



**Gladstone Liquefied Natural Gas
Initial Advice Statement**

19 July 2007

Contents

1	Project Overview	5
1.1	Purpose and Scope of Initial Advice Statement (IAS).....	5
1.2	Project Proponent.....	5
1.3	Project Rationale.....	6
1.3.1	Economic Benefits.....	6
1.4	Regulatory Approvals Process.....	8
1.4.1	State	8
1.4.2	Commonwealth.....	9
2	Project Description	10
2.1	Project Components.....	10
2.2	LNG Facility	11
2.2.1	LNG Facility Location	11
2.2.2	Alternative Locations Considered.....	12
2.2.3	LNG Facility Description	13
2.3	Gas Transmission Pipeline.....	16
2.4	Gas Fields.....	16
2.4.1	Gas Composition – Feed and Product	16
3	Existing Environmental and Potential Environmental Impact.....	17
3.1	Climate	17
3.1.1	LNG Facility	17
3.1.2	Gas Fields	17
3.2	Land Use and Tenure	18
3.2.1	LNG Facility	18
3.2.2	Gas Transmission Pipeline.....	18
3.2.3	Gas Fields	18
3.3	Geology, Soils and Geomorphology.....	19
3.3.1	LNG Facility	19
3.3.2	Gas Transmission Pipeline.....	20
3.3.3	Gas Fields	21
3.4	Topography	22
3.4.1	LNG Facility	22
3.4.2	Gas Transmission Pipeline.....	23

3.4.3	Gas Fields	24
3.5	Water Quality	24
3.5.1	Groundwater	24
3.5.2	Surface Water	26
3.6	Air Quality	28
3.6.1	LNG Facility	28
3.6.2	Gas Transmission Pipeline	29
3.6.3	Gas Fields	29
3.7	Noise and Vibration	30
3.7.1	LNG Facility	30
3.7.2	Gas Transmission Pipeline	30
3.7.3	Gas Fields	31
3.8	Terrestrial Ecology	31
3.8.1	LNG Facility	31
3.8.2	Gas Transmission Pipeline	32
3.8.3	Gas Fields	33
3.9	Marine Ecology	33
3.9.1	LNG Facility and Gas Transmission Pipeline Component	33
3.10	Visual Amenity	35
3.10.1	LNG Facility	35
3.10.2	Gas Transmission Pipeline	35
3.10.3	Gas Fields	36
3.11	Cultural Heritage	36
3.11.1	LNG Facility	36
3.11.2	Gas Transmission Pipeline	36
3.11.3	Gas Fields	37
3.12	Socio-Economics	37
3.12.1	LNG Facility	37
3.12.2	Gas Transmission Pipeline	38
3.12.3	Gas Fields	38
3.13	Transport and Infrastructure	39
3.13.1	LNG Facility	39
3.13.2	Gas Transmission Pipeline	40
3.13.3	Gas Fields	40

3.14	Waste Streams	40
3.14.1	LNG Facility	40
3.14.2	Gas Transmission Pipeline.....	41
3.14.3	Gas Fields	41
3.15	Risk Assessment	41
4	Project Environmental, Health and Safety and Social Management	42
4.1	Introduction	42
4.2	Santos’ Environmental, Health and Safety Management System	42
4.3	Santos’ Greenhouse Policy	42
4.4	Project Environmental Management	42
4.4.1	Construction Stage	42
4.4.2	Operational Stage.....	43
4.4.3	Decommissioning	43
4.5	Community/Social Management	43
4.6	Health and Safety Issue Management	43
4.7	Monitoring	43
5	References	44
	Appendix 1: Distributions of Mangroves and Seagrass Habitats	45
	Appendix 2: Marine Conservation Parks in the Port Curtis Area	46

Executive Summary

Santos Limited (Santos) has prepared this Initial Advice Statement (IAS) to initiate the impact assessment procedures of the Queensland *State Development and Public Works Organisation (SDPWO) Act 1971* for a proposed Liquefied Natural Gas (LNG) Facility development on Curtis Island, near Gladstone in Central Queensland.

The Project has been declared a 'significant project for which an Environmental Impact Statement (EIS) is required. The Project will:

- Potentially impact on a number of environmental related values including climate; land use and tenure; geology, soils and geomorphology; topography; water quality; air quality; noise and vibration; terrestrial ecology; marine ecology; visual amenity; cultural heritage; socio-economics; transport and infrastructure; and waste streams;
- Encompass multiple local authority planning schemes; and
- Comprise multiple components that will require the input from several government jurisdictions, requiring efficient whole-of-government coordination.

The Project will encompass planning, construction and operation of three major components including:

- Upstream gas fields development of predominately coal seam gas (CSG) deposits;
- A gas transmission pipeline linking the upstream gas fields to a LNG liquefaction and export facility located on Curtis Island, near Gladstone; and
- LNG liquefaction and export facility development (comprising LNG facility and associated infrastructure including bridge and access road) on Curtis Island, near Gladstone. The bridge will span "The Narrows", which is the body of water separating Curtis Island from the mainland.

Figure 1-1 provides an overview of the Project components.

The IAS describes:

- The proposed Project components;
- Raw material requirements;
- Process description;
- Waste, effluent and emission streams;
- A summary of the Project's benefits;
- Existing environmental values;
- Potential impacts on environmental values; and
- Nominal monitoring and mitigation measures for the identified impacts.

The IAS will assist the Department of Infrastructure to formulate the Terms of Reference (ToR) for the Environmental Impact Statement (EIS).

1 Project Overview

1.1 Purpose and Scope of Initial Advice Statement (IAS)

The purpose of this IAS is to provide sufficient information to allow the Coordinator General to make a determination as to whether the Project should be declared a 'significant project for which an Environmental Impact Statement (EIS) required' under Section 26 (1) (a) of the *State Development and Public Works Organisation Act 1971*.

