year was recorded over the period 1920 to 2000. In Sydney, the frequency of extreme sea-level events reaching 2.1 to 2.2 m AHD has doubled or tripled, respectively, since 1950 (CSIRO, 2004).

For NSW, climate change related sea level rise and an increased frequency and intensity of storms has the potential to impact virtually all aspects of occupation of the low lying coastal areas (NSW DoP, 2008) including:

- Loss of sandy beaches, especially where they are backed by seawalls;
- Increased flood levels in the tidal reaches of estuaries by approximately the amount of sea level rise, this would be especially significant around coastal lakes and lagoons;
- Changed estuarine tidal regimes (flows and elevation);
- Problems with local drainage in the lower estuaries and adjacent to beaches where falls are currently small, potentially exacerbating nuisance storm flooding (increased frequency and water depths);
- Reduction in under bridge clearances; and,
- Landward migration of mangroves and salt marshes in areas of no development and, where development restricts migration, potential loss of threatened and endangered species.

The potential for the proposed development to be affected by direct wave action and SLR is considered to be low because the pipeline is buried and the southern portion of the pipeline and the HDS are located at Hexham, approximately 19 km from where the Hunter River meets the sea. Other components of the Project including the Stage 1 GFDA and CPF would not be impacted by the anticipated SLR due to their elevation; however, these areas may experience more intense precipitation events. Mitigation measures for flooding events in the vicinity of the Stage 1 GFDA and CPF have been incorporated into the design of the infrastructure as described in **Chapter 12.**

Changes in sea level within the ranges predicted by CSIRO are not anticipated to impact on the operation of the proposed development or be adversely impacted by the proposed development. The Project is anticipated to be decommissioned by approximately 2040, and as such, long term changes in SLR would not impact the Project.

21.4 Temperature Increase

Since 1950, the Hunter region has experienced warming of around 1.3ºC. This is likely to be partly due to human activities. The CSIRO (2007) has indicated that average Hunter temperatures are set to increase by 0.2 to 1.6°C by 2040 and by 0.7 to 4.8°C by 2070. The report stated that the number of extremely hot days (above 35°C could almost double by 2040 and there could be almost 4 to 4.5 more days above 35°C by 2070 (up to 78). The report also suggested that the number of days below zero could significantly drop from current levels.

Temperature changes within the ranges predicted by CSIRO are not anticipated to impact on the operation of the proposed development or be adversely impacted by the proposed development. The Project is anticipated to be decommissioned by approximately 2040, and as such, long term changes in temperature would not impact the Project.

There is also the potential for increases in the abundance of weeds, feral animals and bushfire associated with climate change. A Weed Management Plan would be prepared as part of the CEMP (refer **Chapter 25)** to mitigate the potential spread and / or establishment of weeds associated with the construction period and initial rehabilitation. During the operational phase of the Project, maintenance vehicles would utilise the existing road network and existing access tracks in addition to liaising with landowners in order to minimise the spread of weeds, per normal land management practice.

21.5 Bushfire Hazard

A projected increase in average temperature and a decrease in the average rainfall of the Hunter region are likely to result in a warmer and drier climate where the potential/occurrence of natural bushfires is increased.

There is potential for bushfire or grassfire to impact on the operations of the Stage 1 GFDA (well site locations and CPF Site 1 and Site 7), however, the wellheads and the gas gathering lines would contain protective fire-safe ball valves and other fire-safe components (refer **Section 15.4**), therefore, such an event would not compromise the integrity of the well infrastructure. Additionally, as part of the operational management measures, the area within the security fencing would be gravelled and controlled for weed and grass regrowth to minimise the incidence of fires and bushfire or grassfires in the general area.

As the pipeline is situated underground, it is not anticipated to be impacted by bushfires. Further bushfire management would be addressed in further hazard and risk studies and would be incorporated into the Emergency Response Plan (ERP) (see **Section 15.7**). Mitigations would be emplaced throughout all stages of the Project to minimise the likelihood of fires. Provided mitigations are emplaced, the Project is not anticipated to impact on increases in the a occurrence of bushfires or to be impacted by these.

21.6 Water Availability

The contribution of human activities to rainfall variability is hard to distinguish from natural variability. Although projected changes in average rainfall are currently not clear, given projected increases in evaporation associated with rising temperatures, the catchment is likely to be drier. Despite this trend toward drier conditions, there is also potential for seasonal increases in extreme rainfall events.

Changes in rainfall and higher evaporation rates are likely to lead to less predictable pattern of water for streams and rivers in the Hunter-Central Rivers Catchment, which would have downstream consequences for storages and place strains on water resources. For example, due to recent trends toward reduced rainfall, as of November 2008, the Glenbawn Dam on the Hunter River and the Glennies Creek Dam were at 62% and 68% of capacity respectively (previously 39% and 35%, respectively, in November 2007). However, the Lostock Dam on the Paterson River was 100% full for the previous two years (DNR, 2008), indicating the variability in precipitation within the region.

CSIRO (2007) has indicated that the Projected rainfall for the Hunter region on average may possibly change by -7% to +7% by 2040 and by -20% to +20% by 2070. Evaporation rates are also expected to increase as the expected average temperatures increase with maximum evaporation rates as high a +40% on current levels a possibility by 2070.

Changes in water availability within the ranges predicted by CSIRO are not anticipated to impact on the operation of the proposed development or be adversely impacted by the proposed development. The Project is anticipated to be decommissioned by approximately 2040, and as such, long term changes in water availability would not impact the Project.

21.7 Greenhouse Gas Assessment

A greenhouse gas assessment was undertaken for this project utilising methods sourced from the Australian Greenhouse Office publication *AGO Factors and Methods Workbook* (DEH, 2008) as detailed in **Appendix F.** The workbook determines the scope that emissions are reported under by the following activity descriptions:

- **Direct (or point source) emission factors** – Emissions produced from sources within the boundary of an organisation and as a result of that organisation's activities. Reported under scope 1; and
- **Indirect emission factors** – Emissions generated in the wider economy as a consequence of an organisation's activities but which are physically produced by the activities of another organisation. Reported under scope 2 (indirect) and scope 3 (various).

Sources or activities from the proposed project which are likely to generate scope 1 emissions include:

- Air emissions from the emission stacks at the CPF and HDS, which include:
  - Power generators;
  - Compressor Engines;
  - Alternator Engines;
  - TEG Facility (Re-boiler and Regeneration Skid);
  - Water Bath Heater (Hexham Delivery Station); and
- Flares during well construction in the Stage 1 GFDA.

A detailed commissioning plan for the well sites would be developed as part of the next stages of the Project planning and design. However, to be conservative, an assumption of flaring at the well heads during commissioning has been assumed. This includes flaring for approximately 1 month per well location. The flaring would occur only once per well and as such would only add to the total GHG emission of the facility for the first year.

Sources or activities from the proposed project which are likely to generate scope 2 emissions include:

- Electricity used to run plant operations.

Sources or activities from the proposed project which are likely to generate scope 3 emissions include:

- Gas pipeline transmission. The methods workbook supplies emission factors based on kilometres travelled for the transmission of natural gas to the government supply grid; and
- End use of gas produced at the facility.

The emission factors from equipment manufacturer's specifications or from Tables 3 and 5 of the workbook (DEH, 2008) were applied to estimate the total GHG emissions as CO_2-e from sources at the facility.

The GHG assessment results for each scope of emissions according to emission factors from equipment manufacturers' specification are provided below in **Table 21-1.**

Table 21-1: GHG Assessment Results for Scope 1, 2 and 3 Emissions

GHG Source	Number of units	Total Consumption		Total GHG kg CO_2-e	Total GHG t CO_2-e
Scope 1					
Power generators	5	1,115,729	(GJ/year)	57,270,395	57,270
Compressors	8	4,302	(GJ/year)	220,820	221
Alternator	1	269	(GJ/year)	13,801	14
TEG re-boiler	1	6	(GJ/year)	283	0.3
TEG regeneration skid	1	10	(GJ/year)	495	0.5
Flares (gas well commissioning)*	52	2989	(t/year)	-	8460.2
Water bath heaters	1	7300	(GJ/year)	374,709	375
Scope 2					
Electricity usage	-	2,000	(kWh/year)	1,780	2
Scope 3					
Pipeline transmission (indirect)	98 km	-		-	855
End user (large user)	-	30,000,000	(GJ/year)	426,000,000	426,000
Total					**492,343**

* each flare would be flared continuously for 4 week; assumed all flares are flared in the same year

Total greenhouse gas emissions resulting from operation of the Project were estimated to be approximately 492,000 t CO_2-e per year. This represents approximately 0.32 % of the total greenhouse gas emissions from NSW in 2007 (151.6 Mt CO_2-e) and 0.42% of the NSW emissions from the energy sector (117.2 Mt CO_2-e).

The beneficial aspects of the Project should be considered. If the power to be supplied by the Project was generated by coal-fired power stations, the associated Scope 3 end user greenhouse gas emissions would be approximately double, in the oder of 850,000 t CO_2-e. Methane is a powerful greenhouse gas, with a potency of around 25 times that of carbon dioxide; removing this methane from the coal seams for use as a power source not only reduces the amount of coal needed to be extracted to provide power, but prevents the release of the methane to atmosphere, reducing net greenhouse gas emissions (burning of natural gas emits primarily CO_2 emissions which has a greenhouse gas potency 25 times lower than Methane).

21.8 Conclusion

It is widely considered that natural gas would play a key transitionary role in reducing Australia's greenhouse gas emissions. The use of natural gas for energy consumption results in roughly half of the greenhouse emissions relative to coal and the avoidance of fugitive methane delivers additional abatement benefits.

In terms of the Gloucester Gas Project, general mitigations to minimise the amount of greenhouse gas emissions produced from the Stage 1 GFDA would include the efficient use of plant during the construction and operation phases of the Project (e.g. vehicles and machinery to be regularly maintained and to be turned off when not in use). Minimising the time that flares are to be active (i.e. minimise the time taken to cap the wells as much as possible) would also reduce the greenhouse gas emissions.

This proposed CSG project has the potential to deliver energy to Australia's most populous state at an emissions intensity that is considerably lower than the typical alternative of black coal. As such, likely greenhouse gas emissions from the Gloucester Gas Project are not considered to have significant impact on increasing greenhouse gas emissions, but rather assist in growth and contribute to achieving Australia's emissions reduction targets.

22.0 Rehabilitation

This section describes the rehabilitation programme proposed for initial rehabilitation of construction footprints at well sites and along the pipeline corridor, as well as rehabilitation of areas affected by the Project following decommissioning of project activities.

22.1 Concept and Project Areas - Overview

A programme of rehabilitation is proposed as part of the Project to ensure that pre-operational land uses are restored following completion of gas field development works within the Concept Area, Stage 1 GFDA and along the pipeline corridor. Rehabilitation would be undertaken at the following stages:

- Initial rehabilitation following:
  - Construction footprint at well site locations;
  - Construction workforce camps;
  - Construction of gas and water gathering system; and
  - Construction of pipeline corridor, including watercourse crossings.
- Decommissioning and final rehabilitation:
  - Operational footprints of well site locations;
  - CPF site;
  - Pipeline; and
  - Hexham Delivery Station.

The existing land uses within the Stage 1 GFDA and along the pipeline corridor are described in **Chapter 11**. The following section describes the staging of rehabilitation works and techniques that would be implemented following construction and operation, as well as environmental safeguards to minimise potential impacts during rehabilitation works. Rehabilitation of construction areas would be undertaken in the Concept Area in the same manner as the Stage1 GFDA and associated potential impacts are considered to be similar. These impactswould be assessed for the Concept Area as part of future project applications.

22.2 Initial Rehabilitation

The initial stage of rehabilitation works would be undertaken following the construction period. Rehabilitation would be undertaken on a site by site basis, with the nature of rehabilitation dependent on the existing land use at each site.

22.2.1 Well Site Construction Footprint

The well site construction footprint would be approximately 90 x 90 m with a 65 x 65 m gravel hardstand area comprising a relatively level construction footprint with drill pad, drilling and surface infrastructure, which would be present for a majority of the duration of construction works (refer to **Photograph 10** of **Figure 22.1**). Once drilling and well completion activities have been undertaken, the well site footprint would be reduced to approximately 15 x 15 m and the surrounding construction footprint would be rehabilitated (refer to **Photograph 11** of **Figure 22.1**). The remaining 15 x 15 m compound would contain well head infrastructure and equipment required for production and commissioning, and would be fenced and secured for the life of the well.

Initial rehabilitation of well site construction footprint would involve the following activities:

- Installation of appropriate sediment and erosion control measures to minimise erosion and sedimentation;
- Backfilling of excavated areas within the well site footprint where no longer required;
- Re-contouring of footprint to match the surrounding land;
- Broadcasting of seedstock and/or planting of seedlings across re-contoured areas in accordance with land owner requirements and Landscape and Rehabilitation Management Plan (LRMP) ; and
- Regular maintenance and monitoring would be carried out upon completion of the rehabilitation works to identify the presence of weeds, erosion and scour, and failure of plantings during the rehabilitation process.

22.2.2 Construction Workforce Camps

Rehabilitation of the construction workforce camps for the Stage 1 GFDA and for the pipeline construction would involve the following activities:

- Installation of appropriate sediment and erosion control measures to minimise erosion and sedimentation;
- Backfilling of excavated areas within the construction workforce camp footprint, upon decommissioning;
- Re-contouring of footprint to match the surrounding land;
- Broadcasting of seedstock and/or planting of seedlings across re-contoured areas in accordance with land owner requirements and LRMP; and
- Regular maintenance and monitoring would be carried out upon completion of the rehabilitation works to identify the presence of weeds, erosion and scour, and failure of plantings during the rehabilitation process.

22.2.3 Gas and Water Gathering System

Gas and water gathering lines would be installed throughout the Stage 1 GFDA to connect each well site to the CPF and water treatment facility, respectively. Gas and water gathering lines would be constructed along roads, access tracks and fence lines where possible to avoid disturbance to existing land uses and vegetation.

Following construction of the gas and water gathering system, trenches would be backfilled and re-contoured according to the surrounding landscape. Gas and water gathering lines would be rehabilitated in accordance with similar principles to those described for the pipeline below, and the location of gas and water gathering lines delineated by surface markers.

22.2.4 Pipeline Corridor

Rehabilitation of Pipeline Corridor

The pipeline ROW and associated construction work areas would be progressively rehabilitated following construction of the pipeline. Rehabilitation activities would generally include the following, but would also be undertaken in accordance with landowner requirements on a site specific basis:

- Pipeline trench would be progressively backfilled following lowering, welding and testing of pipe;

- Waste and other materials such as pipe off-cuts, pipe caps and timber skids would be removed from the site;
- Re-contouring of ROW would be undertaken to match the surrounding land;
- Stream beds and banks and drainage lines would be reconstructed to near original condition and provided with scour protection, such as rip rap or geotextile fabric;
- Broadcasting of seedstock and/or planting of seedlings across re-contoured areas would be undertaken in accordance with land owner requirements (refer to **Photograph 1** and **2** of **Figure 22.1**).
- Stockpiled topsoil and mulched vegetation would be respread evenly across the corridor area to assist in soil retention and structure, weed control and visual impact mitigation prior to establishment of vegetation (refer to **Photograph 3, 4, 8** and **9** of **Figure 22.1**);
- Regular maintenance and monitoring would be carried out upon completion of the rehabilitation works to identify the presence of weeds, erosion and scour, and failure of plantings during the rehabilitation process.

Rehabilitation of Watercourse Crossings

Watercourses affected by the construction of the pipeline would be reconstructed as soon as possible following disturbance to near original condition and provided with scour and erosion protection. A list of the watercourses that would be crossed during construction of the pipeline is provided in **Table 5-3** in **Chapter 5**. During construction, stabilisation requirements for banks and beds would be determined on a site specific basis. Local consideration of hydrology, soil type, land use and riparian vegetation would be undertaken to determine the most appropriate method. The following measures would be observed:

- Watercourse banks would be restored to their original profiles following construction;
- Stabilisation techniques such as the placement of rip rap, sand bags or gabion along the banks and bed at watercourse crossings shall be implemented to reinstate near original conditions, and so as not to block fish passage;
- Fencing would be installed where required to prevent access to restored sites to assist site recovery;
- Site specific requirements for additional sediment and erosion control measures during and following rehabilitation. These may include terracing and surface water diversion berms, silt and sediment fences, re-seeding and replanting, application stabilisation materials such as mulch, jute matting or other geotextile, minimising access, and application of appropriate ASS measures in accordance with the ASSMP (refer to **Photograph 5, 6** and **7** of **Figure 22.1**); and
- Topsoil excavated during construction would be stockpiled appropriately on site and reused along banks during rehabilitation to assist in bank stabilisation.