The Terms of Reference (ToR) for the EIS will be developed taking into account the potential environmental impacts identified in this IAS, and the specific requirements of regulatory and other stakeholders, as identified through the EIS public consultation process. An EIS and associated Environmental Management Plan (EMP) will be developed as part of the approvals process.

The IAS describes:

- The proposed Project components;
- Raw material requirements;
- Process description;
- Waste, effluent and emission streams;
- A summary of Project benefits;
- The existing environment;
- Potential environmental impacts; and
- Nominal monitoring and mitigation measures for the identified impacts.

1.2 Project Proponent

The Project proponent is described below:

Santos Limited
60 Flinders Street
Adelaide, 5000, South Australia

Attn: Mr. Steven Hoyle

Santos is a major Australian oil and gas exploration and production company with vast CSG interests in Queensland, and interests and operations in every major Australian petroleum province and in Indonesia, Papua New Guinea, Vietnam, India, Kyrgyzstan and Egypt. Santos is Australia's largest onshore domestic gas producer, supplying sales gas to Queensland and all other mainland Australian states and territories, ethane to Sydney, and oil and liquids to domestic and international customers.

The Cooper Basin oil and gas fields in south west Queensland and central Australia, which Santos and its joint venture partners have discovered and developed, is one of Australia's largest onshore resources project. Over \$8 billion has been invested to date in this basin.

In Australia, Santos has one of the largest exploration portfolios by area of any company and has assembled a large, well-situated acreage position in Indonesia. The company is also pursuing new venture opportunities in North Africa and Central and South East Asia.

Santos is positioning itself to perform alongside the top quartile of the world's oil and gas companies - expanding its exploration interests and delivering production growth through an exciting suite of development projects.

Significant development projects contributing to Santos' growth include CSG exploration and developments in Queensland, the Bayu-Undan Liquids and Darwin LNG projects in the Timor/Bonaparte Basin area offshore Darwin, the Mutineer-Exeter oil fields and John Brookes gas field developments in the Carnarvon Basin offshore Western Australia, the Casino gas development in offshore Victoria and the Oyong oil and gas field and Maleo gas field in offshore East Java.

Santos' market capitalisation makes it one of Australia's Top 50 companies.

1.3 Project Rationale

The Australian Bureau of Agricultural and Resource Economics (ABARE) have noted that Queensland and New South Wales total coal seam gas resource potential is estimated to be 250,000 PJ in-place (Australian Supply and Demand Balance report 2002). Santos strongly believes the Project will give further impetus to coal seam gas development in Eastern Australia, further promoting supply options.

As such, the primary objective of this Project is to commercialise Santos' vast Queensland coal seam gas resource in a sustainable manner. This includes continuing to protect environmental values; managing environmental, health and safety requirements; implementing best environmental practice, and providing employment opportunities in Queensland throughout all phases of the Project.

To meet this objective, Santos will adhere to its Sustainability Framework for the proposed project during the EIS process. This framework is based on widely accepted sustainability principles and will assess the full impact of the Project. The framework will also enable better business decisions through a deeper understanding of their impacts on people, communities, economics and the environment.

1.3.1 Economic Benefits

The estimated capital worth of the Project is estimated to be between A\$5 - \$7 billion, in 2007 dollars including upstream field exploration and development and the LNG liquefaction and export facility. The economic benefits resulting from the Project will have national, state and regional dimensions.

The Project will contribute substantial, positive economic benefits to Queensland and Australia, derived from the combination of: export income the Project produces; foster accelerated exploration and reserve booking of the extensive coal seam gas resources; tax and royalty revenue paid by the upstream producers; businesses and individuals employed; and the amount of money spent in the local economy.

Providing an avenue to commercialization of coal seam gas resources in Eastern Australia will expand and diversify existing coal seam gas exploration and development and significantly extend the contribution that the coal seam gas sector makes to the Queensland economy.

Some of the key benefits will include:

- Stimulate Queensland CSG development;
- Expand Queensland's gas transmission pipeline network;
- Generate multiple billions of dollars in revenue (over the life of the Project) from royalties and taxes;
- An expected increase in Gross Domestic Product (GDP) upon commencing the expansion of upstream coal seam gas development activities;
- An increase in exports in excess of \$1 billion per year (at 2007 prices) during operation;
- An increase in Queensland's economic welfare from significant improvements to business investment and Gross State Product (GSP); and

- The Gladstone and Roma regions will benefit from increased demand for goods and services that will further stimulate business development and employment opportunities.

The Project is predicted to generate a peak of approximately 3000 jobs during construction (refer Figure 1-2) and sustain over 200 jobs during operation, with most of these generated in Queensland.

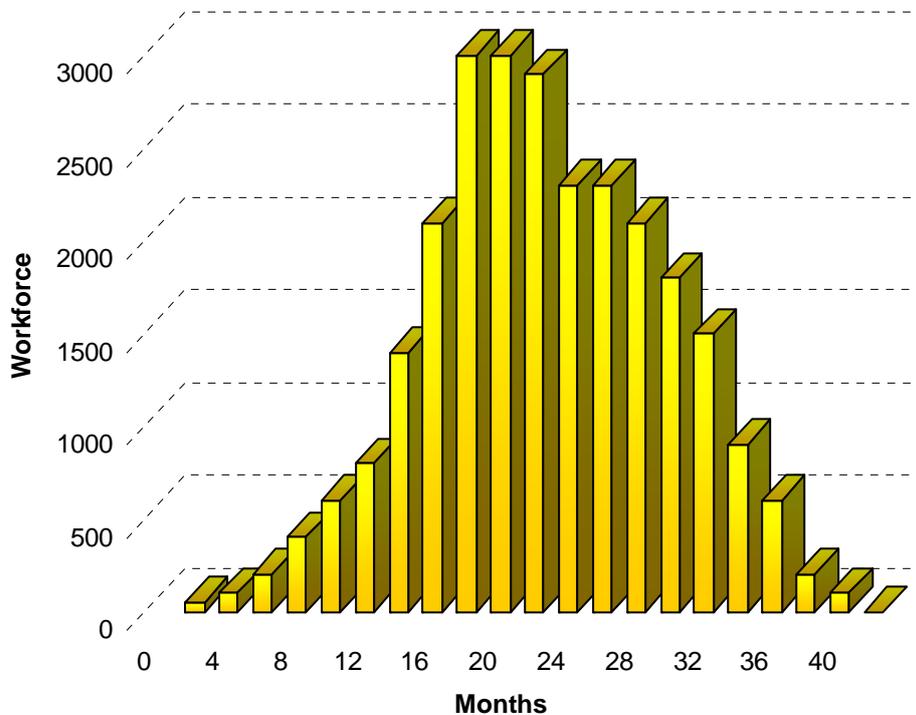


Figure 1-2: Expected Construction Workforce

Economic models will be used to predict the impact of the Project on the regional economies of the Gladstone and Roma areas.

In summary, the Project will benefit the economy through capital investment, jobs creation, infrastructure creation, income through royalties and taxes, and a positive trade balance from energy exports.

Consequences of Missing the Current Development Opportunity

Federal and state legislation and policy require Australia’s resources to be developed expeditiously. As holders of the petroleum licences, Santos is obliged to bring the hydrocarbon resources into commercial production as soon as reasonably practicable.

If the Project does not proceed, the economic, social and strategic benefits described in this document will not be realised.

1.4 Regulatory Approvals Process

Santos has developed a comprehensive Regulatory Approvals Plan for the Project to facilitate regulatory compliance through the implementation of the regulatory approvals process. The Plan identifies applicable project regulations, develops implementation strategies, and tracks the compliance status of all project requirements.

All proposed works will be undertaken in accordance with applicable environment and planning legislative requirements (Local, State and Commonwealth). All associated approvals detailed under this Regulatory Approvals Plan will be obtained as required. These shall include:

- State and Australian Government project planning approvals;
- Local government development approvals;
- Operational approvals (eg. EPA Environmental Authorities, Petroleum Facility License/s, Resource Allocation Authority/s, approval for Prescribed Tidal Works, Clearing Permits under the Nature Conservation Act); and
- Other potential approvals required under the:
 - Aboriginal Cultural Heritage Act 2003;
 - Queensland Heritage Act 1992;
 - State Planning Policy (SP/02) ASS;
 - Transport Infrastructure Act 1994;
 - Transport Operations (Marine Pollution) Act 1995;
 - Marine Parks Act 1982; and
 - Water Act 2000.

1.4.1 State

The Project has industrial and economic importance to the State of Queensland. Owing to this importance, Santos has sought to have the Project declared by the Coordinator-General a 'significant project for which an Environmental Impact Statement (EIS) required' under the *State Development and Public Works Organisation Act 1971*.

The Responsible Authority for this Project is expected to be the Coordinator-General. The Coordinator-General will be responsible for managing the Project's impact assessment process.

As the Project components are located within a number of different local government areas (including Gladstone City, Calliope Shire, Banana Shire, Bendemere Shire, Bauhinia Shire, Bungil Shire, Duaringa Shire, and Taroom Shire), should environmental approval be granted, development applications and decisions from these Councils may be required in respect of a material change of use for the sites pursuant to the requirements of the *Integrated Planning Act 1997*. Approval will also be required from the Environmental Protection Agency for any Environmentally Relevant Activities to be carried out on site in accordance with the *Environmental Protection Act 1994*.

1.4.2 Commonwealth

Under the *Environment Protection and Biodiversity Conservation Act 1999*, the Project will require approval by the Commonwealth Minister for the Environment if the Project is deemed to have, or is likely to have, significant impact on a matter of national environmental significance. Matters of national environmental significance include:

- World Heritage properties;
- Ramsar Wetlands of international importance;
- Listed threatened species or communities;
- Migratory species protected under international agreements;
- Nuclear actions; and
- The Commonwealth marine environment.

A referral will be submitted to the Commonwealth Department of Environment and Water Resources (DEWR) by Santos so that a decision can be made with respect to environmental effects. The Minister may approve the Project, reject the Project, or request more information be made available. The form that this additional information takes may be an environmental impact study. Its purpose is to facilitate a better understanding of the magnitude of potential impacts and whether these can be adequately managed so that matters of national environmental significance are not affected.

2 Project Description

2.1 Project Components

Santos is proposing to develop its abundant Queensland coal seam gas resources in the Bowen and Surat Basins in the area around Roma as feed gas for an initial 3 - 4 million tonne per annum (MTPA) LNG liquefaction and export facility, having the potential for possible expansion to a nominal 10 MTPA facility.

The following components are part of the overall Project:

- Coal seam gas (CSG) fields;
- Gas transmission pipeline; and
- LNG liquefaction and export facility development.

The coal seam gas fields will be developed and expanded to provide sufficient gas supply to the facility.

A gas transmission pipeline is to be constructed linking the LNG facility with the coal seam gas fields.

A gas processing and LNG facility located on Curtis Island, near Gladstone will facilitate the acceleration and long-term development of Queensland coal seam gas. The differing gas compositions from the various coal seam gas fields that will provide feedstock to the gas processing and LNG facility require that it be designed to handle a range of expected feed gas types. No hydrocarbon condensate is anticipated to be produced from the coal seam gas fields.

Refer to Figure 1-1 for Project component location details.