22.3 Decommissioning and Final Rehabilitation

22.3.1 Operational Well Site Footprint and Field Infrastructure

Well site locations within the Stage 1 GFDA have an anticipated life span of some 15 to 25 years, therefore CSG production is likely to be ongoing until approximately 2040, subject to project staging (refer **Section 5.3** and **5.8**). The 15 x 15 m operational footprint would be decommissioned and rehabilitated once a well site has reached the end of its life. Rehabilitation would be undertaken in accordance with the land owner, and the surrounding land use, and would generally include the following activities:

- Removal of above ground infrastructure and steel tubing from the well;
- Filling of well with cement as per the DPI plug and abandon guidelines;
- Installation and maintenance of sediment and erosion control measures;
- Filling in excavated areas and trenches and removal of hardstand areas;
- Lightly harrowing and recontouring of disturbed areas to reduce compaction and assist in seeding and seedling planting;
- Broadcasting of seed stock and/or planting of seedlings across recontoured areas in accordance with land owner requirements;
- Regular maintenance and monitoring would be carried out upon completion of the rehabilitation works to identify the presence of weeds, erosion and scour, and failure of plantings during the rehabilitation process; and
- Gas / water gathering lines would be left in situ and purged of gas, filled with an inert material, and capped to minimise further soil disturbances.

22.3.2 CPF

On decommissioning of the CPF, the site would be rehabilitated to standards consistent with regulatory requirements. This would generally include:

- Removal of above ground infrastructure and ancillary equipment;
- Installation and maintenance of standard sediment and erosion control measures;
- Lightly harrowing and recontouring of disturbed areas to reduce compaction and assist in seeding and seedling planting;
- Broadcasting of seed stock and/or planting of seedlings across recontoured areas in accordance with land owner requirements; and
- Regular maintenance and monitoring would be carried out upon completion of the rehabilitation works to identify the presence of weeds, erosion and scour, and failure of plantings during the rehabilitation process.

22.3.3 Pipeline

Following decommissioning of CSG extraction in the Stage 1 GFDA, it is likely that the pipeline infrastructure would no longer be required. The Proponent would consult with the relevant authority at such time to determine the most appropriate technique for the decommissioning of pipeline infrastructure. The pipeline would likely be suspended or abandoned in accordance with AS 2885 requirements, or accepted industry and environmental practice at the time. Current abandonment procedures include purging the pipeline of gas, filling with an inert material and allowing the pipeline and below ground infrastructure to remain *in-situ*. Other beneficial uses of the pipeline may be investigated at the time of decommissioning.

Above ground infrastructure such as marker signs would be removed along the length of the pipeline, and the ROW and disturbed areas such as access tracks that are no longer required would be rehabilitated in accordance with similar procedures described in **Section 22.3.1** above. Consultation would be undertaken with landowners to determine site specific requirements along the pipeline corridor, however where the pipeline is to remain *in-situ* the pipeline corridor would generally remain in its existing condition.

22.3.4 HDS

As for the CPF site, the HDS site would be rehabilitated on decommissioning to standards consistent with the regulatory requirements. Again this would generally include:

- Removal of above ground infrastructure and ancillary equipment;
- Installation and maintenance of standard sediment and erosion control measures;
- Lightly harrowing and recontouring of disturbed areas to reduce compaction and assist in seeding and seedling planting;
- Broadcasting of seed stock and/or planting of seedlings across recontoured areas in accordance with land owner requirements; and
- Regular maintenance and monitoring would be carried out upon completion of the rehabilitation works to identify the presence of weeds, erosion and scour, and failure of plantings during the rehabilitation process.

22.4 Potential Impacts

Rehabilitation activities have the potential to impact the environment primarily through sedimentation and erosion. Exposed areas within construction and operational footprints, access tracks, pipeline corridor and other disturbed areas could potentially result in sedimentation and erosion that may impact nearby watercourses and habitats if inappropriately managed. Additionally, stockpiling of vegetation, mulch and topsoil may also result in sedimentation and erosion with similar potential impacts if appropriate control measures are not implemented.

The rehabilitation would be undertaken generally in accordance with the techniques and activities described above, as well as in accordance with the *Australian Pipeline Industry Association Code of Environmental Practice – Onshore Pipelines* (APIA, 2005) which represents current best practice for the management of onshore pipelines. Environmental safeguards would be implemented to ensure rehabilitation does not result in significant environmental impacts.

22.5 Environmental Safeguards

Environmental safeguards would be implemented during all phases of rehabilitation to minimise potential impacts on the environment. Environmental safeguards would form part of a Landscape and Rehabilitation Management Plan (LRMP) which could be incorporated into the Proponents existing Environmental Management Plan to be implemented for the proposed works. The LRMP would detail landscaping and rehabilitation to be undertaken at well site locations, the CPF site, construction workforce camps and along the pipeline route at the initial and final stages of rehabilitation. This plan would be prepared with reference to Rehabilitation Security Deposits for Mining and Petroleum Titles (DPI, 2006) and other relevant guidelines with respect to completion criteria and would generally include the following:

- Ground disturbance during rehabilitation shall be minimised as far as practicable;
- Installation and maintenance of sediment and erosion control measures, such as silt fencing surrounding exposed areas and stockpiles;

- Soil and mulched vegetation would be stockpiled during the construction period where possible to be reused during the initial rehabilitation phase. Topsoil and subsoil would be replaced in an appropriate order;
- Surfaces would be re-contoured to match the surrounding land and natural drainage lines would be re-instated;
- Where revegetation is to be undertaken, native endemic species would be utilised;
- Where surrounding land use is agricultural, consultation would be undertaken with the land owner to determine the appropriate level of crop cover for the rehabilitated area;
- Appropriate weed control measures shall be implemented during rehabilitation works in consultation with relevant land owners and regulatory authorities, and weed monitoring shall be undertaken regularly on rehabilitated sites;
- Regular maintenance and monitoring would be carried out upon completion of the rehabilitation works to identify the presence of weeds, erosion and scour, and failure of plantings during the rehabilitation process;
- The success / completion of the rehabilitation at the initial and final stages would be determined according to success / completion criteria which would be detailed in the LRMP. Success / completion criteria may include:
  - Species cover and abundance;
  - Presence of weeds;
  - Presence of rock and soil inversion; and
  - Presence of erosion;
- Rehabilitated areas would be fenced with stock proof fencing where required to minimise unauthorised access and maximise success of rehabilitation works.

22.6 Conclusion

The proposed rehabilitation activities would result in areas affected by the proposal being returned to pre-operational and productive land uses following the initial and final rehabilitation phases. Ongoing consultation with land owners throughout the construction and operational phases of the development would ensure that land is rehabilitated to be consistent with surrounding land uses and in accordance with operational requirements for the land owner.

A LRMP would be developed and implemented for the Project as part of the Proponent’s Construction Environmental Management Plan to ensure that potential environmental impacts are minimised during the undertaking of rehabilitation works, and the rehabilitation works are monitored to ensure their success.

23.0 Waste

This section addresses the legislative requirements and classification of waste management in NSW, and details waste generation anticipated from the Project within the Concept Area, Stage 1 GFDA, CPF and pipeline corridor. Environmental safeguards and proposed waste management procedures are detailed to manage waste generation and minimise potential generation of waste.

23.1 Concept and Project Areas - Overview

The approach for the Concept Area regarding the management of wastes would be similar to the assessment undertaken for the Stage 1 GFDA as further detailed below. Wastes generated from future developments within the Concept Area would be similar to those assessed for the Stage 1 GFDA, due to the similar nature of the development (i.e. well field) and as such, a similar detailed assessment would be undertaken as part of future project applications.

23.1.1 Legislative Requirements

The *Protection of the Environment Operations Act 1997* (PoEO Act) primarily applies for activities identified as a 'Scheduled Activity' as listed in Schedule 1 of the PoEO Act. There are no scheduled activities, in relation to waste generating activities, for the construction and operation of the Project.

The *NSW Waste Avoidance and Resource Recovery Strategy 2007* (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 would encourage efficient resource use alternatives, re-use and recycling. Waste that cannot be re-used or recycled would be disposed of in an appropriate manner.

23.1.2 Waste Classification

The DECCW Waste Classification Guidelines (DECC, 2008) describe a number of pre-classified wastes and provide specific direction on the classification of wastes, based on chemical composition and associated environmental impacts. Waste streams require different management, transportation and disposal depending on their classification. The six waste categories are:

- Special waste (e.g. Clinical and related, asbestos and tyres);
- Liquid waste (e.g. human waste);
- Hazardous waste (e.g. waste with pH ≤ 2, coal tar, lead paint waste, etc);
- Restricted solid waste;
- General solid waste (putrescibles) (e.g. household wastes, manure, food wastes, etc); and
- General solid waste (non-putrescible) (e.g. glass, plastic, rubber, garden waste, etc).

A chemical assessment may also be undertaken to classify wastes. Potential wastes generated from the construction and operation of the Stage 1 GFDA, CPF, pipeline and HDS are described below in **Section 23.2.**

23.2 Potential Impacts

The proposed development would generate wastes during each of the construction and operation phases.

Waste would predominantly be generated during the construction phase of works from activities including:

- Civil works associated with the construction and preparation of the CPF, well site locations, drill pads, gas / water gathering lines and transmission pipeline;
- Drilling activities;
- Fracture stimulation and workovers;
- Initial rehabilitation of surplus construction areas;
- Construction workforce camps for the Stage 1 GFDA and pipeline construction; and
- Sanitary waste from contractors and personnel on site.

Waste materials generated from the construction and operation / decommissioning of the CPF, GFDA and the transmission pipeline have been classified according to the Waste Classification Guidelines as shown in **Table 23-1** and **Table 23-2** respectively.

One type of potential waste which may not be accurately classified until the water treatment process commences is the brine stream produced from the RO desalination and the resulting salt product from evaporation as described in **Chapter 5.** According to Step 5 of the waste classification guidelines, a further chemical assessment would be required to determine whether the solid salt waste produced may be classified as general solid waste or restricted solid waste. This would depend on the contaminant threshold of the product.

Table 23-1: Classification of Wastes Generated from the Project during Construction

Type	Stage 1 GFDA	CPF site	Pipeline Corridor	HDS
Special Waste				
Waste tyres	Temporary work sites and maintenance areas	Temporary work sites and vehicle maintenance areas	Temporary work sites and maintenance areas	Temporary work sites and maintenance areas
Liquid Waste				
Produced waters, drilling fluids and well completion fluids including approved water based products or synthetic lubricants	Well construction and production		HDD, Thrust bore	
Produced water (saline with some trace dissolved metals)	Well production			

Type	Stage 1 GFDA	CPF site	Pipeline Corridor	HDS
Hydrostatic test water			Hydrostatic testing of pipeline	
Human waste including pump out waste and sewage.	Temporary work sites and construction camps	Temporary work sites	Temporary work sites and construction camps	Temporary work sites
Fuels, engine coolant and hydrocarbon residuals	Temporary work sites during construction	Temporary work sites during construction	Pigging / scraper operations during maintenance	Temporary work sites during construction
Hazardous Waste				
Lead-acid or nickel-cadmium batteries	Temporary work sites and maintenance areas	Temporary work sites and maintenance areas	Temporary work sites and maintenance areas	Temporary work sites and maintenance areas
Cleaning agents, water treatment chemicals, spent pipeline x-ray film, fusion bonded epoxy powder or other plastic material.	Temporary work sites during construction and maintenance areas	Temporary work sites during construction and maintenance areas	Temporary work sites during construction	Temporary work sites during construction and maintenance areas
Any other generated wastes that meet the criteria for dangerous good under the *Australian Code for the Transport of Dangerous Goods by Road and Rail*.	None	None	None	None
General Solid Waste (putrescible)				
General waste including food waste and household waste from personnel and non recyclables	Temporary work sites, construction camps and maintenance areas	Temporary work sites and maintenance areas	Temporary work sites, construction camps and maintenance areas	Temporary work sites and maintenance areas
General Solid Waste (non-putrescible)				
Cleared exotic vegetation and surplus vegetation cuttings, timber skids	Construction of well pads and gathering line routes	Potential minor clearing during construction	Construction of pipeline route, weed control operations, pipe stringing	Potential minor clearing during construction

Type	Stage 1 GFDA	CPF site	Pipeline Corridor	HDS
Drained oil filters, empty oil containers and oil absorbent materials that do not contain free liquids, plastics (e.g. packaging, pipe caps), asphalt wastes, concrete wastes, cured resins, paints, glues	Temporary work sites during construction and maintenance areas	Temporary work sites during construction and maintenance areas	Temporary work sites during construction and maintenance areas	Temporary work sites during construction and maintenance areas
Excess virgin soil materials from excavation / grading activities, sand bags	Preparation and construction of well site locations	Preparation and construction of CPF and associated access route	Preparation and construction of pipeline route	Preparation and construction of HDS
Recyclables including glass, PET bottles, aluminium, scrap metal (e.g. pipe cuttings), rope spacers, paper and cardboard	Preparation and construction of well site locations and at temporary work sites	Temporary work site during construction	Preparation and construction of pipeline route and at temporary work sites	Temporary work site during construction

Table 23-2: Classification of Wastes Generated from the Project during Operation and Decommissioning

Type	Stage 1 GFDA	CPF site	Pipeline Corridor	HDS
Special waste				
Waste tyres	Vehicle maintenance	Vehicle maintenance	Vehicle maintenance	Vehicle maintenance
Liquid waste				
Produced waters, drilling fluids and well completion fluids including approved water based products or synthetic lubricants	Potential well re-completion and workovers			
Produced water (saline with trace dissolved metals)	Well operation	Water products from RO system		

Type	Stage 1 GFDA	CPF site	Pipeline Corridor	HDS
Human waste including pump out waste and sewage.		Operation of CPF		
Fuels, engine coolant and hydrocarbon residuals	Maintenance well workovers during operation	Maintenance during operation	Pigging / scraper operations during maintenance	Maintenance during operation
Hazardous Waste				
Lead-acid or nickel-cadmium batteries		Maintenance of vehicle and plant	Maintenance of vehicle and plant	
Cleaning agents, water treatment chemicals, spent pipeline x-ray film, fusion bonded epoxy powder or other plastic material.	Maintenance activities	Operation and maintenance	Potentially during cathodic protection, coating integrity surveys and pigging operations	
General Solid Waste (putrescible)				
General waste including food waste from personnel and non recyclables	Operation personnel	Operation personnel	Operation personnel	Operation personnel
General Solid Waste (non-putrescible)				
Cleared exotic vegetation and surplus vegetation cuttings, timber skids			Maintenance clearance and weed control	
Drained oil filters, empty oil containers and oil absorbent materials that do not contain free liquids, plastics (e.g. packaging, pipe caps), asphalt wastes, concrete wastes, cured resins, paints, glues	Well site location maintenance and well decommissioning	Maintenance activities for vehicles and decommissioning		Maintenance activities for vehicles and decommissioning

Type	Stage 1 GFDA	CPF site	Pipeline Corridor	HDS
Recyclables including glass, PET bottles, aluminium, scrap metal (e.g. pipe cuttings), rope spacers, paper and cardboard	Operational activities and personnel and decommissioning	Operational activities and personnel and decommissioning		Operational activities and personnel and decommissioning
Solid salt product		Water treatment of produced water by RO desalination and further brine evaporation		
Aboveground infrastructure free of liquids	During decommissioning stage	During decommissioning stage	During decommissioning stage	During decommissioning stage

23.3 Waste Avoidance and Management

As described in **Section 23.1**, 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. The following sections describe ways in which the Proponent aims to undertake the key outcomes outlined in the Waste Strategy, which include:

- Preventing and avoiding waste;
- Increasing use of renewable and recovered materials;
- Reducing toxicity in products and materials; and
- Reducing litter and illegal dumping.

23.3.1 Preventing and Avoiding Waste

Water produced from the wells would be stored in the water storage ponds. Investigations are underway in conjunction with community consultation for the alternative re-use of produced water once it is treated by RO desalination (see **Chapter 5)** to meet acceptable standards. Investigations are also currently underway into the potential downstream use of the solid salt produced from the RO desalination and brine evaporation treatment. There is the potential for this product to be transported to a salt producer for further processing into saleable products. Such practices would minimise the amount of waste water and salt produced as waste from the Project as the potential waste stream could be beneficially re-used by the local community and industry.

Further mitigations to prevent and avoid wastes throughout the Project are described in **Section 23.4.**

23.3.2 Use of Renewable and Recovered Materials

Management measures would be implemented to maximise the recycling of waste materials such as the stockpiling of reusable and recyclable materials including timber pallets and skids, drums, and scrap metals and the installation of designated bins at all sites for aluminium cans, glass, and paper. Designated recycling bins would be provided at each of the construction workforce camps and domestic wastes would be segregated.

Produced gas from the Project would primarily be used to power the CPF components (e.g. compressors) thus reducing the amount of energy used from the local electricity network. Additionally, waste heat from compressors at the CPF may be captured and utilised to heat the concentrated waste brine in the evaporation pond in order to enhance the rate of evaporation. This may result in an overall smaller evaporation pond required, therefore minimising the disturbance footprint at the CPF location.

23.3.3 Reducing Toxicity

Water treatment prior to disposal (e.g. to downstream users) would be undertaken to ensure that the disposed water meets acceptable criteria as further described in **Section 5.5.4**. The treatment would involve the removal of salts and other trace elements which may be present in the produced water.

The biological treatment of sewage at construction camps prior to discharge would be undertaken in accordance with the Waste Management Plan which would form part of the CEMP to ensure that effluent is treated and disposed in an appropriate manner as further detailed in **Section 5.6.7**.