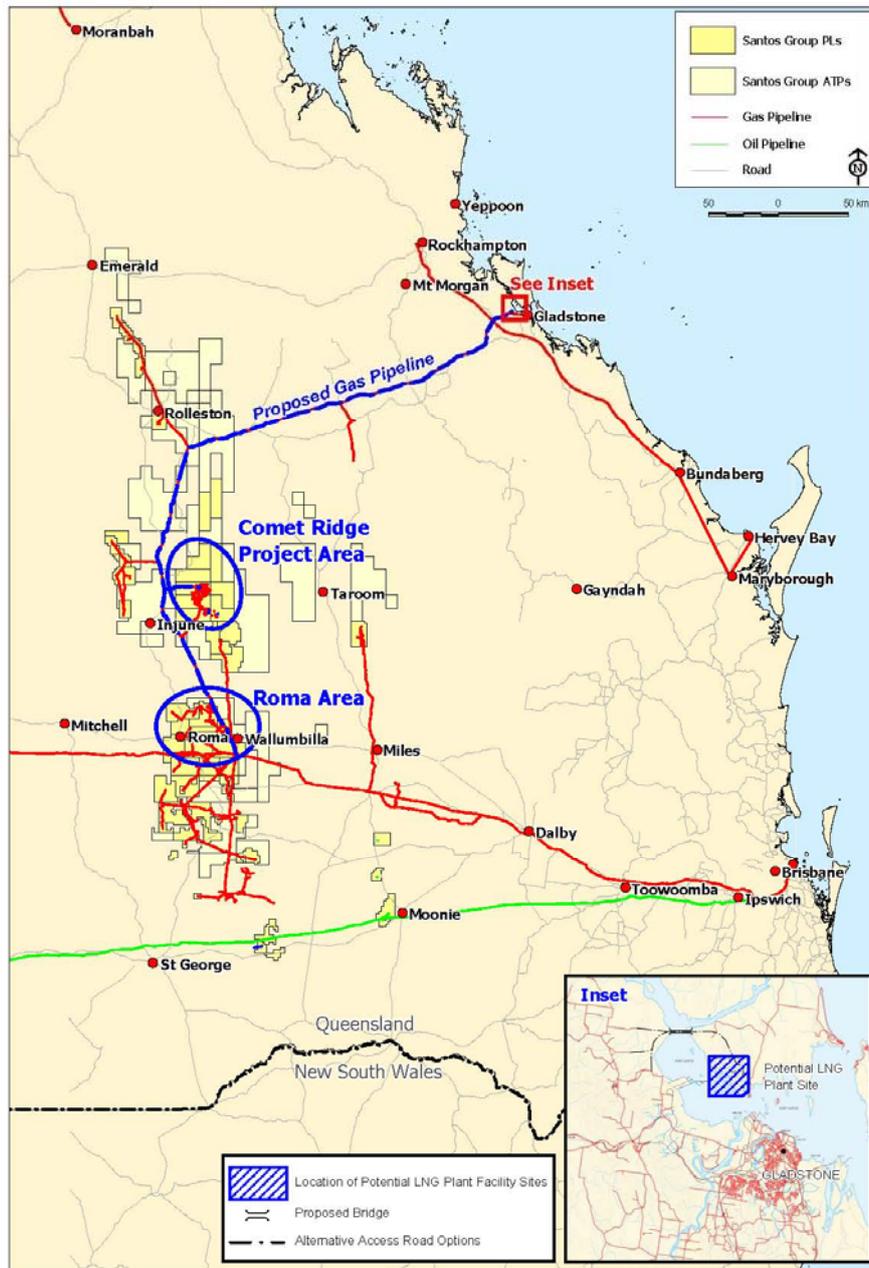


Figure 1-1: Project Component Locations

2.2 LNG Facility

2.2.1 LNG Facility Location

The proposed LNG facilities will be located on Curtis Island, which is situated approximately 5 kilometres north-east of the City of Gladstone in Queensland. Access to the site will be via a proposed bridge linking Curtis Island (Laird Point area) with the mainland (Friend Point area). A new access road is also proposed to be built on the western side of Curtis Island as well as on the mainland linking the bridge with the existing regional road network.

2.2.2 Alternative Locations Considered

A LNG facility site selection study has been undertaken as part of continuing studies into the development of an LNG export facility on the Queensland coast. The study to date has focussed on the region between Townsville and Brisbane due to the proximity of the coal seam gas fields.

The site selection process has involved five steps:

1. Identification of suitable coastal/port locations. Suitable coastal locations were assessed on a technical basis. This step was undertaken by Santos and involved the consideration of technology and industrial design aspects specific to the Project. The key feasibility criteria applied were:
 - Available and unencumbered land, minimum area of 200 ha, safe from flooding and storm surge, and capable of withstanding high foundation loads;
 - LNG facility to be located adjacent to sheltered and navigable water, within economically viable dredging distance to deep water for LNG carriers;
 - Controllable site safety and security, both landside and marine;
 - Environmental and operational impacts; and
 - Development cost.
2. An evaluation of social, environmental, economic and risk factors for each site aimed at ranking the sites from least sensitive to most sensitive. The desired outcome of the site ranking process was to identify a site that was considered to be the least sensitive from an environmental, social and safety risk perspective, and also provided Santos with an opportunity to contribute to the sustainability of the local and regional community.
3. A cost analysis of the sites selected in Step 2.
4. A literature review and site reconnaissance. This step involved a literature review to establish relevant background information to identify local and regional issues of relevance to each site and a preliminary site reconnaissance to assess the feasible sites.
5. Selection of a preferred site. This step is still in progress, with a short list of potential sites being considered based on the outcomes of Steps 3 and 4.

In total, seven potential ports were considered, including:

- Port of Townsville;
- Port of Abbot Point;
- Port of Mackay;
- Port of Hay Point;
- Port Alma;
- Port of Gladstone; and
- Port of Brisbane.