23.3.4 Reducing Litter and Illegal Dumping

Staff and contractors would be regularly monitored to ensure that waste materials are managed appropriately and according to the Waste Management Plan within the CEMP. Wastes would be classified according to the DECCW Waste Classification Guidelines and suitable means of disposal would be provided to ensure that litter is reduced and that no illegal dumping occurs. Litter bins and recycling bins would be provided at each work site and regular site maintenance would be undertaken to ensure litter accumulation is avoided. Waste management at construction workforce camps would be incorporated into the CEMP. Further mitigation measures to reduce litter and prevent illegal dumping throughout the Project are described in **Section 23.4.**

23.4 Environmental Safeguards

A number of environmental safeguards would be implemented during all phases of the Project to minimise waste and to re-use and / or recycle potential generated wastes. A CEMP would be prepared and implemented prior to the commencement of construction activities (refer **Chapter 25**) and would include:

- Procedures to classify wastes in accordance with the Waste Guidelines and NSW legislative requirements;
- Mitigations to be implemented to avoid waste generation, and encourage reuse, recycling and disposal of wastes;
- Details of how waste would be quantified, stored, treated (on site) and disposed; and
- Reporting and recording procedures to track wastes in accordance with regulations.

Environmental safeguards and management measures to be implemented during the life of the Project are described below in accordance with the DECCW's Waste Classification Guidelines (DECC, 2008) and the *Waste Avoidance and Recovery Act 2001*. This legislation is designed to protect the general environment, surface water bodies and groundwater.

23.4.1 General Safeguards

General safeguards throughout the Project would include:

- Reuse and / or recycling of generated wastes would be undertaken where possible. Waste materials from the pipeline construction such as timber skids, sandbags, pipe caps and rope spacers would be recycled and re-used where appropriate;
- Wastes which are not suitable for reuse or recycling would be disposed of at an appropriately licensed facility and no wastes would be discarded at sites. Drill cuttings would be de-watered at the construction site with the fluids then disposed appropriately off-site and the cutting re-buried on-site. This would be managed in accordance with specific provisions of the CEMP;
- Waste management at construction workforce camps would include segregation and recycling of domestic wastes;
- Appropriate spill, incident management and response procedures would be implemented as part of the CEMP including measures to avoid spillages of chemicals, liquids and other wastes;
- Resource recovery and reuse strategies would be implemented for each type of waste material where applicable;
- Removal of aboveground infrastructure at decommissioning stage in accordance with best practices at the time; and
- Work sites would be cleaned up and rehabilitated following works.

23.4.2 Safeguards for Special Wastes

Safeguards for special wastes would include:

- Waste tyres would be disposed of at a licensed waste facility and would need to be tracked if transported interstate.
- Contaminated waste and oils would be removed from site for disposal by a licensed contractor.

23.4.3 Safeguards for Liquid Wastes

Safeguards for liquid wastes would include:

- Water returned to surface from the fracture stimulation process would be stored in lined pits to be reused in future fracture stimulation and finally transferred to the water storage ponds prior to treatment and subsequent disposal according to regulations (see **Chapter 12)**;
- Produced water from operational wells would be transferred to the water storage ponds via gathering lines prior to treatment and subsequent approved disposal (see **Chapter 12**);
- Liquid hydrocarbons would be removed by a licensed contractor to be disposed appropriately;
- Portable toilet facilities would be installed in construction areas during the construction period and maintained by a waste contractor; and
- Human wastes (effluent/sewage) generated at construction workforce camps would be managed in accordance with the Waste Management Plan.

23.4.4 Safeguards for Hazardous Wastes

Safeguards for hazardous wastes would include:

- Handling, storage, transport and tracking of hazardous materials and waste would be in accordance with the *National Code of Practice* and the relevant safety data sheet for the product; and
- Hazardous wastes would be transported by an authorised contractor and disposed of appropriately according to regulations at a licensed waste facility.

23.4.5 Safeguards for General Solid Wastes (Putrescibles)

Safeguards for general solid wastes (putrescibles) would include:

- Domestic wastes would be placed in dedicated covered rubbish bins for removal off site;
- Bins / rubbish bags containing putrescibles would be kept away from surface water drains and would be regularly removed and disposed of at an approved waste facility; and
- General waste generated during operations would be collected on site and removed to licensed facilities for disposal.

23.4.6 Safeguards for General Solid Wastes (Non-Putrescibles)

Safeguards for general solid wastes (non-putrescibles) would include:

- Excavated topsoil would be stockpiled and appropriately maintained onsite for reuse during backfill and / or initial rehabilitation of construction areas;
- Vegetation cleared from construction areas would be stockpiled (mulched when excess vegetation is present) onsite and maintained appropriately. Mulch would be respread during initial rehabilitation to minimise erosion and promote revegetation. Excess mulched organic material would be removed from the site and disposed of at a licensed waste facility as appropriate; and
- Solid salt produced from the water treatment and evaporation would ideally be transported to a salt producer for further processing into saleable products. If this option is not possible, the salt product would be disposed of to an appropriate facility. Dependent upon its final waste classification this would comprise a local landfill (if General Solid Waste) or a licensed landfill facility in Sydney (if Restricted Solid Waste).

23.5 Residual Impacts

The proposed development of the Stage 1 GFDA and the pipeline corridor is likely to result in the generation of wastes, in particular during the construction phase. Waste management procedures would be developed as part of the CEMP and Waste Management Plan implemented for the Project which would ensure waste is handled, stored and appropriately reused, recycled or disposed.

Furthermore, the generation of waste is likely to be predominantly during the construction phase, and therefore temporary in nature. As such, residual impacts associated with waste are not anticipated.

23.6 Conclusion

The project would result in the generation of wastes. Wastes such as excavated topsoil, cleared and mulched vegetation, produced waters from the well sites, and other reusable materials such as timber and sand would be managed and reused onsite or recycled where appropriate. Waste requiring offsite disposal would consequently be minimised, and as such residual impacts are not anticipated.

The implementation of waste management procedures would detail measures and environmental safeguards including those identified above in order to effectively manage waste generated by the Project. As such, waste generation is not considered to represent a significant constraint to the Project.

24.0 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 individual 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.

24.1 Cumulative Impact of the Project

The cumulative impacts of the proposal have been considered in relation to each of the identified environmental issues in **Chapter 9** to **Chapter 23** of this EA. Cumulative impacts of the proposal, particularly with respect to hazards and risks, noise and vibration, air quality, 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 acceptable provided the prescribed mitigation measures and safeguards are implemented. It should also be noted that the well site locations are a temporary and transient land use which would be removed in the decommissioning and final rehabilitation phase. As a result, no significant cumulative impact is expected.

24.2 Cumulative Impact with other Projects

The cumulative impacts of the proposal must also be considered taking into account other major projects planned in the local area. These include:

- The Queensland Hunter Gas Pipeline (QHGP) Project (MP06-0286) which would intersect the proposed pipeline in the vicinity of Hexham (Approval determined on 11 February 2009); and
- The Hexham Redevelopment Project (MP07-0171) involving a concept plan for a train support facility, intermodal terminal and industrial subdivision and a project application for the train support facility (Director-General's Requirements issued).

The proposed pipeline for this EA would intersect the QHGP Project Pipeline approximately two kilometres north of Woodberry (i.e. approximately 7 km from the Hexham Delivery Station). Specific details regarding the crossover of the pipelines would be developed in accordance with the accepted guidelines and regulations which would include consultation with Hunter Gas Pipeline Pty Ltd.

Apart from the location where the two pipelines overlap at approximately the 87.5KP or run parallel to each other approximately 80 m apart (from approximately the 86 to 87.5 KP mark), each pipeline would be situated in different geographical areas so the cumulative impacts during construction would be minimal. There is the potential for cumulative impacts if the timing of construction of each pipeline were to overlap at the location of the crossover and where the two pipelines run 80 m apart. If this were to occur, the cumulative impacts such as potential noise and traffic impacts would be relatively short-term, lasting the duration of the construction phase. Additionally, the pipelines are not anticipated to run parallel to each other for more than 1.5 km, minimising cumulative impacts. Consultation would be undertaken with the proponent of the QHGP Project to manage potential interaction and cumulative impacts when working in close proximity. As such, the cumulative impacts of the two projects are deemed to be temporary and minor and can be suitably managed in a co-operative manner.

The Hexham Redevelopment Project is proposed to be located on the western side of Maitland Road in the vicinity of the Hexham Delivery Station. The original pipeline route was to pass through the land proposed to be utilised for the train support facility, however, the route was subsequently altered in order to avoid impacts to the Hexham Redevelopment Project.

There is the potential that the construction period for the train support facility may overlap with the construction of the Hexham Delivery Station and the southern portion of the proposed pipeline which may result in temporary cumulative impacts such as construction noise and increased traffic. As such, there is some potential for cumulative impacts, however the cumulative impacts of the two projects are deemed to be temporary and minor and can be suitably managed in a co-operative manner.

24.3 Conclusion

Cumulative impacts of the proposal have been considered with respect to impacts associated with the proposed development, in addition to impacts associated with other projects in the region. The cumulative impact assessment concluded that the construction phase of the Project is temporary in nature, the operational phase of the Project would have negligible cumulative impacts and that there would be no significant net residual impacts associated with the proposed development’s interaction with other known projects in the area. Where the potential for cumulative impacts exists, the cumulative these are deemed to be temporary and minor and can be suitably managed in a co-operative manner.

25.0 Environmental Management

The purpose of this chapter is to provide information in relation to the management of environmental impacts during the course of the construction and operation of the Project. The chapter outlines the management plans to be prepared in respect of the Project, responsibilities and monitoring and reporting requirements to ensure that the potential impacts of the Project are minimised.

25.1 Introduction

Subject to the granting of Concept Plan and Project Approval, the proposed development would be implemented as described in this EA and in accordance with relevant legislative and regulatory requirements and guidelines including the Australian Pipeline Industry Association Code of Environmental Practice for the Onshore Pipelines (APIA Code) and the conditions of the Concept Plan and Project Approval.

A Statement of Commitments (SoC) has been prepared for the components of the Project in accordance with the EARs (refer to **Chapter 26**), however a more detailed account of the environmental management measures and monitoring to be undertaken in respect of the Project would be incorporated into the Proponent's Construction Environmental Management Plan (CEMP) and the Operational Environmental Management Plan (OEMP).

The CEMP would incorporate the following sub-plans:

- Air Quality Management Plan (AQMP);
- Soil and Water Management Plan (SWMP);
- Erosion and Sediment Control Plan (ESCP);
- Acid Sulfate Soils Management Plan (ASSMP);
- Flora and Fauna Management Plan (FFMP);
- Noise Management Plan (NMP);
- Waste Management Plan (WMP);
- Traffic Management Plan (TMP);
- Aboriginal Heritage Management Plan (AHMP);
- Landscape and Rehabilitation Management Plan (LRMP);
- Weed Management Plan (WMP);
- Construction Workforce Management Plan (CWMP);
- Groundwater Management Plan (GMP); and
- Emergency Response Plan (ERP).

The OEMP would incorporate the following sub-plans:

- Air Quality Management Plan (AQMP);
- Weed Management and Monitoring Plan (WMMP) / Plant Pathogen Management Plan (PPMP);
- Traffic Management Plan (TMP);
- Noise Management Plan (NMP);
- Landscape Management Plan (LMP); and
- Emergency Response Plan (ERP).

Management functions are outlined in **Section 25.4** in respect of the roles and responsibilities for implementing the various components of the CEMP and OEMP. Details on the training and induction, inspection, monitoring and auditing of procedures and the Emergency Response Plan are outlined in **Section 25.5 – 25.7**.

25.2 Construction Environmental Management Plan

The CEMP shall detail specific management strategies to be implemented during the construction phase of the Project, including strategies and protocols relating to soil and water management, protection of vegetation to be retained, fauna protection, rehabilitation strategies, containment of waste, and an emergency response program for accidental spills and other emergencies. The Proponent shall develop an induction program for the CEMP and induct site workers involved in construction activities (whether directly or indirectly) into the CEMP program prior to their commencement of duties.

A number of management sub-plans would form part of the CEMP. The CEMP would be prepared in consideration of the relevant legislation and guidelines. The management sub-plans are outlined below:

25.2.1 Air Quality Management Plan

An Air Quality Management Plan (AQMP) would be prepared and implemented as part of the CEMP outlining all activities required to minimise air emissions (including dust and vehicle emissions) within relevant air quality criteria and guidelines, during the construction of the Stage 1 GFDA, CPF, pipeline and HDS. Mitigation measures for construction would include:

- Dust control measures for traffic including:
  - Control of access via sealed roadways where possible; and
  - Vehicle speed limits on site.
- Monitoring of wind speed and direction to manage dust-generating activities during undesirable conditions;
- Minimisation of areas of disturbed soils during construction;
- Dust suppression with water sprays or other media during windy periods (as required);
- Stockpiling of soils on site should be kept to a minimum;
- Excavation with limited soil free fall;
- Progressive rehabilitation of disturbed areas wherever feasible;
- Construction equipment idling time and engine tuning to minimise exhaust emissions;

- Visual assessment of air emissions on a routine basis;
- Procedures to address any complaints received;
- Use of wet drilling methods or emission capture devices e.g. baghouse to reduce dust emissions during well drilling; and
- Contingency measures.

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The Construction AQMP would outline activities required to minimise potential impacts to air quality from flaring of wells during commissioning, as follows:

- Minimising the time that flares are to be active i.e. minimise the time taken to cap the wells;
- Assuming a conservative gas emission rate of 500,000scfd, ensure a separation distance of at least 500 m for wells positioned in a straight line (maximum of five wells simultaneously flaring), to prevent cumulative impacts from flaring emissions; and
- Assuming a conservative gas emission rate of 500,000scfd, ensure a separation distance of at least 800 m for wells positioned in a triangular grid.

Lesser separation distances could be adopted depending on the gas emission rate.

CPF and Pipeline

The AQMP would outline all activities required to minimise dust and vehicle emissions during the construction of the CPF and pipeline.

25.2.2 Soil and Water Management Plan / Erosion and Sediment Control Plan

Prior to commencement of construction, a Soil and Water Management Plan (SWMP) as well as an Erosion and Sediment Control Plan (ESCP) would be prepared as part of the CEMP. These plans would detail specific management and mitigation to minimise potential impacts to surface water, including measures to address erosion and sedimentation controls, water flows, runoff and drainage. They would also provide measures to ameliorate potential impacts to the soils and geology of the Project Area, including measures to manage stockpiling activities. Management measures would include those detailed below:

- The installation of surface water diversion berms or equivalent in steep sloping areas and areas where natural drainages have been altered to assist in diverting ‘clean’ water runoff away from the following areas:
    - Stage 1 GFDA: gathering line footprint, well sites, access roads, graded areas and work areas where required, particularly for periods of high rainfall / runoff to minimise the likelihood of flooding and sedimentation;
    - the CPF and HDS footprint, access roads, graded areas and work areas where required;
    - the pipeline ROW, the construction camp and other work areas where required;
- Installation and maintenance of silt fences and other sediment control devices on the downslope of stockpiles and between construction areas and watercourses to minimise sedimentation, particularly during heavy rainfall;

- All stockpiles (e.g. bed material, bank material, top and sub soil, vegetation) would be kept separate and appropriately managed with erosion and sediment control measures;
- Stockpiles shall not impede surface drainage as far as practicable;
- Clearing of vegetation and the exposure of bare sediment would be minimised as much as practicable to minimise erosion;
- Vehicles would utilise access tracks and designated roadways where possible to minimise erosion and sedimentation;
- Construction vehicles would be kept well maintained and personnel would be trained and provided with spill response kits;
- Consistency with the publication “managing urban stormwater (the Bluebook)” (Landcom 2004);
- Testing of soils during excavation where the potential exists for the presence of contamination, in order to determine the requirements for potential contaminated soil management during the Project construction;
- Clear identification of drill locations, with works undertaken according to the Project CEMP and standard operating procedures. Should soil limitations (such as waterlogged soils) require relocation of any individual site, additional investigation would be required to determine the suitability of the new location;
- Disturbed areas would be rehabilitated as soon as practical after construction;
- Soil and water management measures to be protective of flora and fauna species and preventative of direct and indirect downstream impacts as they pertain to:
  - soil handling and stockpile management; and
  - erosion and sediment controls and water crossings.

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- Worksites, the construction workforce camp, parking areas, site-offices, stockpiles and other ancillary works areas would be located in existing cleared areas, away from waterways or other sensitive areas;
- Gas and water gathering line routes would be designed to avoid large remnant riparian vegetation patches in order to cross watercourses at sites with no or limited native vegetation, wherever possible;
- Watercourse crossings (open trench) for the gas/water gathering system would be undertaken during no flow or low-flow conditions and temporary flow diversions would be installed if moderate flows are present as required. Sensitive watercourses may be crossed using thrust bores or HDD techniques to avoid impacts on these watercourses;
- The construction of watercourse crossings would be done as rapidly as possible with the open trench across the watercourse crossing being open for the minimum amount of time to minimise the potential for erosion and turbidity; and
- Drilling fluid and produced water spill prevention and response procedures would be put in place.

CPF

Safeguards to be implemented to avoid / minimise impacts to surface water during the construction phase of the CPF include:

- Additional water storage areas for storage of produced and treated water would be constructed in accordance with design and engineering specifications to minimise environmental impacts, including:
  - Cut-and-fill construction techniques to avoid the need to import soil from other sites;
  - Storage capacity to take into consideration probable water production rate as well as climatic conditions, in order to minimise the risk of spillage;
  - Installation of geomembrane liner to eliminate leaching;
  - Design of the pond with sufficient freeboard to ensure management during prolonged rainfall conditions;
  - Implementation of and adherence to operational procedures to minimise risk of spillage.

Pipeline

Safeguards would be implemented throughout the construction of the pipeline to minimise / avoid impacts to surface water. These would be incorporated into the CEMP and would include preparation of a SWMP which would adhere to the APIA *Code of Environmental Practice – Onshore Pipelines* (APIA, 2005) as well as relevant sections of Landcom's *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) prior to construction. Mitigation measures relating to surface water may include a reduced pipeline ROW in areas consisting of sensitive vegetation or riparian vegetation to minimise impacts.

Watercourse Crossings

At identified watercourse crossings, the Proponent would construct a crossing to an acceptable standard according to sensitivity criteria**.** Sensitive watercourses with permanent high water flows (e.g. Hunter River, Williams River and Karuah River) would be crossed using HDD. Open trenching of less sensitive watercourses would be undertaken during no or low flow conditions where possible. Open trenching with stream flow diversions may be used when moderate water flows are present to further reduce potential impacts to the surface water.

Safeguards specific to watercourses may include:

- Avoiding impacts to hydrological flow regimes at crossings of 3rd order streams with variable flows. Utilise open trench construction techniques when waterflows are not present or very low. Implement open trench with flow diversions and environmental management measures when waterflows are increased (e.g. >1000 L/s);
- Minimise clearing of native riparian vegetation at other watercourses by utilising existing clearings (where present) or utilising a reduced ROW width. A wider ROW would be required at watercourse crossings with steep banks to allow for the temporary opening up of the bank to construct the pipeline. Such works would be undertaken in accordance with a SWMP to minimise impacts to surface water quality;
- Site-specific geotechnical investigations would be undertaken prior to HDD to identify the geology, potential issues and to select appropriate drill equipment;

- The construction of watercourse crossings would be done as rapidly as possible with the open trench across the watercourse crossing being open for the minimal amount of time to minimise the potential for erosion and turbidity; and
- Watercourses and banks would be rehabilitated after construction.

Wetlands

A range of safeguards would be adopted to minimise impacts to wetlands, surface water and acid sulfate soils which can affect water quality, including:

- Minimise disturbance to freshwater wetlands and their associated vegetation. A reduced ROW may be utilised and works would be undertaken in the minimum amount of time possible during the dry periods, where feasible, to minimise potential impacts;
- Monitoring water levels of nearby wetlands and / or sensitive water bodies for impacts associated with dewatering of the pipeline trench, which would be incorporated into the dewatering design (e.g. pumping rates); and
- Utilise matting to minimise the compaction and / or erosion of soft or erodible soils in sensitive areas such as watercourses and wetlands during construction.

25.2.3 Acid Sulfate Soils Management Plan

As part of the CEMP an Acid Sulfate Soils Management Plan would be prepared in consultation with relevant authorities, to mitigate potential impacts from the disturbance of potential acid sulfate soils (PASS) during construction in the vicinity of Hexham. This would include the following:

- A detailed account of the geology, hydrology, physical characteristics and environmental receptors within the locality and along the pipeline corridor.
- Pre-construction monitoring program to establish baseline water quality conditions prior to excavation where the potential for acid sulfate soils exists;
- Management options considered for the Project, including construction, operation and decommissioning. The four main strategic options for the management of acid sulfate soils in the environment are:
    - **Containment** within the soil profile in natural depressions, ponds or drains;
    - **Neutralisation** typically utilising either lime ($CaCO_3$) or the bicarbonate (HCO_3) in seawater;
    - **Dilution** by use of freshwater to raise the pH; and
    - **Transformation** reduction into stable compounds.
- Treatment measures proposed – including bunding, testing, application of lime or bicarbonate, sampling and any other relevant measures;
- Leachate controls;
- Monitoring requirements and frequencies;
- Requirements and application for disposal of ASS materials;
- Responsibilities of individuals relating to ASS management – including reporting requirements, authorities, and training requirements;
- Measures to manage acid sulfate soils in order to be protective of fauna species and preventative of off-site and downstream effects, particularly in the vicinity of freshwater wetlands;

- The ASSMP would also consider measures suggested by the *National Strategy for the Management of Coastal Acid Sulfate Soils* (NWPASS, 2000) to prevent ASS problems becoming worse including:
  - **Awareness** of the nature and distribution of ASS as well as its potential adverse impacts;
  - **Education** to achieve healthier environmental outcomes; and
  - **Planning and development controls** to minimise the risk of disturbing ASS.

25.2.4 Flora and Fauna Management Plan

The FFMP would detail a number of management strategies to be implemented during the construction phase of the proposed development, including:

- Site induction and training with respect to flora and fauna issues;
- Wildlife-clearance surveys would therefore be required by appropriately qualified persons immediately ahead of vegetation clearing operations to avoid disturbance to threatened fauna species;
- Plant pathogen management strategy; and
- Develop and implement offset strategies for residual biodiversity impacts.

The CEMP would also provide general safeguards in order to:

- Measures to minimise clearing of native vegetation for all components of the Project;
- Measures to minimise impacts from removal of large hollow-bearing trees, dead trees and fallen timber and surface rock;
- Measures to minimise disturbance to watercourse crossings, freshwater wetlands and their associated vegetation; and
- Minimisation of earthworks to avoid impacts on threatened fauna species.

Habitat Offset Strategy for Residual Biodiversity Impacts

The Flora and Fauna Management Plan would contain offset strategies, if required, to compensate for loss of biodiversity values that cannot be adequately avoided or mitigated by the proposed measures. Offset strategies may be required for:

- Clearing and / or disturbance of one EEC (up to 0.23 ha);
- Clearing of native vegetation totalling 18.17 ha for pipeline construction; and
- Removal and / or disturbance of recorded *Grevillea parviflora* populations.

Habitat offset plans would be developed, if required, according to the following principles:

- Impacts must first be avoided as far as possible by using prevention and mitigation measures, which are described further below in this section).
- All regulatory requirements must be met;
- Offsets should complement other government programs;
- Offsets must be underpinned by sound ecological principles;
- Offsets should aim to result in a net improvement in biodiversity over time;

- Offsets must be enduring – they must offset the impact of the development for at least the period that the impact occurs;
- Offsets should be agreed prior to the impact occurring;
- Offsets must be quantifiable – the impacts and benefits must be reliably estimated;
- Offsets must be targeted – they must offset impacts on a like-for-like or better basis;
- Offsets must be located appropriately – they must offset the impact in the same region;
- Offsets must be supplementary – they must be beyond existing requirements and not already be funded under another scheme; and
- Offsets and their actions must be enforceable – through development consent conditions, licence conditions, conservation agreements or a contract.

Habitat offset plans would be developed in liaison with DECCW and DoP before development commences to define types and levels of biodiversity loss (debits), calculate the amounts of offsets (credits) required and develop appropriate implementation, monitoring and protection strategies.

Small-flower Grevillea Management Strategy

Develop and implement an appropriate multi-faceted management plan for the small-flower grevillea in the existing powerline easement at approximately KP 59.

Development of strategies to minimise potential impacts during the construction phase, including, but not necessarily limited to:

- Conduct a detailed survey for the small-flower grevillea population within the proposed ROW along the powerline easement and adjacent area to determine population characteristics (including precise distribution, extent and abundance);
- Investigate and use the absolute minimum construction width within the ROW wherever the grevillea occurs;
- Select the alignment of access tracks for vehicle and construction machinery along the powerline easement to minimise compaction of soil around the underground rhizomes of the grevillea;
- Manage the construction process to avoid impacts on grevilleas within and adjacent to the construction footprint, including:
    - High visibility barrier installation around the population adjacent to the development to avoid accidental damage;
    - development and implementation of appropriate sediment and erosion control systems;
    - stockpiling of topsoil containing seeds of this species and respreading it following construction;
    - revegetation with native species as soon as possible following construction; and
    - development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.

Development of a monitoring program (including pre-construction baseline data) for the abundance and geographical extent of this species in the easement, including as far as possible, but not necessarily limited to the following:

- Conduct a detailed survey for the small-flower grevillea population within the proposed ROW along the powerline easement and adjacent area to determine population characteristics (including precise distribution, extent and abundance), as recommended above;
- Document the pre-construction (baseline) management regime of the powerline easement; and
- Monitor and record the annual management regime of the powerline easement in a way that can be compared to baseline to detect relevant changes.

Development of an offset strategy in consultation with DECCW to compensate for residual impacts that cannot be mitigated, including, but not necessarily limited to:

- Develop the offset strategy in consultation with DECC;
- Assess the extent and number of plants that would be impacted and calculate the biodiversity credits required to offset the impact;
- Identify and procure an appropriate offset area nearby where a population of this species can be established, preferably adjacent to an existing conservation area;
- Investigate and develop appropriate translocation, propagation and cultivation techniques. Olde and Marriott (1995) note that *G. parviflora* adapts readily to cultivation and can be grown from seeds and cuttings of half-hardened new growth in early Spring. No published information on translocation of *G. parviflora* could be located, but other species of *Grevillea* have been successfully translocated (e.g. Stack *et al*., 2003);
- Undertake seed collection, propagation and translocation would be in accordance with currently accepted Australian guidelines, including:
  - *Guidelines for the Translocation of Threatened Plants in Australia. 2nd edition* (Vallee *et al*., 2004);
  - *Germplasm Conservation Guidelines for Australia* (ANPC, 1997);
  - *Floradata: A guide to the collection, storage and propagation of Australian native plant seed* (Mortlock and Lloyd, 2001);
  - *Growing Australian Native Plants from Seed - for revegetation, tree planting and direct seeding* (Murray, 2003).
- Propagate sufficient plants to offset the number impacted by the proposed development;
- Plant and maintain propagated plants (and translocated plants, if translocation is considered feasible) in the offset area for at least 2 years;
- Monitor to evaluate the success of the offset program for at least 5 years and identify any problems that require remedial actions;
- Manage weeds for at least 2 years following planting; and
- Arrange for appropriate legislative protection of the offset area.

Wildlife Clearance Surveys

Wildlife clearance surveys would be required to be undertaken by appropriately qualified persons immediately ahead of vegetation clearing operations to avoid disturbance to the following threatened fauna species:

- Bush stone-curlew, which nests on the ground amongst fallen timber and undergrowth in open woodland. If a nest is found in the clearing path then clearing operations should be locally suspended or re-routed;
- Square-tailed kite, which constructs large stick-nests in large trees. If a nest is found in the clearing path then clearing operations should be locally suspended or re-routed;
- Black-necked stork, which constructs large stick-nests in large trees. If a nest is found in the clearing path then clearing operations should be locally suspended or re-routed;
- Conduct surveys for nests of the barking owl, which nests in large hollows in large hollow-bearing trees in open woodlands. If a nest is found in the clearing path then clearing operations should be locally suspended or re-routed;
- Powerful owl, which nests in large hollows in large hollow-bearing trees in tall forests. If a nest is found in the clearing path then clearing operations should be locally suspended or re-routed;
- Sooty owl, which nests in large hollows in large hollow-bearing trees in tall closed forests. If a nest is found in the clearing path then clearing operations should be locally suspended or re-routed;
- Masked owl, which nests in large hollows in large hollow-bearing trees in woodlands and forests. If a nest is found in the clearing path then clearing operations should be locally suspended or re-routed;
- Yellow-bellied glider, which nests in large hollows in large hollow-bearing trees in tall forests. If a nest is found in the clearing path then clearing operations should be locally suspended or re-routed; and
- Koalas, which rest in trees by day. If a koala is found in the clearing path then clearing operations should be suspended locally until the koala moves out of the impact zone.

Wherever it is not possible to avoid the removal of large, old-growth, hollow-bearing trees then the following protocols should to be employed:

- Clear the vegetation surrounding large, old-growth, hollow-bearing trees but leave the tree standing in order to give fauna an opportunity to move;
- Large, old-growth, hollow-bearing trees should be felled no less than two days after the removal of the surrounding vegetation;
- Large, old-growth, hollow-bearing trees should be felled carefully and left intact on the ground overnight to give fauna the opportunity to escape.

Authorised wildlife rescuers should be on hand to rescue and relocate fauna disaffected, disoriented or displaced by vegetation clearing and excavation of the trench. The NSW Roads and Traffic Authority has an applicable policy that could be used as a model.

Hollow Bearing Tree Management Strategy

The Hollow Bearing Tree Management Strategy would also include a strategy for the management of dead trees and fallen timber. Mitigations would include:

- Avoiding the removal of large-hollow-bearing trees wherever possible;
- Minimising the impacts arising from removal of large hollow-bearing trees wherever they are encountered;

- Undertake surveys to map the location of hollow bearing trees in timbered habitats and large paddock trees prior to clearing and construction;
- Having wildlife-clearance surveys conducted by qualified people to identify hollow-bearing trees likely to be important for the following threatened species that occur or potentially occur in the Project Area, including:
  - barking owl, which nests in large hollows in large hollow-bearing trees in open woodlands;
  - powerful owl, which nests in large hollows in large hollow-bearing trees in tall forests;
  - sooty owl, which nests in large hollows in large hollow-bearing trees in tall closed forests;
  - masked owl, which nests in large hollows in large hollow-bearing trees in woodlands and forests;
  - yellow-bellied glider, which dens in large hollows in large hollow-bearing trees in tall forests;
- Avoid felling dead trees wherever possible;
- Minimising the impact of removing dead trees and fallen timber wherever possible;
- Avoiding disturbing, removing or breaking up fallen timber (especially larger logs) wherever possible;
- Wherever it is unavoidable to disturb fallen timber, either relocating it to adjacent areas of native vegetation or stockpile it and return to the ROW following completion of earthworks;
- Where possible, recycling timber cleared from the ROW by placing logs on the ground in the ROW following construction; and
- Wherever it is not possible to avoid the removal of hollow bearing trees, large hollows would be salvaged and strapped to standing trees nearby, where possible, to restore the potential habitat.

Strategy for the Removal of Surface Rock

If an area of outcropping rock is encountered, the following mitigations would be implemented, where possible, to minimise the potential impact from the removal of surface rock:

- Adjust the local alignment of the proposed pipeline to avoid it; and
- Wherever it is unavoidable to disturb surface rock, stockpile it and return it to the ROW following completion of earthworks.

Management Strategy for Freshwater Wetlands and Associated Vegetation

A number of mitigations to minimise potential impacts to wetlands and their associated vegetation would be included in the strategy, including:

- Minimising disturbance to freshwater wetlands and their associated vegetation;
- Implementing an appropriate ASSMP if potential ASS are detected (see safeguard 3) during pre-construction investigations;
- Wherever feasible, avoiding the construction footprint encroaching or impacting on wetlands identified in the **Appendix G** .This should include indirect impacts such as down-stream sedimentation, eutrophication and pollution;

- Wherever the proposed pipeline cannot be routed around wetlands identified in the **Appendix G**, consider using HDD techniques to avoid disturbance to hydrology and threatened species;
- Wherever feasible, avoid damage or modification to emergent vegetation (e.g. sedges, spike rushes. bulrushes and reeds) fringing the wetlands identified in the **Appendix G**;
- Minimising the use and passage of heavy machinery and vehicles within and adjacent to wetlands during construction; and
- Not removing dead wood and dead trees from near the wetlands identified in the **Appendix G.**

Management Strategy for Potential Impacts To Permanent Streams

Potential impacts to permanent streams would be minimised by the implementation of a number of mitigations, including:

- Wherever the proposed pipeline crosses permanent streams, using HDD techniques to avoid disturbance to hydrology, riparian vegetation and threatened species (for further details, see **Chapter 12**); and
- Avoiding the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.

Management Strategy for Native Vegetation Clearance

Mitigations would include:

- Minimising clearing of native riparian vegetation at other watercourses by utilising existing clearings (where present) and reducing the width of the ROW.
- When transecting native vegetation, utilising existing cleared areas and reduce the width of the ROW wherever feasible.
- Conducting pre-clearing surveys just prior to construction to identify minor route refinements that reduce clearing of native vegetation.

The following general measures are recommended to minimise impacts on native vegetation:

- Retaining and protecting hollow-bearing trees wherever possible.
- Locating site compounds and parking areas, site-offices, stockpiles and other ancillary works areas in existing cleared areas, away from waterways or other sensitive areas.
- Installing highly visible barriers (e.g. barrier webbing) between the construction area and adjacent sensitive vegetation.
- Restricting access from the construction area into adjacent areas of native vegetation and waterways.
- Providing clear instructions regarding the limits of vegetation clearing to all workers and contractors.
- Minimising the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint in timbered habitats.
- Avoiding removal of large paddock trees wherever feasible.
- Fitting spark arresters on diesel engines used in construction.

- Ensuring fire extinguishers and personnel trained in fire fighting are on-hand during welding operations to minimise damage caused by accidental fires.