Of the seven potential ports, Gladstone proved to be the most feasible due to its sheltered deep water, existing industrial infrastructure and proximity to the coal seam gas fields. Within the Port of Gladstone, seven potential LNG facility sites were assessed. These were:

- Fisherman's Landing;
- Wiggins Island;
- South Trees Point;
- Boatshed Point, Curtis Island;
- North China Bay, Curtis Island;
- Hamilton Point, Curtis Island; and
- Hamilton Point West, Curtis Island.

Fisherman’s Landing, Wiggins Island, South Trees Point and Boatshed Point did not meet the key feasibility criteria. Hamilton Point, Hamilton Point West, and North China Bay (Curtis Island) proved to be feasible from a technical, environmental and safety standpoint, however with different development cost and operating cost outcomes for each site. The final site selection is still being undertaken in consultation with the Coordinator-General and the Central Queensland Ports Authority.

2.2.3 LNG Facility Description

Gas will be processed at a nominal feedstock rate in the range of 420 to 600 million standard cubic feet per day for the initial process train, which is expected to be sized for a nominal rate of between 3 and 4 MTPA of LNG. These rates will be further defined during the Project Pre FEED (Front End Engineering Design) stage.

The major LNG facility components may include, but are not limited to:

- Inlet separation / filtration / treatment to remove pipeline debris and liquids;
- Gas treatment to remove major components within the gas stream that are detrimental in the process of liquefaction of natural gas, including carbon dioxide, water and other contaminants;
- Refrigeration and liquefaction to liquefy the natural gas;
- LNG storage tank(s) with vapour recovery;
- Marine facilities;
- Utilities including water, steam, fuel systems, control systems and possibly power generation;
- Flares including a plant flare, tank flare, and/or jetty flare; and
- Supporting facilities (eg. construction accommodation, roads and bridge).

Refer to Figure 2-1 for a schematic representation of the gas treatment and liquefaction process and Figure 2-5 for a general indication of the location of the potential LNG facility area, roads and bridge.

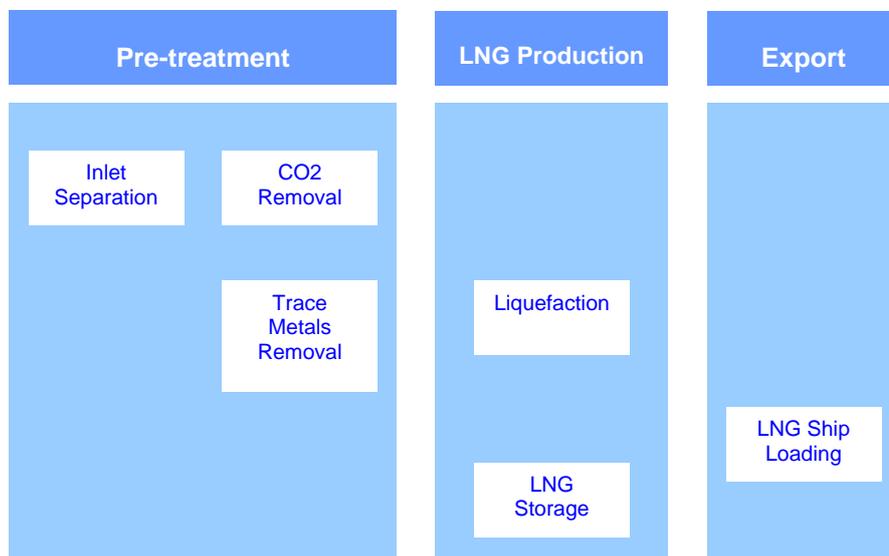


Figure 2-1: Typical LNG Facility Process

Figures 2-2 to 2-4 below provide conceptual layouts of the proposed bridge, jetty and LNG facility sites.



Figure 2-2: Proposed Bridge



Figure 2-3: Proposed Jetty



Figure 2-4: Proposed LNG Site

2.2.3.1 Supporting Facilities

Accommodation

The construction workforce will be housed in a combination of local housing and camp facilities. An accommodation study will be undertaken to determine the extent of housing available in the Gladstone region. The specific location of the accommodation is still under consideration and may be within an extension to an existing camp or within its own dedicated location. The operations work force is expected to be housed within the City of Gladstone and vicinity.

Roads

The construction of the gas processing facility will require the re-alignment and upgrading of several existing roads on the mainland, construction of a new access road approach to the western abutment of a new bridge to Curtis Island and a new road on Curtis Island. The upgrades will involve widening, grading and sealing. These upgrades will increase the safety for road users. Paving the main roads will also reduce dust generation. Stormwater runoff management will be a criterion in the design to ensure potential for scour is minimised and pooling on the sides of roads is reduced.

Bridge

A bridge will be required to access Curtis Island. The design and specific location of the bridge will be assessed at a later stage in the Project.