Management Strategy for Impacts to Threatened Fauna

Mitigations would include:

- Using temporary fencing to exclude access to the trench by livestock and larger native wildlife, (APIA, 2005) where appropriate;
- Trenching progressively to minimise the period of time the trench is open and the length of open trench. The length of open trench at any one time would be the minimum practicable;
- Constructing ramps and trench plugs with slopes of no greater than 50% (APIA, 2005) and located at regular intervals to assist escape for larger fauna species. Where possible, locate trench plugs to coincide with stock and wildlife trails;
- Placing branches, ramped gangplanks or similar to create 'ladders' at regular intervals to assist small fauna to exit the trench (APIA, 2005);
- Supply some form of cool insulated cover in the trench to allow smaller fauna species to shelter in shade and / or climb above accumulated water. Following the method employed during construction of the North Queensland Gas Pipeline (Wilson and Swan, 2004), sawdust-filled hessian sacks used to support pipes prior to laying-in should be soaked in water and placed in pairs at approximately 250 m intervals;
- Employing qualified fauna spotters and handlers to survey the open trench and remove trapped fauna species. Such surveillance should occur along the entire length of the trench and not merely those areas described as fauna habitats or sensitive areas. Fauna spotters and handlers should be qualified or appropriately trained to assess and handle injuries to native fauna that may occur due to trenchfall; and
- Having qualified veterinarian staff available on call to assess and treat or euthanase (as necessary) any large native vertebrates that are seriously injured.

25.2.5 Noise Management Plan

A Noise Management Plan (NMP) would be prepared as part of the CEMP to address construction noise and vibration, and methods to minimise impacts (refer to **Appendix H**). The NMP would be prepared in consultation with relevant authorities such as the DECCW and construction contractors. As part of the NMP, the following would be addressed:

- A constraints analysis and consultation with potentially affected landowners would be undertaken when determining the location of the two construction workforce camps;
- A noise assessment may be incorporated into the Construction Workforce Management Plan to ensure that potential noise impacts to nearby residences are assessed and are acceptable;
- Selection of plant and equipment where practical on acoustic performance;
- Noise certification of all site plant and equipment prior to commencing site work and regular monitoring to ensure equipment noise emission levels do not deteriorate due to poor maintenance or damage;
- Work practices to minimise potential noise and vibration impacts;
- A monitoring program to ensure that construction noise and vibration emissions are controlled and that the best possible practices are implemented;

- Noise and vibration monitoring shall be conducted in response to community complaints and at the request of the DECCW. Reports of investigations shall be provided to the DECCW upon request;
- Site noise and vibration training and awareness program for all staff and contractors engaged during construction;
- Development and implementation of a public relations program to inform residents and the community of the progress of activities and potential noise and vibration impacts of each phase of the Project;
- Establishment of procedures to address noise and vibration complaints received from the public during the construction period; and
- Acoustic attenuation and mitigation provided where necessary as recommended by the Project noise assessment to ensure impacts upon surrounding land uses (particularly residential land) are minimised.

Stage 1 GFDA

The following noise safeguards would be implemented in relation to the Stage 1 GFDA:

- Fraccing to be undertaken only during daytime hours subject to geological conditions. Fraccing at times would be required to extend into the evening as the fracc process can not be interrupted once commenced. Scheduled timing for fraccing would be required to ensure that adequate daylight is remaining prior to commencing the frac process. Secondary noise controls such as portable acoustic screens would be utilised for fraccing activities;
- Drilling activities shall be undertaken during evening / night hours only where project noise goals can be achieved or as otherwise agreed with affected landowners;
- Secondary noise controls such as portable acoustic screens would be installed for drilling activities as appropriate; and
- Activities associated with the construction of access tracks and the clearing of vegetation would be undertaken during daytime hours only.

CPF

The following safeguards would be implemented in relation to the CPF:

- Selection of plant and equipment where practical on acoustic performance;
- Noise certification of all site plant and equipment prior to commencing site work and regular monitoring to ensure equipment noise emission levels do not deteriorate due to poor maintenance or damage;
- Work practices to minimise potential noise and vibration impacts;

Pipeline

The following noise safeguards would be implemented in relation to the pipeline:

- Construction activities are to be limited to daytime hours only, with the exception of HDD where continuation of the process is necessary to ensure integrity and safety.
- Advanced notification of commencement of construction works to be provided to potentially affected landowners (generally those within 2 km of the pipeline construction works) indicating the length of time during which impacts may be

experienced, the nature of potential impacts and a contact number for complaints to be recorded and responded to.

- No use of rock hammers within 20 m of a residence.
- No blasting to be undertaken within 200 m of a residence.

HDS

The following noise safeguards would be implemented in relation to the HDS:

- During construction, plant selections, temporary noise controls and work practices would be considered to minimise noise impacts.

25.2.6 Traffic Management Plan

A Traffic Management Plan would be prepared as part of the CEMP for the Project and would include detail on the following in order to minimise potential impacts to traffic / transport and the surrounding road network:

- A Transport Code of Conduct which would outline and manage the transportation routes to the sites for heavy vehicles;
- Heavy vehicle access to the various laydown areas and construction sites;
- Deliveries, dispatch and heavy vehicle parking during construction;
- Internal speed limits and use of truck turnaround areas;
- Details of road/intersection upgrades;
- Consultation to be undertaken with potentially affected landowners and relevant road authorities with regard to the timing of plant and equipment delivery campaigns and potential localised impacts on the road network;
- Consultation would be undertaken with the proponent of the Queensland Hunter Gas Pipeline (QHGP) Project (MP06-0286) to manage interaction and potential cumulative impacts when working in close proximity;
- Where oversized vehicles are used, suitable controls and management would be put into place and heavy vehicle permits would be obtained as required. Oversized loads would be transported in accordance with relevant RTA guidelines;
- Heavy vehicle movements would be timed wherever possible to avoid or minimise localised impacts such as avoiding peak traffic zones and school zones between the hours of 7am - 9am and 2pm - 4pm;
- Traffic direction control would be used where appropriate for open trenching of road crossings. Available measures would be taken to minimise disruption during open trench crossings to no more than one to two days;
- Multi-passenger vehicles and car pooling would be used wherever possible for the transportation of construction personnel to the construction site/s in order to minimise the number of vehicle movements;
- Once the location of laydown areas has been established, the potential impacts of vehicle movements would be more accurately assessed and appropriate mitigation measures developed as part of the TMP;
- The internal Stage 1 GFDA road network and pipeline ROW would be used to facilitate access and accommodate vehicle movements wherever possible;

- AGL would prepare pre and post dilapidation reports for major access roads affected by the Project. Impacts considered to be attributable to the Project, as determined by the dilapidation reports, following the construction phase of the Project would be remediated by AGL. Vehicle movements would be minimised wherever possible;
- Materials would be sourced from local suppliers where possible;
- Nominated transport routes would be clearly identified in the TMP and contractors would be made aware of the requirements to use these routes when travelling to and from the Project Area; and
- Access to residential and farming properties would be kept maintained where possible.

25.2.7 Aboriginal Heritage Management Plan

An Aboriginal Heritage Management Plan (AHMP) would detail procedures for the management of existing Aboriginal heritage sites and procedures for management of objects that are encountered during the construction phase of the development (e.g. procedures for construction in the vicinity of known sites and PADs, procedures for the discovery of skeletal remains, procedures for the discovery of unrecorded Aboriginal objects).

The Awabakal Descendants Traditional Owners Aboriginal Corporation would be consulted during the development of the AHMP. Management commitments in the AHMP would include, but not be limited to, the management commitments outlined below and in **Chapter 19** and **Appendix K**.

- All standing archaeological structures would be avoided by the pipeline construction footprint;
- Should historical archaeological sites be encountered during the excavation process, then work would cease at that location and a qualified historical archaeologist consulted;
- Should Aboriginal archaeological sites be encountered during the excavation process, then work would cease at that location and DECCW and the relevant Aboriginal stakeholders notified; and
- Construction crews would be made aware of the potential for cultural heritage values to occur in the Project Area. Training and induction would be provided and reinforced during regular toolbox meetings.

A series of specific mitigation recommendations have been provided to the proponent regarding the Aboriginal, historic and PAD sites recorded throughout the Stage 1 GFDA, CPF and pipeline corridor as detailed in **Table T2** of **Appendix K**.

25.2.8 Landscape and Rehabilitation Management Plan

The LRMP would detail landscaping and rehabilitation to be undertaken at well site locations, the CPF site and along the pipeline route at the initial and final stages of rehabilitation. This plan would be prepared with reference to Rehabilitation Security Deposits for Mining and Petroleum Titles (DPI, 2006) and other relevant guidelines with respect to completion criteria. The LRMP would include the following management measures:

- Ground disturbance during rehabilitation shall be minimised as far as practicable;
- Installation and maintenance of sediment and erosion control measures, such as silt fencing surrounding exposed areas and stockpiles;

- Soil and mulched vegetation would be stockpiled during the construction period where possible to be reused during the initial rehabilitation phase. Topsoil and subsoil would be kept separated and replaced in an appropriate order;
- Surfaces would be re-contoured to match the surrounding land and natural drainage lines would be re-instated;
- Where revegetation is to be undertaken, native endemic species would be utilised;
- Where surrounding land use is agricultural, consultation would be undertaken with the land owner to determine the appropriate level of crop cover for the rehabilitated area;
- Appropriate weed control measures shall be implemented during rehabilitation works in consultation with relevant land owners and regulatory authorities, and weed monitoring shall be undertaken regularly on rehabilitated sites;
- Regular maintenance and monitoring would be carried out upon completion of the rehabilitation works to identify the presence of weeds, erosion and scour, and failure of plantings during the rehabilitation process;
- The success / completion of the rehabilitation at the initial and final stages would be determined according to success / completion criteria which would be detailed in the LRMP. Success / completion criteria may include:
  - Species cover and abundance;
  - Presence of weeds;
  - Presence of rock and soil inversion;
  - Presence of erosion;
- Rehabilitated areas would be fenced with stock proof fencing where required to minimise access and maximise success of rehabilitation works.

Ecological safeguards within the LRMP would include:

- Obtaining local provenance native seeds, either from commercial seed suppliers or collection by qualified bush regenerators prior to clearing, for use in the revegetation of disturbed areas;
- Stockpiling topsoil that is excavated from areas of native vegetation for application to rehabilitation areas in the ROW, to retain the natural seed bank from the site and assist in the regeneration of local flora;
- Progressive rehabilitation as construction proceeds, to reduce exposure of unstabilised surfaces and minimise opportunities for weed establishment;
- Rehabilitating with site-specific species compositions to match the characteristics of the local endemic communities; and
- Revegetating (using local native species) as soon as possible, wherever further fragmentation of existing native vegetation cannot be avoided, in order to minimise edge effects.

The landscaping and rehabilitation plan should aim to reconnect any patches of native vegetation isolated or fragmented by the proposed development, to improve connectivity for wildlife and reduce edge effects. Utilising *Allocasuarina* species in revegetation works wherever they occur naturally, to compensate for the loss of potential foraging habitat for the Glossy Black-Cockatoo in the Project Area.

25.2.9 Weed Management Plan

A WMP would be prepared and implemented as part of the CEMP. This would include measures to control the spread of weeds into adjacent native vegetation (i.e. weed hygiene). Weed control measures would be particularly important where the proposed development traverses large, intact stands of vegetation, in riparian areas, and around freshwater wetlands. The WMP would include the following measures:

- Remove existing noxious weeds within the Project construction footprint;
- Destroy weed material removed from construction sites;
- Develop weed quarantine zones along the proposed pipeline route based on weed distribution and sub-catchments, for application of weed hygiene activities;
- Wash down vehicles, machinery and equipment moving between weed quarantine zones, especially after clearing activities and earthworks in weed infested areas;
- Implement a certification process to ensure that all vehicles and plant are weed-free whenever entering or leaving the site and whenever moving between weed quarantine zones within the site;
- Minimise the potential for the transport of weeds in soil, by not transporting excavated soil further than the nearest stockpile locations;
- Use shredded native plant material (uncontaminated by weeds) removed from the site as a mulch and groundcover on disturbed soil surfaces to reduce the potential for weed establishment;
- Use sediment control fencing to prevent soil contaminated with weed seeds from washing into waterways and wetlands;
- Conduct weed management works and monitor for at least two years following construction.

25.2.10 Groundwater Management Plan

As part of the CEMP for the Project, a Groundwater Management Plan would be prepared prior to the commencement of works. This would particularly relate to the Stage 1 GFDA and would include the following:

- Details on the installation of a network of nested piezometers (within the target coal seams and shallow aquifers) to allow for monitoring of changes in water levels and quality in response to operations;
- A schedule for the monitoring of water levels prior to gas extraction in the Stage 1 GFDA to establish baseline groundwater conditions in both newly installed piezometers and existing bores, to enable assessment of changes in aquifer water levels in the vicinity of the Stage 1 GFDA;
- A schedule for the collection of groundwater samples from selected piezometers and wells to assess changes in water quality from aquifers present in the vicinity of the Stage 1 GFDA;
- Response procedure and management measures that would be implemented in the event that adverse impacts to groundwater are detected through the piezometer network or water quality monitoring program.
- Wells with higher than average water production rates would be investigated and if beneficial aquifers were suspected of being dewatered, remedial action would be implemented to seal these coal seams from production;

- Contingency measures that would be implemented if the piezometer network indicated adverse impacts and shallow aquifers currently in use by surrounding property owners; and
- 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.
- Water storages as part of the CPF would be constructed and lined in accordance with current standards in order to prevent infiltration of the extracted saline groundwater, and in turn prevent impacts on groundwater levels and groundwater quality.

25.2.11 Emergency Response Plan

The CEMP would incorporate an Emergency Response Plan (ERP) detailing response measures for spills and leaks of fuels and other chemicals to be used during the construction process. This would include:

- Stage 1 GFDA and CPF:
  - Personnel would be trained and provided with spill response kits at each well site location;
  - Drilling fluid and produced water spill prevention and response procedures would be put in place;
- Pipeline and HDS:
  - Spill response kits and trained personnel would be present at each worksite and along the ROW;
  - Prohibition of vehicle maintenance or refuelling within a designated distance of any surface water body;
  - Chemical storage sites would be contained within bunded area to catch any accidental spills and would not be located proximate to waterways and drainage lines as far as practicable;
  - The management of hydrostatic test water would form part of the CEMP as the Proponent is yet to finalise the logistics regarding hydrostatic testing. Precautions would be taken to avoid spills / leaks of the hydrostatic water.

25.2.12 Construction Workforce Management Plan

The Proponent shall prepare and implant a site specific Construction Workforce Management Plan (CWMP) which would include:

- Measures to manage potential impacts associated with the construction workforce camp/s. This would include procedures to minimise environmental impacts from the construction workforce camp; and
- Measures to address site management principles, designed to consider both construction personnel and the local population, while not stifling the potential economic benefits that the presence of the temporary construction workforce may have on local communities.

25.2.13 Waste Management Plan

A Waste Management Plan would be prepared and implemented prior to the commencement of construction activities as part of the CEMP for the Project and would include the following management measures:

- Procedures to classify wastes in accordance with the Waste Guidelines and NSW legislative requirements;
- Mitigations to be implemented to avoid waste generation, reuse, recycle and dispose of wastes;
- Details of how waste would be quantified, stored, treated (on site) and disposed; and
- Reporting and recording procedures to track wastes in accordance with regulations.

General safeguards throughout the Project would include:

- Reuse and / or recycling of generated wastes would be undertaken where possible. Waste materials from the pipeline construction would be recycled and re-used where appropriate;
- Wastes which are not suitable for reuse or recycling would be disposed of at an appropriately licensed facility and no wastes would be discarded at sites;
- Waste management at construction workforce camps would include segregation and recycling of domestic wastes;
- Appropriate spill, incident management and response procedures would be implemented as part of the CEMP including measures to avoid spillages of chemicals, liquids and other wastes;
- Resource recovery and reuse strategies would be implemented for each type of waste material where applicable;
- Licensed and approved removal of aboveground infrastructure at decommissioning stage in accordance with best practices at the time;
- Work sites would be cleaned up and rehabilitated following works.

Safeguards for special wastes would include:

- Waste tyres would be disposed of at a licensed waste facility and would need to be tracked if transported interstate;
- Contaminated waste and oils would be removed from site for disposal by a licensed contractor.

Safeguards for liquid wastes would include:

- Water returned to surface from the fracture stimulation process would be stored in lined pits to be reused in future fracture stimulation and finally transferred to the water storage ponds prior to treatment and subsequent approved disposal;
- Produced water from operational wells would be transferred to the water storage ponds via gathering lines prior to treatment and subsequent approved disposal;
- Liquid hydrocarbons would be removed by a licensed contractor to be disposed appropriately;
- Portable toilet facilities would be installed in construction areas during the construction period and maintained by a waste contractor.

Safeguards for hazardous wastes would include:

- Handling, storage, transport and tracking of hazardous materials and waste would be in accordance with the *National Code of Practice* and the relevant safety data sheet for the product;
- Hazardous wastes would be transported by an authorised contractor and disposed of appropriately according to regulations at a licensed waste facility.

Safeguards for general solid wastes (putrescibles) would include:

- Domestic wastes would be placed in dedicated covered rubbish bins for removal off site;
- Bins / rubbish bags containing putrescibles would be kept away from surface water drains and would be regularly removed and disposed of at an approved waste facility;
- General waste generated during operations would be collected on site and removed to licensed facilities for disposal.

Safeguards for general solid wastes (non-putrescibles) would include:

- Excavated topsoil would be stockpiled and appropriately maintained onsite for reuse during backfill and / or initial rehabilitation of construction areas;
- Vegetation cleared from construction areas would be stockpiled (mulched when excess vegetation is present) onsite and maintained appropriately. Mulch would be respread during initial rehabilitation to minimise erosion and promote revegetation. Excess mulched organic material would be removed from the site and disposed of at a licensed waste facility as appropriate;
- Solid salt produced from the water treatment and evaporation would ideally be transported to a salt producer for further processing into saleable products. If this option is not possible, the salt product would be disposed of to an appropriate facility. Dependent upon its final waste classification this would comprise a local landfill (if General Solid Waste) or a licenced landfill facility in Sydney (if Restricted Solid Waste).

25.3 Operational Environmental Management Plan

An OEMP would be developed for operation and maintenance of gas wells, gas gathering lines, CPF and the transmission gas pipeline.

The OEMP would include strategies and protocols relating to soil and water management, protection of retained vegetation and rehabilitation areas, fauna protection, site closure and rehabilitation strategies, containment of waste, an emergency response program for accidental spills and other emergencies, and monitoring / auditing protocols.

The OEMP would consist of the management sub-plans detailed below. In addition, the following management measures are required to be included within the OEMP in general.

Air Quality

The OEMP would include measures aimed at monitoring, assessing and if required rectifying any air quality issues associated with the operation of the Stage 1 GFDA, CPF, pipeline and HDS.

Within the OEMP, specific air quality measures associated with the operation of the CPF would include:

- Catalytic converters would be installed on the generators and compressors in order to reduce formaldehyde emissions;
- Air monitoring measures may include:
  - Emissions testing to confirm post commissioning emissions for generator units and compressors;
  - Regular emissions monitoring to ensure efficient operation of generator units and compressors;
  - Provision for ambient monitoring of pollutants for a period of time post commissioning to demonstrate that impacts are not occurring;
- A contact number would be provided to local residents for reporting of environmental concerns;
- The OEMP would include an air emissions monitoring regime as follows:
  - Level 1: Year 1 to 2: air emissions testing conducted quarterly;
  - Level 2: Year 3 to 4: air emissions testing conducted semi-annually;
  - Level 3: Year 5 onwards: air emissions testing conducted annually, if required;
  - If there are any deviations on air emissions the testing regime would regress to a former level for two periods;
  - If additional units are installed that are identical to ones previously installed then these new units would adhere to the older unit testing regime.

Flora and Fauna

The OEMP would address flora and fauna management related to for operation and maintenance of gas wells, gas gathering lines, CPF and the transmission gas pipeline and would include flora and fauna management measures including site inductions relating to flora and fauna issues. Induction programs to induct all site workers involved in operation and maintenance activities into the requirements of the OEMP in relation to flora and fauna management would be developed. Induction would be required prior to their commencement of duties.

25.3.1 Soil and Water Management Plan

An Operations SWMP would be prepared as part of the OEMP and would include the following management measures for each project component.

Stage 1 GFDA

During operation of the Stage 1 GFDA, safeguards for surface water included in the Operations SWMP would include:

- The installation of a surface water drainage system for hardstand areas to prevent erosion / sedimentation from the concentration of water in some areas;
- Design of gas wells so that they can be shut-in or opened remotely from the CPF;
- Design measures would be implemented 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 within the CPF;
- Design of gas wells so that the wellhead, separator and meter run could be safely submerged for an extended period of time with no risk to the environment or the infrastructure. The infrastructure at wellheads would not impede the natural movement of floodwaters in the event of a flood;
- The relocation of unsecured plant and equipment from low-lying areas when flood warnings are received;
- Implementation / utilisation of appropriate flood warning systems to allow for the maximum amount of time to remove unsecured plant from flood-prone areas and to enable operations on flood-prone land to be made secure;
- Inspection / auditing of all plant and infrastructure following a flood event to ensure that all elements are operating effectively, and necessary rehabilitation works are carried out immediately;
- Installation of low water traps in low areas of the gathering system to allow for the removal of water that may collect. This would be emptied and contained for disposal as required;
- Incorporation of design measures to ensure that isolation valves on the gathering system would close, isolating each well field and shutting off gas flow to prevent uncontrolled release;
- Maintenance and personnel vehicles would be kept well maintained;
- Regular maintenance of the gas/water gathering system including visual inspection to identify potential leaks in the water gathering system.

Rehabilitation works such as installation of sedimentation and erosion control methods, revegetation and reconstruction and stabilisation of stream banks and drainage lines at watercourse crossings are in themselves safeguards to minimise erosion, sedimentation, turbidity and other direct and / or indirect environmental impacts associated with the Project.

The construction workforce camp would be rehabilitated to pre-disturbance conditions or better in consultation with the relevant landowners.

General safeguards to minimise impacts to surface water associated with rehabilitation include:

- Installation and maintenance of sediment and erosion control measures, such as silt fencing surrounding exposed areas and stockpiles;
- Stockpiling of soil and mulched vegetation during the construction period where possible for reuse during the initial rehabilitation phase. Topsoil and subsoil would be replaced in the appropriate order;
- Stockpiling of topsoil away from flood prone areas;
- Recontouring of surfaces to match the surrounding land and natural drainage lines;
- Re-establishment of native species or pasture, as required;
- Installation of trench breakers at watercourse crossings, on either side of the watercourse to prevent disturbances to natural flows; and
- Fencing of rehabilitated areas with stock proof fencing where required to minimise access and maximise success of rehabilitation works.

CPF

During the operation of the CPF, the following safeguards would be implemented to minimise / avoid impacts to surface water:

- The installation of a surface water drainage system for hardstand areas around the CPF to prevent erosion / sedimentation from the concentration of water in certain areas;
- Adoption of monitoring and reporting procedures to check the integrity of the water storage ponds and identify any leaks;
- Regular monitoring of storage pond water levels to minimise the risk of overflow / spillage;
- Installation of bunding around chemical storage areas to prevent runoff of contaminant in the case of a spill;
- Treatment of waste water: the volume of waste from the produced water would be greatly reduced through RO desalination treatment and subsequent evaporation of the brine. As such, the residual waste would be a solid salt product and treated water would be utilised by downstream users. Set procedures would be emplaced for the removal of the residual salt product from the RO plant by truck (if required) in accordance with accepted disposal guidelines and with appropriate safeguards (e.g. tarpaulins covering trucks, sealed loads, etc). Such procedures would be incorporated into the OEMP and would assist in avoiding and minimising spills. The solid salt product would be either transported to a salt processing plant or would be disposed of at a licenced waste facility depending on the composition and classification of the final product.
- Surfaces would be re-contoured and landscaped to match the surrounding land and natural drainage lines would be re-instated.

Pipeline

Environmental safeguards that would be implemented during operation of pipeline to minimise potential impacts to surface water would include regular monitoring and inspections of the pipeline during operation (especially after heavy rain) to identify scouring and possible exposure of the pipeline or other underground infrastructure. These areas would be rehabilitated to control further scouring and minimise turbidity / sedimentation;

The pipeline corridor including watercourses and banks, the construction camp and laydown areas would be rehabilitated after the construction phase using techniques such as:

- The re-spreading of topsoil from where it was removed and the backfilling of sub-soil from where it was removed in the correct order to prevent soil inversion;
- Installation of matting that is incorporated with seedlings to assist in stabilising the underlying soil of the bank, where required;
- Installation of silt and sediment fences to filter surface water runoff where deemed necessary (i.e. particularly sensitive locations);
- In locations where berms are used along the ROW, regular breaks would be installed, particularly at drainage lines, to minimise disturbances to natural surface water flows and scouring / formation of ponds along the ROW;
- The replacement of items of value to the fishery (e.g. logs, large rocks and other snags) which may have been disturbed during the construction of the watercourse crossing;
- Installation of rocks, riprap, sandbags, and/or matting to minimise scouring, ensuring that these assimilate with the existing environment as much as possible;
- Reinstatement of disturbed drainage lines after the construction works using the same material that was removed for backfilling, where possible;
- Compaction of trench backfill to account for backfill settlement.
- For watercourse crossings to be open trenched, the disturbance corridor for the bed, bank and riparian vegetation would be the narrowest practicable for safe construction, utilising a reduced ROW width;
- Installation of trench breakers at watercourse crossings on either side of the watercourse to prevent disturbances to natural flows; and
- Avoidance of permanent above-ground structures within floodways so as to not impede flood waters, where possible.

25.3.2 Weed Management and Monitoring Plan / Plant Pathogen Management Plan

A Weed Management and Monitoring Plan (WMMP) and a Plant Pathogen Management Plan (PPMP) would be prepared and implemented as part of the OEMP, as required by the Flora and Fauna Assessment.

25.3.3 Traffic Management Plan

A Traffic Management Plan would be prepared as part of the OEMP for the Project and would include detail on the following, in order to minimise potential impacts to traffic / transport and the surrounding road network:

- A Transport Code of Conduct which would outline and manage the transportation routes to the sites for heavy vehicles;
- Deliveries, dispatch and heavy vehicle parking during operation;

- Internal speed limits, use of truck turnaround areas;
- Heavy vehicle movements would be timed wherever possible to avoid or minimise localised impacts such as avoiding peak traffic zones and school zones between the hours of 7am - 9am and 2pm - 4pm.
- The internal Stage 1 GFDA road network and pipeline ROW would be used to facilitate access and accommodate vehicle movements wherever possible.
- Nominated transport routes would be clearly identified in the TMP and contractors would be made aware of the requirements to use these routes when travelling to and from the Project Area.

25.3.4 Noise Management Plan

The Operational NMP would include detail on:

- A noise monitoring program to validate the predicted noise levels from the Stage 1 GFDA, CPF and HDS and to ensure that noise levels remain within the relevant project noise goals.
- During the detailed design phase for the HDS, the acoustic investigations would assess for the need to adjust the source noise to account for tonality, impulsiveness, intermittency, irregularity or low-frequency content.
- The Proponent shall undertake a detailed assessment for the acoustic design measures required for the CPF plant and the HDS plant to ensure that operational noise levels are maintained within the relevant project noise goals.

The Proponent shall undertake a detailed assessment for the acoustic design measures required for the CPF plant to ensure that operational noise levels are maintained within the relevant project noise goals;

- Following final plant selection and detailed design, the Proponent shall commission a further detailed operational noise assessment of the CPF plant to establish and confirm expected operational noise levels and inform detailed design of noise mitigation for the plant;
- The Proponent shall undertake a program of noise monitoring once the CPF is operational in order to validate the design and mitigation measures applied to the facility. Details of the monitoring frequency would be detailed in the NMP, however it is anticipated that the Proponent would rigorously monitor noise at the commencement of the operation of the CPF followed by monitoring on a quarterly basis for a period of 12 – 24 months. If required, further mitigation may be recommended following the monitoring program to ensure that operational noise is maintained at an acceptable level. After 24 months of operation and when the CPF is operating consistently within the noise goals, external validations would be undertaken on a yearly basis; and
- Upgrading of acoustic enclosures for the power generators and compressors to achieve project noise goals if required.

The following safeguards would be implemented in relation to operation of the HDS:

- Secondary noise controls for the HDS plant could include the reselection of valves and fittings, design of pipe trains to reduce velocities and turbulence, lagging pipes and acoustic rated compound walls or mounds; and
- The Proponent shall undertake a program of noise monitoring once the HDS is operational in order to validate the design and mitigation measures applied to the facility. Details of the frequency of monitoring would be detailed in the NMP, however these would likely be similar to those for the CPF as indicated above. If required,

further mitigation may be recommended following the monitoring program to ensure that operational noise is maintained at an acceptable level.

25.3.5 Landscape and Rehabilitation Management Plan

The OEMP would incorporate a LRMP to be implemented during operation of the Project to minimise potential visual impacts. The LRMP would include the following:

- Identification of appropriate landscaping and rehabilitation treatments which would provide or retain screening vegetation to obscure views of project components;
- Monitoring and maintenance of landscaping and rehabilitation planting;
- Details of ongoing consultation with landowners on the visual impacts related to operation and maintenance of well site infrastructure and other above ground infrastructure and facilities;
- Details of design of exterior lighting at the CPF to minimise light spill, generally in accordance with *Australian Standard 4282-1997 Control of the Obtrusive Effects of Outdoor Lighting,* notwithstanding functional and safety requirements.

25.3.6 Emergency Response Plan

The OEMP would incorporate an ERP detailing response measures for spills and leaks of fuels and other chemicals to be used during the operations phase. This would include:

- Within the Stage 1 GFDA, personnel would be trained and provided with spill response kits at each well site location; and
- The provision of spill kits at the CPF site to allow for a rapid response in the case of an accidental spill to minimise potential environmental impacts.

25.4 Roles and Responsibilities

Implementation of the CEMP and OEMP is the ultimate responsibility of AGL.

Internally, the requirements of both the CEMP and OEMP would be monitored, audited and approved in the first instance by the Environmental Manager, and subsequently by the Approvals Manager and if required by an independent Environmental Consultant.

The Construction Contractor appointed for the construction phase of the Project would designate a Project Manager to be responsible for all aspects of compliance with these documents.

The Construction Contractors Project Manager (CCPM) would review the CEMP and prepare their own working document in respect of management plan objectives, policies and requirements. This document (Contractors CEMP or CCEMP) would be practical, workable and able to be implemented on site, by relevant contractors, site engineers and personnel.

The AGL Environmental Manager and Approvals Manager would be responsible for the ongoing auditing, monitoring and management of the CEMP and OEMP to ensure compliance with both construction and operational management plan requirements as set out in the Environmental Assessment.

25.5 Training and Induction

Construction and operations personnel would be required to attend an induction prior to the commencement of activities for the construction and operation of the Project and its components. The induction would 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 would be conducted for personnel prior to the start of work at that site. Induction would address general environmental and OH&S management issues identified in this EA, including any specific issues which would be identified in the appropriate management plans.

It would 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 would be required prior to implementation.

25.6 Inspection, Monitoring and Auditing

Inspection, monitoring and auditing would be undertaken to assess and record whether activities are in compliance with regulatory requirements and the objectives outlined in the CEMP and OEMP.

In addition to the conditions of the Minister's approval and the Proponent's SoC, project components would be carried out in accordance with:

- Conditions specified by the PPL for the Project;
- Conditions specified by the Pipelines Licence for the Project; and
- Conditions specified by the EPL issued for the Project.

25.6.1 Outline of Environmental Reporting

Environmental reporting is an important tool for environmental management as it can facilitate the collection of information regarding environmental impacts and issues thereby facilitating the identification of possible solutions to minimise these potential 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 would be considered a vital component. Reporting information would include:

- 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 would ensure that reporting undertaken in relation to environmental and OH&S issues would be in compliance with the relevant licence conditions and regulatory requirements.

25.6.2 Outline of Environmental Auditing

Environmental compliance auditing would 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 would be undertaken on a regular basis by a suitably qualified person. On-going monitoring of these activities would be essential to ensure compliance with regulatory requirements and conditions of approval.

The Proponent would ensure that records are kept of auditing that is conducted. Based on results of the audits, the Proponent would ensure modifications and corrective actions are undertaken to rectify any identified environmental impacts or concerns of the Project.

25.7 Emergency Response Plan

An Emergency Response Plan (ERP) would be prepared prior to the commencement of construction and operational activities associated with the Project. The ERP would be updated during the life of the Project in consultation with relevant emergency authorities, where necessary. Further hazard and risk studies would be undertaken prior to the preparation of the ERP as indicated in **Appendix I**. The ERP would 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 would include the following information:

- Contact details for emergency services in the area and directions to the nearest medical facility;
- The contact details (including before and after hours) of relevant AGL, contractor and government department personnel;
- First aid procedures;
- Fire fighting procedures;
- Bushfire Management;
- 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 would 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 personnel.

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26.0 Statement of Commitments

The Director-General's EARs for the Project require that the Proponent prepare a Statement of Commitments in respect of the Project outlining further investigation/design considerations for the Concept Area and environmental management, mitigation, offset and /or monitoring measures for the Project Area.

This chapter describes the Proponent's overarching environmental philosophy and provides a detailed Statement of Commitments for the Project, in line with the Director-General's EARs.

26.1 Environmental Philosophy

AGL is governed by its policies which cover a range of areas of relevance to the Project such as:

- Health, Safety and Environment (HSE);
- AGL Environmental Principles;
- Greenhouse Gas; and
- Risk Management.

Of particular relevance to the Project is the AGL HSE Policy, which states that AGL is committed to the protection of the environment, as well as the AGL Environmental Principles, which state that AGL's corporate ambition is underpinned by a commitment to sustainability. The Environmental Principles sets out a number of objectives in relation to environmental management including:

1. AGL will meet or exceed statutory obligations and relevant codes of conduct.
2. AGL's environmental performance reporting will be consistent with recognised standards established by independent performance rating agencies.
3. AGL will reduce risk and minimise environmental impact, by integrating considerations of environmental sustainability in all activities.
4. Consistent with business objectives, AGL will work in consultation with its external stakeholders to improve greenhouse gas emission outcomes.
5. AGL will provide customers with products and services that deliver environmentally sustainable solutions.
6. AGL requires that all its businesses promote and demonstrate the efficient use of energy, minimisation of waste and recycling of materials.
7. Contractors and supply chains are expected to demonstrate consistency with AGL's approach by fulfilling their environmental responsibilities.
8. AGL's employees are recognised for their expertise and are encouraged to contribute to improving the company's environmental performance.
9. AGL will consult with its stakeholders on how best to achieve its environmental objectives.
10. AGL will assess the potential environmental impacts of all its acquisitions.