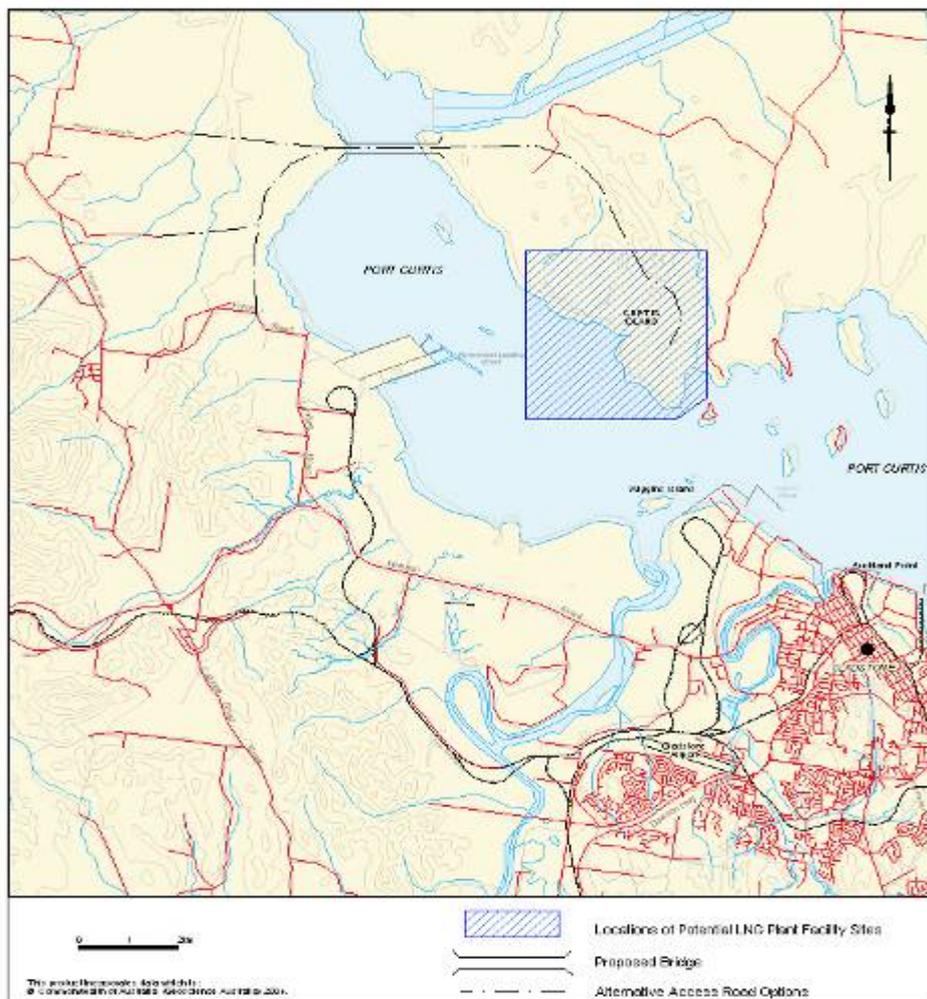


Figure 2-5: Location of Roads, Bridge and LNG Facility area

2.3 Gas Transmission Pipeline

The feed gas transmission pipeline will deliver processed pipeline quality gas to the LNG facility. It will be constructed as an underground pipeline from the coal seam gas fields to the Port of Gladstone to Curtis Island (Figure 1-1). The transmission pipeline crossing at the Port of Gladstone may include a range of shore crossing techniques including horizontal directional drilling, laying the pipe on the seabed or in a trench in the seabed, or above water associated with the proposed bridge joining Curtis Island to the mainland. The transmission pipeline is anticipated to be of nominal diameter 650 – 800mm and some 425 km in overall length (length determined by eventual sources of CSG feed), with an expected operating pressure of approximately 5 - 15 MPa.

Additional feed gas pipelines and associated shore crossings may be required in the same area to enable future phases of development. Some capacity expansion might also be achieved by additional intermediate boost compression.

2.4 Gas Fields

Santos has been involved with drilling in the Bowen and Surat Basins for coal seam gas since the mid 1990s and commenced production in 2002. Santos' future operation is focussed on increasing the size and productivity its coal seam gas fields to support an initial 3 – 4 million tonne per annum LNG facility. Santos expects that its coal seam gas fields will be capable of delivering approximately 4 trillion cubic feet (4,200 petajoules) necessary to operate the initial LNG facility over a 20 year project life.

As part of its proposed coal seam gas field development activities, Santos proposes to drill and complete approximately 540 development wells prior to 2015 and over 800 wells post 2015 (excluding exploration wells). In addition, installation of other operationally related infrastructure will be required including:

- Access roads,
- Accommodation camps;
- Water gathering networks and water management facilities;
- In-field gas gathering networks (to transport gas from the wells to field compression stations); and
- Field gas compression stations, which pressure the gas and direct it into the transmission pipeline.

Well development (well drilling and well completion) activities are addressed under the normal petroleum tenures approvals processes and are considered to be outside of the impact assessment for this project

Santos' current general CSG acreage is highlighted in yellow in Figure 1-1. Field development work will mostly be confined to these areas.

2.4.1 Gas Composition – Feed and Product

The natural gas feed for the LNG plant will primarily come from coal seam gas fields. However it is possible that at times, other natural gas may be used to augment coal seam gas supply.

The feed gas composition will vary somewhat over the life of the Project due to variances in the supply sources used and variability of coal seam gas composition from each supply source as the gas is produced from the coal seams. The coal seam gas is predominantly methane with very low concentrations of nitrogen, carbon dioxide and ethane.

3 Existing Environmental and Potential Environmental Impact

Santos will adhere to its Sustainability Framework for the proposed Project during the EIS process, should the Project be declared a significant project requiring an EIS. This framework is based on widely accepted sustainability principles and will assess the full impact of the Project. The framework will also enable better business decisions through a deeper understanding of their impacts on people, communities, economics and the environment.

3.1 Climate

3.1.1 LNG Facility

Existing Environment

The climate of the Gladstone region is defined as sub-tropical, with an average annual rainfall of approximately 1,000 millimetres per annum. This rainfall mainly occurs in the summer months (December to March). The warmest months are typically from November to March, with a mean daily maximum temperature of greater than 30°C. The mean daily maximum temperature in winter is approximately 24°C. Prevailing winds are typically from the south-east to east year round.

Potential Environmental Impacts

Natural gas and LNG are often referred to as 'transition' fuels in the context of fossil fuel use and greenhouse gas emissions. This is due to the recognition that natural gas has a lower greenhouse gas intensity compared to other fossil fuels, and while renewable energy sources have low emissions, they are currently considered high cost and not yet sufficiently developed to meet global energy needs. Electricity generated from gas has, on average, about half the full life-cycle greenhouse gas emissions of electricity generated from coal (APPEA, 2007).