All operations of AGL Energy are undertaken in accordance with these policies and AGL Energy commits to the objectives and overarching vision of these policies in relation to the implementation and management of the activities comprising the Project described in this EA.

26.2 Draft Statement of Commitments

The following Statement of Commitments (SoC) is provided in accordance with the EARs issued under Part 3A of the EP&A Act,. The Project comprises two separate components – the Concept Area and the Project Area. One application has been lodged seeking Concept Plan Approval for activities within the Concept Area and concurrent Project Approval for certain activities within the defined Project Area (Stage 1 GFDA, pipeline, CPF and HDS). In reflection of this, and in accordance with the EARs, two separate Statements of Commitment have been developed.

As described in the EARs, the SoC for the Concept Area describes further investigation and design considerations in respect of the future development of this area, whilst the SoC for the Project Area outlines environmental management, mitigation and monitoring which would be undertaken as part of the Project to ensure that the potential impacts identified in this EA are adequately managed. As the Project Area comprises four distinct components – the Stage 1 GFDA, CPF, pipeline and HDS, the SoC has been split up into the component parts of the Project in order to differentiate specific commitments relating from more general measures applicable to all project components.

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 Concept and concurrent Project approvals.

26.2.1 Draft Commitments – Concept Area

Table 26-1: Draft Statement of Commitments - Concept Area

Issue	Commitment
General	1. The Concept Plan would be subject to further detailed environmental assessment on a range of issues as identified in this SoC undertaken as part of future project applications. 2. The location of wells and associated infrastructure forming part of the Concept Plan 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. 3. The location of wells within the Concept Area would be selected generally in line with the following: • Not within 200 m of existing residences unless otherwise agreed; • Minimum of 40 m from a major watercourse or 20 m from a minor watercourse; • Avoidance of vegetation and riparian areas wherever possible; • Avoidance of Indigenous and European heritage places or items; • Adjacent to existing fence lines and access tracks wherever practicable; • Avoidance of existing infrastructure; • On relatively flat ground, where possible; • In consideration of visual effects and opportunistic use of natural screening such as vegetation; and • In consultation with landowners.
	4. The location of gas and water gathering lines and access roads within the Concept Area would be selected generally in line with the following:

Issue	Commitment
	• In existing disturbed areas wherever possible; • Avoidance of vegetation and riparian areas wherever possible; • Avoidance of Indigenous and European heritage places or items; • Avoidance of existing infrastructure; • Utilising existing fence lines and access tracks wherever practicable; • On relatively flat groundwhere possible; • In consideration of land use and landowner preferences. 5. The location of infill wells within the Concept Area would be selected generally in line with the following: • Infill wells would comprise either new wells co-located within the pad of existing wells 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. 6. The location of supporting infrastructure within the 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.
Air Quality	7. The selection of potential well site locations and associated infrastructure within the Concept Area would consider opportunities to minimise air quality impacts generated by the construction and operation of the Project. 8. A further Air Quality Impact Assessment (AQIA) would be prepared and submitted in respect of future stages of the GFDA within the Concept Area.
Ecology	9. The Proponent shall undertake further detailed ecological assessment of proposed works within the Concept Area once details of proposed well site locations and associated infrastructure are confirmed. Details of this assessment shall form part of subsequent project applications in respect of the proposed works. 10. The selection of potential well site locations in the Concept Area shall consider all practicable measures to minimise the potential ecological impacts of the proposed Project.
Land Use	11. The Proponent will ensure that locational principles are used to guide the location of future infrastructure within the Concept Area (refer Commitment 3 above).
Water	12. The Proponent shall undertake further detailed assessment of the potential impacts of proposed works within the Concept Area upon groundwater once further details of the proposed works are known and the results of monitoring programs to be implemented in respect of the Stage 1 GFDA are available for review. 13. The Proponent shall undertake further studies relating to the potential discharge of treated water during periods of high rainfall, particularly

Issue	Commitment
	relating to a potential discharge point.
Noise	14. The Proponent shall undertake further detailed noise assessment in respect of proposed works within the Concept Area once further details of well site locations and associated infrastructure are confirmed. Details of this assessment shall form part of subsequent project application/s required to be submitted in respect of the proposed works. 15. As a guide, the following general principles would be considered when identifying potential well site locations for the Concept Area: • Well site 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 that noise minimisation would 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.
Visual	16. The selection of potential well site locations and associated infrastructure within the Concept Area would consider opportunities to minimise visual impacts resulting from the proposed project. 17. The Proponent shall undertake further assessment of the visual impacts of proposed works within the Concept Area once details of well site locations and associated infrastructure are confirmed.
Heritage	18. The Proponent shall undertake further studies in respect of Indigenous and Non-Indigenous heritage in relation to works within the Concept Area as part of broader environmental assessment associated with a subsequent project application(s) required to be submitted in respect of the proposed Project.

26.2.2 Draft Commitments – Project Area

Table 26-2: Draft Statement of Commitments – Project Area

Issue	Commitments
General (applicable to all four project components)	
General	1. The Proponent shall undertake the activities subject of the Project application in accordance with the general descriptions and details provided in this EA, including the mitigation and management measures recommended by this EA. 2. The Proponent will gain all necessary approvals and permits supporting both construction and operation. 3. The Proponent will prepare and implement the following management plans for the Project: • A Construction Environmental Management Plan (CEMP); and • An Operations Environmental Management Plan (OEMP). 4. The Proponent will ensure that the location of compound sites and other ancillary facilities are selected generally in line with the following : • In existing disturbed areas wherever possible; • Avoiding vegetation and riparian areas where possible; • Minimum of 40 m from a major watercourse and 20 m from a minor watercourse; • Avoiding Indigenous and European heritage places or items • Utilising existing access tracks where practicable; • Avoiding impacts on existing infrastructure • On relatively flat ground where possible; • Considering visual effects and opportunistic use of natural screening such as vegetation; • In consultation with landowners.
Further Studies	5. The Proponent shall prepare and implement the following studies, to the satisfaction of the Director General prior to the commencement of construction: • A Hazard and Operability Study; • A Final Hazard Analysis (update of the PHA); • A Fire Safety Study; • An Emergency Response Plan; • A Construction Safety Study. 6. The Proponent shall prepare/undertake the following to the satisfaction of the Director General prior to the commencement of operation of the Project: • A Safety Management System; • An Independent Hazard Audit.

Issue	Commitments
	7. The Proponent shall prepare a Petroleum Production Operations Plan in accordance with DPI requirements.
Air Quality	8. An Air Quality Management Plan (AQMP) will be prepared for inclusion in the CEMP. The Proponent will ensure that the AQMP outlines all activities required to minimise dust and vehicle emissions during the construction of the Stage 1 GFDA, CPF, pipeline and HDS. 9. The Proponent will ensure that the OEMP includes measures regarding monitoring, assessing and if required rectifying any air quality issues associated with the operation of the Stage 1 GFDA, CPF, pipeline and HDS.
Ecology	10. The Proponent shall ensure that all practicable measures are implemented to minimise the potential impacts on flora and fauna. 11. The Proponent shall manage the potential ecological impacts of the construction of the proposed project in accordance with the Flora and Fauna Management Plan which is to form part of the CEMP for the Project, as detailed in **Chapter 25** of this EA. 12. The Proponent shall manage the potential ecological impacts of the operation of the proposed project in accordance with the OEMP for the Project as detailed in **Chapter 25** of this EA. 13. Rehabilitation shall be undertaken in areas disturbed by the Project in accordance with a Landscape and Rehabilitation Management Plan (LRMP) as detailed in **Chapter 5, 10, 12** and **22** of this EA to ensure that the site is restored to existing or better conditions.
Land Use	14. The Proponent will ensure that ongoing consultation is undertaken with affected landowners throughout the detailed design phase of the Project and prior to and during the construction and operation phases of the Project. 15. The Proponent will adopt locational principles for siting of the construction workforce camps within the Stage 1 GFDA and proximate to the pipeline. 16. The Proponent will prepare and implement a Construction Workforce Management Plan as part of the CEMP to manage potential impacts associated with the construction workforce camps. 17. The Proponent will implement acoustic attenuation and mitigation where necessary as recommended by the Project noise assessment to ensure impacts upon surrounding land uses (particularly residential land) are minimised. 18. The Proponent will provide landscape screening as recommended in the visual assessment to ensure visual impacts are minimised. 19. The Proponent will negotiate access arrangements during construction and operation with relevant landholders and stakeholders in advance of commencement of works. 20. The Proponent will undertake rehabilitation as soon as practical upon completion of construction works to allow normal farming practices to resume. 21. The Proponent will ensure that access to properties and farming land is maintained during works. Should the works require closure of access, a detailed consultation program would be undertaken with affected

Issue	Commitments
	stakeholders and landholders. 22. The Proponent will ensure that upon completion of construction activities, disturbed areas (excluding the Stage 1 GFDA) would be rehabilitated to restore the areas to their original land use. 23. The Proponent will ensure that upon completion of the Project, the entire site would be rehabilitated, including restoration of the area to its original land use.
Water	24. The Proponent shall implement all practicable measures to minimise soil erosion and discharge of sediments from the various project sites. 25. The Proponent shall prepare and implement the following management plans as part of the CEMP for the Project prior to commencement of construction, as detailed in **Chapter 25**: • Construction Soil and Water Management Plan; • Erosion and Sediment Control Plan; • Acid Sulfate Soils Management Plan; • Emergency Response Plan. 26. The Proponent shall prepare and implement the following management plans as part of the OEMP for the Project, as detailed in **Chapter 25**: • Soil and Water Management Plan; • Emergency Response Plan.
Groundwater	27. The Proponent shall prepare and implement a Groundwater Management Plan (GWMP), as detailed in **Chapter 25**.
Noise	28. A Noise Management Plan (NMP) would be prepared as part of the CEMP to address construction noise and vibration, and methods to minimise impacts. 29. A NMP would also be prepared as part of the OEMP to address operation noise and vibration, particularly related to operation of the CPF and HDS and post-commissioning noise monitoring.
Hazard and Risk	30. The Proponent shall prepare and implement the following for the Project prior to commencement of construction, as detailed in **Chapter 15**: • Hazard and Operability Study; • Final Hazard Analysis (comprising an update of the PHA); • Fire Safety Study; • Emergency Response Plan. • A Construction Safety Study. 31. The Proponent shall undertake the following for the Project prior to commencement of operations, as detailed in **Chapter 15**: • Development of a Safety Management System • An Independent Hazard Audit. 32. The Proponent shall undertake the following specific mitigation measures in respect of the Stage 1 GFDA, CPF and HDS:

Issue	Commitments
	• Designed and operated in accordance with the relevant Australian Standards; • Security fencing would be installed around infrastructure as appropriate, including installation of a security fence around the HDS outside the hazardous area classified by AS 2430 to minimise risk of ignition sources; • Vehicle barriers would be installed around infrastructure where appropriate; • A regular program of maintenance/inspection of infrastructure would be adopted in accordance with the Proponent's standard procedure; • Gravel or hardstand area to be constructed inside the fenced site around gas filled equipment to minimise risk of grass fires; • Lightning protection to be fitted as appropriate; • Adoption of the Proponent's standard operating procedures in respect of the proposed facilities; • Monitoring of pressure via SCADA system. • Use of remotely operated ESD valves; • Ignition control as per AS2430 Hazardous Area requirements; • Appropriate separation distances to be maintained between release points and site boundary in accordance with the consequence impact distances reported in the PHA report; • Disused wells and coal holes encountered throughout the Stage 1 GFDA would be cemented to minimise the likelihood of gas migration.
Traffic and Transportation	33. The Proponent shall ensure that construction and operational traffic is managed in accordance with a Traffic Management Plan prepared and implemented as part of the CEMP and OEMP for the Project.
Geology and Soils	34. The Proponent shall prepare and implement the following management plans as part of the CEMP for the Project prior to commencement of construction, as detailed in **Chapter 25**: • Construction Soil and Water Management Plan; • Acid Sulfate Soils Management Plan.
Visual	35. The Proponent shall ensure that directional lighting is employed during construction, to minimise light spill from construction footprints, particularly for night time drilling. 36. The Proponent shall prepare and implement a Landscape and Rehabilitation Management Plan as part of the OEMP for the Project, to minimise potential visual impacts during operations.
Heritage	37. The Proponent shall prepare and implement a Heritage Management Plan as part of the CEMP for the Project, to minimise potential impacts on Aboriginal and/or historic heritage during operations.

Issue	Commitments
Socio Economic	38. The Proponent shall prepare and implant a site specific Construction Workforce Management Plan (CWMP) as part of the CEMP for the Project.
Rehabilitation	39. The Proponent shall prepare a Landscape and Rehabilitation Management Plan as part of the CEMP for the Project, as detailed in **Chapter 25**.
Waste	40. The Proponent shall prepare and implement a Waste Management Plan as part of the CEMP for the Project.
Stage 1 GFDA	
Air Quality	41. The Proponent will ensure that the Construction AQMP outlines activities required to minimise potential impacts to air quality from: • Flaring of wells during commissioning. • Dust and vehicle emissions during the construction of the Stage 1 GFDA. 42. The Proponent will ensure that the OEMP includes measures aimed at monitoring, assessing and if required rectifying any air quality issues associated with the operation of the Stage 1 GFDA.
Ecology	43. The Proponent shall implement the following measures to minimise clearing of native vegetation required for construction of the Stage 1 GFDA: • Place disturbance footprints of gas wells outside remnant vegetation patches (about 6% of GFDA) and at least 40 m from major watercourses. • Design gas gathering system to avoid large remnant vegetation patches and to cross watercourses at sites with no or limited native vegetation, wherever possible, based on further survey work.
Land Use	44. The Proponent shall adopt an environmental envelope approach to allow for the movement of proposed well locations within designated limits, in order to be able to address and accommodate constraints as they arise. 45. The Proponent will decommission each well upon expiration of the life of the well. Land comprising the Stage 1 GFDA will be rehabilitated and returned to its previous use.
Noise & Vibration	46. The proponent shall conduct construction activities that are generally between the following hours of 7.00 am to 6.00 pm Monday to Saturday. Where it is demonstrated that construction noise goals can be achieved construction would be undertaken outside these hours. 47. Fraccing to be undertaken only during daytime hours, subject to geological conditions. Secondary noise controls such as portable acoustic screens would be utilised for fraccing activities. 48. Activities associated with the construction of access tracks and the clearing of vegetation would be undertaken during daytime hours only.
Heritage	49. The Proponent shall prepare and implement a Heritage Management Plan as part of the CEMP for the Project, to minimise potential impacts on Aboriginal and/or historic heritage during operations.
CPF	
Air Quality	50. The Proponent will ensure that the AQMP outlines activities required to minimise potential impacts to air quality from dust and vehicle emissions

Issue	Commitments
	during the construction of the CPF. 51. The Proponent will ensure that the OEMP includes measures aimed at monitoring, assessing and if required rectifying any air quality issues associated with the operation of the CPF. .
Ecology	52. Place disturbance footprints of the CPF outside remnant vegetation patches and at least 40 m from major watercourses.
Land Use	53. The Proponent will decommission the CPF plant upon completion of the Project. CPF Site 1 will be redeveloped with a land use compatible with the land use zoning at the time of decommissioning.
Noise and Vibration	54. The proponent shall conduct construction activities that are generally between the following hours of 7.00 am to 6.00 pm Monday to Saturday. Where it is demonstrated that construction noise goals can be achieved construction would be undertaken outside these hours. 55. The Proponent shall undertake a program of noise monitoring once the CPF is operational in order to validate the design and mitigation measures applied to the facility. If required, further mitigation may be recommended following the monitoring program to ensure that operational noise is maintained in accordance with the relevant project noise goals. 56. The Proponent shall undertake the following design measures for the CPF plant to ensure that operational noise levels are maintained within the relevant project noise goals: 57. Following final plant selection and detailed design, the Proponent shall commission a further detailed operational noise assessment of the CPF plant to establish and confirm expected operational noise levels and inform detailed design of noise mitigation for the plant.
Hazard and Risk	58. The PHA should be updated when final design details are known, particularly for the operation of the flare. 59. Once final design details are known, a HAZOP of the design will be undertaken, particularly to assess abnormal operating modes such as flare and blowdown operations.
Pipeline	
General	60. The Proponent shall ensure that the pipeline is provided with marker tape at all sections of pipeline located within 35 m of residential development (as measured from the pipeline centreline). 61. Pipeline works, including construction, operation and decommissioning, would be undertaken in accordance with the recommendations in The Australian Pipeline Industry Association Limited – *Code of Environmental Practice – Onshore Pipeline (2005)* and AS 2885.
Air Quality	62. The Proponent will ensure that the Construction AQMP outlines activities required to minimise potential impacts to air quality from dust and vehicle emissions during the construction of the pipeline. 63. The Proponent will ensure that the OEMP includes measures aimed at monitoring, assessing and if required rectifying any air quality issues associated with the operation of the pipeline. .
Ecology	64. The Proponent shall implement all practicable measures to minimise potential impacts to flora and fauna from the construction of the pipeline in accordance with the Flora and Fauna Management Plan which is to form