The production of LNG will result in greenhouse emissions, mostly in the form of carbon dioxide (CO₂), arising from the combustion of natural gas at the LNG facility. Measures will be implemented to reduce these emissions where possible in accordance with the Santos Greenhouse Policy. Accurate volumes of greenhouse gas emissions will be determined during the pre-FEED and FEED phases of the Project, however estimates based on a similar sized LNG plant indicate emissions will be approximately 1 million tonnes per year. This would generate an increase of approximately 0.6% in Queensland's annual greenhouse gas emissions, or an increase of approximately 0.2% in Australia's annual emissions (based on 2004 data). However, to the extent that exported LNG replaces more greenhouse intensive energy in the importing country, emissions in that country can be significantly reduced, resulting in a substantial net reduction in emissions globally.

The impacts of greenhouse emissions are of a global scale rather than affecting local climate. Given that net global emissions could potentially be reduced from the production and use of the LNG, the project could have a positive impact in reducing climate change.

3.1.2 Gas Fields

Existing Environment

The climate of the gas field development area is classed as sub-tropical with a distinct to moderately dry winter. Average daily maximum temperatures in the region, based on climate data from stations at Roma and Injune Post Offices range from 20°C during winter (July) up to 33-34°C in summer (January). Over 60% of the average annual rainfall at Roma occurs between November and March. Annual rainfall in Roma averages 599 mm and the average annual pan evaporation rate is 2482 mm (Roma Airport). Rainfall is higher in the north of the Project area, with Injune averaging 632 mm per year.

At Roma, winds from the north-east generally dominate during the warmer months (November to March). During the cooler months (April to October), winds are predominantly from the south-west.

Potential Environmental Impacts

Minor greenhouse gas emissions will be emitted with the development of the field, namely from well testing, power generation, compressor exhausts, drilling rigs and vehicles. These emissions will be incorporated into a Greenhouse Gas Management Strategy.

3.2 Land Use and Tenure

3.2.1 LNG Facility

Existing Environment

Curtis Island land use is essentially rural based with undeveloped land parcels subject to cattle grazing. According to the *Hamilton Point Feasibility Study 2002* the Port of Gladstone (now Central Queensland Ports Authority (CQPA)) Strategic Plan 1997-2047 identifies Hamilton Point as the site for a future deep water port facility, with the CQPA currently having options to purchase land for potential future port development.

Queensland Energy Resources Ltd (QERL) holds an Exploration Permit Minerals (EPM) over selected areas in Port Curtis. This EPM is associated with oil shale exploration activities and may potentially impact the location of the mainland access road but will not impact the proposed LNG plant site.

QERL also holds a Mineral Development License Application (MDLA) in the area but this does not impact the proposed site.

Potential Environmental Impacts

With the development of the LNG facility the future land use will be industrial which is in line with Central Queensland Port Authority's Strategic Plan. Tenure will remain freehold.

Santos will actively manage land requirements on Curtis Island to minimise footprint area and vegetation clearing. The land required for the LNG facility site is expected to be approximately 200 hectares (ha) but will be further defined as the design progresses.

3.2.2 Gas Transmission Pipeline

Existing Environment

The gas transmission pipeline will link the gas fields to the LNG facility on Curtis Island. Existing land use along the route is predominantly rural based with a number of rural based communities situated in the vicinity of the proposed route including Biloela, Banana and Bauhinia Downs.

Potential Environmental Impacts

Santos is in the process of investigating the feasibility of installing the gas transmission pipeline adjacent to the existing Queensland Gas Pipeline easement that runs from Wallumbilla to Gladstone. This will minimise the need for additional clearing of vegetation and disturbance to additional land and existing land uses.

It is anticipated that impacts on existing landholder activities will be minimal. Santos will implement a thorough landholder consultation program to assess specific landholder requirements.

3.2.3 Gas Fields

Existing Environment

The tenure within the existing gas field development area includes freehold, leasehold and crown land. Land use comprises:

- Freehold and leasehold cattle properties (both individually owned and pastoral/grazing company owned);
 - Resource Reserve (Lonesome Holdings);
- National Parks (eg. Beiba and Expedition); and
- State Forests (eg. Beiba, Baroondah and Pony Hills).

Potential Environmental Impacts

Potential impacts on land use include increased petroleum field development activities, including:

- Geophysical exploration;
- Gas well drilling;
- Production and processing activities; and
- Water management facilities.

Field development activities will necessitate application for new petroleum leases from exploration licences.

3.3 Geology, Soils and Geomorphology

3.3.1 LNG Facility

Existing Environment

The geology of the Gladstone region has been mapped at a scale of 1:100,000 by the Queensland Department of Mines and Energy (1988). The information on the geologic map indicates that the Curtis Island area is underlain by rocks from the Palaeozoic-Devonian Wandilla Formation. This formation generally consists of sequences of mudstone, quartz greywacke and chert units. These units are overlain by Quaternary alluvial, colluvial and marine sediments.

The seismicity of the Gladstone area has been studied by the Queensland University Advanced Centre for Earthquake Studies (QUAKES). In addition, seismic risk maps for the Gladstone area were developed by McCue et al (1993) and are reproduced in AS 1170.4 and Gaull et al (1990). The Gladstone area is considered to be the sixth most seismically active area in Australia, and lies on the northern edge of a seismic belt that stretches between Brisbane and Gladstone. Additionally, Curtis Island falls within or near the boundary of the faults that define the Narrows Graben, a prominent structural feature in the area. The available data indicate that these faults are not known to be active.