Issue	Commitments
	part of the CEMP for the Project, as detailed in **Chapter 25** of this EA.
Land Use	65. The Proponent will ensure that where possible, the pipeline route remains within existing infrastructure easements. 66. The Proponent will ensure that the proposed pipeline is buried underground in accordance with AS2885 and protected by easements. The Proponent will ensure that future landowners and other stakeholders are aware of the location of the pipeline and any restrictions on the use of land within the easement. 67. Upon expiration of the life of the Project, the Proponent will abandon the pipeline in accordance with the regulator's guidelines. The easement will be extinguished from the title and the above ground infrastructure removed.
Noise and Vibration	68. Construction works would typically occur between 7.00am to 6.00pm, seven days per week with the exception of HDD which may need to be continued beyond typical construction hours in order to ensure the integrity and safety of the process. Blasting would typically occur between 9.00am to 5.00pm Monday to Friday, 9.00am to 1.00pm Saturday and no blasting on Sundays, if blasting is required. 69. The Proponent shall ensure that advanced notification of commencement of construction works is provided to potentially affected landowners indicating the length of time during which impacts may be experienced, the nature of potential impacts and a contact number for complaints to be recorded and responded to. 70. The Proponent shall ensure that works requiring the use of rock hammers do not occur within 20 m of a residence. 71. The Proponent shall ensure that works requiring blasting do not occur within 200 m of a residence.
Hazard and Risk	The Proponent shall undertake the following specific mitigation measures in respect of the pipeline: 72. The pipeline is to be provided with marker tape at all sections that would be located within a 35 m distance of residential development (as measured from the pipeline centreline) and or additional depth of cover in these areas. 73. Appropriate safety measures to be designed and adopted for sections of the pipeline which are in close proximity to 132 and 330 kV power lines to ensure the safety of personnel and equipment. These measures may include: • Selective earthing at certain positions along the pipeline; • Installation of zinc ribbon in the pipeline trench; • Installation of inline isolation in the pipeline; • Restriction of access to the pipeline and its facilities; • Use of equi-potential grids or other similar safety equipment during maintenance of the pipeline; and • Use of lockable test points for the cathodic protection system. 74. Preparation of a Construction Safety Study in respect of the pipeline. This

Issue	Commitments
	study should address general construction safety requirements as well as specific locational hazards such as AC induction. 75. Pipeline to be designed and operated in accordance with AS 2885-2007. Pipeline design to meet the requirements for T1 locations, being rural areas developed for residential, commercial or industrial use, where allotments are less than 1 hectare in area and buildings do not exceed four floors. 76. Regular maintenance/inspection of pipeline in accordance with the Proponent's standard procedures. 77. Relieving of stress where ground movement stresses pipework. 78. Installation of marker signs and marker tape along the length of the pipeline to alert people to the presence and location of the pipeline. Signage to include details of 'One-Call'/'Dial before-you-dig' services. 79. External surfaces of pipeline to be coated to protect against corrosion. Testing of the integrity of the coating ('Holiday' detection) to be carried out prior to burial of the pipeline. 80. Use of sacrificial anode cathodic protection system to provide further protection against corrosion. 81. Gas quality to be such that corrosion enhancing components are minimised. 82. Intelligent pigging of the pipeline to be carried out to assess pipeline condition every 5-10 years. 83. Regular patrolling of pipeline by the Proponent to assess for damage or activities which have the potential to cause damage to the pipeline. Patrols would also facilitate detection of ground movement or land subsidence. Where significant ground movement is detected and stresses are determined to be high, the ground around the pipeline/gathering line would be dug up to relieve stresses. 84. Pipeline design to make provision for current subsidence parameters for the location (as provided by the Mine Subsidence Board), where required. 85. Liaison with Mine Subsidence Board to determine the location and details of likely future mining activity in the vicinity of the pipeline.

27.0 Residual Risk Analysis

27.1 Approach

The Residual Environmental Risk Analysis for the proposed Project is based on a process adapted from Australian Standard AS 4360:2004 Risk Management. The process is qualitative and is based on the Residual Risk Matrix shown below.

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	Resilient 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.Straight forward	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 27-1: 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)

27.2 Analysis

The analysis of residual environmental risk for issues related to the proposed project is shown in **Table 27-2**. 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 27-2: Risk Profile

Issue	Significance	Manageability	Residual Risk
Air Quality	3	3	**6 (Medium)**
Ecology	3	3	**6 (Medium)**
Land Use	3	2	**5 (Low/Medium)**
Surface Water	2	3	**5 (Low/Medium)**
Groundwater	2	2	**4 (Low/Medium)**
Noise	3	2	**5 (Low/Medium)**
Hazard and Risk	2	2	**4 (Low/Medium)**
Traffic and Transport	3	2	**5 (Low/Medium)**
Geology and Soils	2	2	**4 (Low/Medium)**
Visual	2	2	**4 (Low/Medium)**
Heritage	2	2	**4 (Low/Medium)**
Socio Economic	2	2	**4 (Low/Medium)**
Greenhouse and Climate Change	1	2	**3 (Low)**
Rehabilitation	1	2	**3 (Low)**

Issue	Significance	Manageability	Residual Risk
Waste	2	2	**4 (Low/Medium)**
Cumulative Impacts	1	2	**3 (Low)**

The above residual risk analysis indicates that the proposal presents an overall low to medium risk in relation to each of the identified environmental issues, provided that the recommended mitigation, management and monitoring measures are implemented.

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28.0 Proposal Justification

Schedule 2 of the Environmental Planning and Assessment Regulation 2000 sets out the matters which an environmental impact statement must consider and includes a requirement for consideration of the justification for the proposal having regard to biophysical, economic and social considerations, including the principles of ESD. This requirement is reiterated in respect of the proposed project in the EARs issued by the Director General.

This chapter provides a justification for the Project in line with the requirements of the EP&A Regulation and the Director General's EARs for the Project.

28.1 Introduction

The Project, which involves the construction, operation and rehabilitation of the Stage 1 GFDA, CPF, pipeline and HDS would provide numerous benefits associated with the provision of an essential and valuable indigenous energy resource to NSW. Substantial benefits would result from the Project, including environmental benefits associated with the provision of an alternative and less carbon intensive fuel to that of coal, in addition to 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, CPF location, pipeline alignment and HDS to minimise environmental impacts.

Environmental compatibility with current and future land uses has been facilitated through extensive consultation with affected landowners and other stakeholders with the regard to the design and siting of the various project components, as well as use of preliminary environmental investigations of the Project Area in order to allow for the up front consideration of environmental constraints in the design process.

Further flexibility has been built into the Project through the use of an environmental envelope approach as described in **Section 1.5** and **5.2** of this EA. This approach means that if specific environmental issues are identified during the construction of wells or the pipeline, the assessment allows for the well site location or the pipeline route to be adjusted within the assessed envelope, subject to the identified environmental constraints. This enables some adjustment of infrastructure siting to account for sensitive issues which may arise 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 existing and future land uses.

28.2 Justification

The Director-General's EARs issued for this Project require justification for the Project to be provided, having regard to environmental, social and economic 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 which are summarised below.

28.2.1 Biophysical

Potential environmental impacts associated with the proposed Project have been assessed in **Chapters 9 to 23** of this EA. The assessment of the biophysical environment has included individual assessments of:

- Ecology;
- Soils and geology;
- Surface and Ground Water management; and
- Land use.

Each of the abovementioned studies concluded that the implementation of a range of environmental safeguards and measures as 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 **Chapter 26** of this EA. The project is justifiable taking into account potential residual biophysical impacts on the environment.

28.2.2 Economic

The economic impacts of the proposal are assessed in **Chapter 20** 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.

There has been a history of CSG exploration in the Gloucester Basin and the Proponent has developed local CSG pilot wells as detailed in **Chapter 1**. Pilot wells have indicated that the CSG resource in the Gloucester basin presents a viable CSG resource to increase gas production in NSW to assist to meet the Projected increase in demand for this resource. The development of this local resource in the Hunter region would reduce the need to transport gas from elsewhere (including interstate) and improve efficiency and potentially reduce the overall cost of gas for consumers and the environment. Additionally, this Project is in line with the Gloucester Shire Council Strategic Plan for the Economic Development of the Shire District as further described in **Chapter 20.**

The Project would require approximately 465 personnel throughout the construction phase of the Project and approximately 30 full-time personnel during the operational phase of the Project as detailed in **Chapter 5.** The development of the Concept Area in the future would additionally provide opportunities for 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 Hunter region and the State. The Project represents a significant investment in the region and a positive impact, providing 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.

28.2.3 Socio-cultural

The potential socio-cultural impacts of the proposal have been assessed in **Chapters 9 to 23** of this EA, and included consideration of:

- Hazards and risk;
- Aboriginal and historic heritage;
- Land use;
- Traffic and transport;
- Visual amenity;
- Socio-economic environments;
- Noise;
- Air quality; and
- Cumulative impacts of the development.

The abovementioned assessments presented in this EA indicate that provided appropriate mitigation and management measures as outlined in the Statement of Commitments are implemented, the Project would have a minimal and acceptable impact on socio-cultural issues. The project is justifiable taking into account potential socio-cultural impacts. The project is likely to have a positive impact on regional and State economies due to the provision of an indigenous gas supply, while the Gloucester Shire may also experience positive impacts associated with additional employment creation and increased demand for local goods and services during both the construction and operation phases of the Project.

28.3 Ecological Sustainability

Ecologically Sustainable Development (ESD) is a concept firmly enshrined in New South Wales environmental legislation and government policy. Schedule 2 of the EP&A Regulation establishes four guiding principles to assist in achieving ESD, as follows:

- **The precautionary principle** – namely, that if 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.
- **Inter-generational equity** – namely, 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.
- **Conservation of biological diversity and ecological integrity** – namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.
- **Improved valuation and pricing of environmental resources** - namely, 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.

The EPBC Act also identifies a fifth principle for consideration in environmental impact, namely:

> *'Decision making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations.'*

These five principles are interrelated and need to be considered both individually and collectively as part of determining whether or not a project would be consistent with the principles of ESD in Australia.

28.3.1 The Precautionary Principle

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 inform project design and the selection of alternatives, identify the potential environmental impacts of the proposal and develop specific environmental management practices and safeguards for the proposed works which aim to avoid significant environmental impacts and manage or minimise residual impacts.

Environmental monitoring would be undertaken throughout the construction, operation and rehabilitation phases of the Project 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 Concept Area approval, further detailed investigations would be undertaken in this area as part of future project applications prior to the commencement of works, to ensure that the potential environmental impacts of the proposal are fully understood and that appropriate safeguards are identified to protect the environment.

28.3.2 Inter-Generational Equity

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 CSG well drilling programs and pipeline construction and recognising the requirement to achieve, where possible, a neutral or beneficial effect on the environment.

The project would not result in the sterilisation of land or other resources and would return the land to as close as possible to its pre-development state upon initial rehabilitation of the wells in the Stage 1 GFDA and the pipeline corridor, following construction. With the implementation of the identified environmental safeguards and mitigation measures, the proposal would result in the provision of a valuable indigenous NSW gas resource without causing significant or irreversible environmental harm.

28.3.3 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 Stage 1 GFDA, CPF and pipeline 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 Project. The assessment found that the proposal would have no significant impact upon threatened species, populations or ecological communities or their habitats as long as the proposed mitigation measures are implemented. Monitoring would be undertaken to ensure that environmental control measures are operating effectively.

Provided the mitigation measures recommended in this EA are implemented, the proposed Project is not expected to present a significant risk to the biological diversity and ecological integrity of the region.

28.3.4 Improved Valuation and Pricing of Environmental Resources

The IGAE and POEO Act require improved valuation, pricing and incentive mechanisms to be included in policy making and program implementation. In the context of environmental assessment and management, this would translate to environmental factors being considered in the valuation of assets and services.

Integration of environmental and economic goals is a key principle of ESD, which can be measured undertaking a cost-benefit analysis, that is, by measuring the costs of proceeding with a project against the benefits arising from the Project.

Given the different values placed on different elements of the environment, and the various components of the environment, it is difficult to assign a monetary value against the environmental costs and benefits associated with a project. In recognition of this, the approach adopted for this project is the management of environmental impacts through appropriate safeguards, and to include the cost of implementing recommended safeguards in the total cost of the Project. Additionally, the relative costs of sourcing CSG locally while utilising modern plant design are deemed to have lower cost on the environment when compared to importing gas to the Hunter Region from interstate or overseas.

The value of the environment is also managed through the legislative process by imposing financial penalties or requirements to rehabilitate on persons responsible for polluting the environment.

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 for future development of the land.

28.3.5 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 **Chapter 26** forms the environmental mitigation, management and monitoring requirements for the proposed works.

The Project/ Concept Plan 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. Further assessment would be undertaken and project approvals sought for the works subject to the Concept Area approval in accordance with the requirements of the legislation and the conditions of any Concept Plan Approval issued.

28.4 Greenhouse Gas Emissions and Climate Change

Maintenance of the earth's climate involves certain gases, known as greenhouse gases, capturing heat radiated from the earth and re-radiating heat back to the earth. Scientific consensus indicates this thermal balance is being influenced by the steadily increasing concentrations of certain greenhouse gases including carbon dioxide (CO_2), and other greenhouse gases such as methane, ozone (O_3), NO_x and Chloro-fluorocarbons (CFCs). Natural gas (including CSG) produces around half the greenhouse gas emissions per gigajoule of energy relative to coal (including carbon dioxide and sulphur compounds), making it a considerable lower emission-intensive fossil fuel. Gas typically costs more per gigajoule than coal, but it is a more efficient fuel and a competitively priced gas supply would assist in reducing local reliance on more emissions-intensive fuels.

The proposed Project would provide for increased production of gas to supply the NSW market, meeting future projected demand and reducing the need for consumers to use alternative and typically higher emissions-intensive fuel sources such as energy produced through the burning of coal. Additionally, growing national and international commitments to the reduction of greenhouse gas emissions increase the importance of natural gas, as a transitionary fuel in generating electricity and other energy applications.

The proposed Project would result in the generation of greenhouse gases during the construction and operation phases, but also would result in savings in greenhouse gas emissions due to the downstream use of CSG in place of other fossil fuels. The Project infrastructure and gas utilised by consumers has been estimated and is discussed in **Chapter 21** of this EA. The total volume of greenhouse gases produced as a result of these activities is minimal given the scale of the Project and the avoided use of higher intensity fossil fuels. The overall impact in terms of climate change and greenhouse gases is therefore expected to be beneficial when considered in the context of the wider energy market.

28.5 Consequences of Not Proceeding

The importance of securing a cost-effective indigenous energy supply, with lower greenhouse emissions is considered vital to the responsible social and economic growth of the Hunter region and the State. Should the proposal not proceed, a cost-effective indigenous source of energy would be lost.

Growth in domestic use of gas is projected to remain strong (growing at 4.0 % per annum in the medium term to 2010–11 and thereafter at 2.5 % per annum) to reach 1,740 PJ nationally in 2019–20 (Roarty, 2008). Gas from the Gloucester Basin would initially be produced in the range of 20 PJ to 30 PJ per annum, which is over 10% of the existing NSW market with potential to increase over time. This represents the gas required for three to four years of the Projected annual growth of the NSW gas market (excluding fuel for power generation). The development of new gas supplies to the growing Newcastle and Sydney market is important to guarantee supply. This Project would provide the next step both in ensuring that supply to the Newcastle and Sydney markets is maintained in the future and in helping to protect the environment.

It is therefore important for the Government to ensure that current Australian supplies of gas are supplemented from additional sources in order to meet the increasing demand and dwindling conventional gas reserves. The main Sydney trunkline runs through Hexham, consequently, the Proponent is well placed to assist in bringing additional gas to the market via the proposed pipeline.

The Project would also assist in the achievement of several State energy objectives and initiatives which are formulated to provide safe efficient, secure and indigenous 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 CSG supply within the Hunter region;
- The loss of resulting economic and social benefits to the local community of the Hunter region and the wider New South Wales community; and
- The likely future shortfall in the gas supply to the 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.

It would also be a lost opportunity to contribute positively to Government initiatives such as the development of CSG resources, the reduction of greenhouse gas emissions, petroleum exploration in New South Wales, and the deregulation of energy markets in Australia.

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. Should the Project not proceed, the State would not receive, or defer receiving, such royalties.

Royalty rates are governed through the *Petroleum (Onshore) Act 1991* (POA Act). Royalties to the State would be in accordance *The Petroleum (Onshore) Regulation 2002* Part 7, which details annual rates of royalty for the purposes of the POA Act.

28.6 Conclusion

Undertaking the proposal in the manner proposed is justifiable taking into consideration potential health, 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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29.0 Conclusion

The Concept Plan and Project Application comprise the development of wells for the extraction of CSG from the Gloucester Basin, development of one Central Processing Facility (CPF) at either Site 1 or Site 7 in the area identified as the Stage 1 GFDA, and the construction and operation of a gas transmission pipeline from the CPF to the Hexham Delivery Station (HDS), NSW.

This EA has been prepared in accordance with the Director-General's Requirements (see Chapter 7) and addresses each of these requirements, with the environmental impacts of the Project detailed in **Chapters 9** to **23** and further discussed in **Chapter 28**.

Additionally, this EA demonstrates the environmental acceptability of the Concept Plan and Project Application, provided the recommended safeguards are implemented, and that the Concept Plan and Project Application would have significant environmental, economic and social benefits.

This EA satisfies all requisite statutory requirements regarding the Concept Plan and Project Applications. It is considered that the construction and operation of the Project is justified taking into account biophysical, socio-cultural and economic considerations and is in accordance with the principles of sustainability.

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