Surficial soils on Curtis Island consist of colluvial and alluvial gravels, sands, and silts. Soil cover is relatively thin (0.5m to approximately 1.5 m) on hill tops and ridgelines, but may be thicker (3m to +5m) in the flatter regions. The sites being considered likely consist of hard, durable quartz greywacke. Mudstone outcrops exist along the fringes of the mudflat and within the interior portion of the sites.

Previous investigations in the Gladstone area have indicated that acid sulphate soils (ASS) could be expected to occur in low lying areas containing Quaternary Holocene marine/estuarine muds. The depth of these muds may vary and would be dependent on their proximity to remnant older alluvial material (eg. underlying Pleistocene clays), residual soils on higher ground and the coastline. In accordance with State Planning Policy 2/02 (*Planning and Managing Developments Involving Acid Sulphate Soils*) any excavation and/or piling activities on land less than 5m AHD that disturbs greater than 500m³ of material would require investigation (including sampling and testing) to determine appropriate management strategies. These investigations would typically be conducted as part of the Environmental Impact Assessment process.

Potential Environmental Impacts

Clearing of vegetation and earthworks will be required during construction to provide a suitable profile and foundation for facilities such as the LNG facility, construction accommodation, access roads, pipelines and utility corridors. The most significant quantity of clearing and earthworks will be associated with construction at the LNG facility site.

The key potential impacts to soil and landform associated with clearing and earthworks include:

- Erosion (wind and water) and sedimentation;
- Soil compaction;
- Soil inversion; and
- Change in landform.

Construction planning and impact assessment studies will be carried out to identify and assess such impacts. A construction environmental management plan will be developed by Santos and implemented to establish a series of environmental controls (administrative, engineering monitoring focussed) to minimise these impacts.

3.3.2 Gas Transmission Pipeline

Existing Environment

Geology along the proposed 425km transmission pipeline route varies considerably. A broad summary of geological sequences along the route (based on an interpretation of the Queensland 1:250,000 Geological Series) includes:

- Curtis Island Group & Wandilla Formation sediments on Curtis Island and across the coastal plain;
- Doonside Formation (cherts, mudstones and limestones); Lower Permian Sediments and Lower to Middle Devonian sedimentary beds (ash flows, tuff, arenite, siltstones and limestones) immediately inland of the coastal plain;
- Middle Devonian Capella Creek Beds (tuffs, arenite, conglomerates, mudstones and limestones) and Permian to Triassic Tonalites across the Calliope Range;
- Tertiary Undifferentiated sediments (sandstones and shales) in the Callide Creek floodplain;
- Permian Sediments (siltstones, mudstones and conglomerates) between the Callide Creek and Dawson River valleys;
- Quaternary alluviums in the Dawson River valley;
- Tertiary sandstones at northern end of Expedition Range;
- Triassic sandstones and siltstones in the vicinity of the Dawson and Expedition Ranges (with some areas of tertiary basalts in the Expedition Range); and
- Lower to Middle Jurassic sandstones and shales (including Hutton and Birkhead Formations) in the gas field areas east of Expedition of Range in the upper Dawson River valley.

Potential Environmental Impacts

Transmission pipeline construction is a lineal process that comprises a number of stages including access track construction, right-of-way clearing and grading, trenching, pipe laying, trench backfilling and right-of-way reprofiling/restoration. These activities will require significant earthworks. Detailed route selection studies (including geological investigations and soils surveys) would be carried out to identify the most appropriate route alignment taking into account any geological, soils or geomorphological constraints. Route alignments would subsequently be modified as required. In

addition, an environmental management plan would be developed which would detail appropriate controls to be implemented to minimise the environmental impact of pipeline construction activities. This would include such controls as:

- Re-establishment of topsoil cover;
- Returning land to a form/use that is consistent with pre-construction productivity;
- Re-establishment of landforms to a stable state;
- Reinstatement of natural drainage patterns;
- Installation of erosion control measures where required (eg. contour banks, filter strips); and
- Rehabilitation of disturbed habitat.

3.3.3 Gas Fields

Existing Environment

Comet Ridge Project Area

Gas is extracted from coal seams of the Late Permian Bandanna Formation of the Bowen Basin at a depth of 500 to 1,000 metres from the surface.

The Jurassic Hutton sandstone, Precipice Formation, Evergreen Formation, and Boxvale Sandstone outcrop in the Fairview field area. The Hutton Sandstone is pervasive in the southern and western parts resulting in typical undulating topography characterised by rounded hills. In the northern and central parts the Precipice and Boxvale Sandstones outcrop resulting in raised plateaus with steep escarpments.

To the north of the Project area is an area known as the Arcadia Valley. The Triassic Rewan Group, Moolayember Formation and Clematis Sandstone all outcrop in or near the Arcadia Valley area.

Roma Area

Coal seam gas areas lie within the Surat Basin which consists of consolidated Jurassic, Cretaceous and Tertiary sediments and poorly consolidated Cainozoic colluvium and alluvium associated with local creeks. Conventional hydrocarbons (oil and gas) are currently extracted from the Permian Tinowon Formation, Triassic Rewan Formation and Showgrounds Sandstone of the Bowen Basin, and Jurassic Precipice Sandstone / Evergreen Formation and Boxvale Sandstone of the Surat Basin at a depth of 500-1,500 metres below the surface. The dominant formation outcropping within the southern part of the Roma area is the Bungil and Wallumbilla Formations which gives rise to typically flat topography. The northern part of the Roma area contains low hill sand scarps, due to outcropping sandstones (Mooga Sandstone, Orallo Formation) and Tertiary basalt caps on hills (Grafton Range).

Soils within the area have been categorised in Land Resource Areas (LRAs) according to the "*Land Management Field Manual: Roma District, 1987*". Mapping LRAs has been undertaken according to geology, soils, vegetation, and geomorphology. A description of soil types present throughout the area is provided in Table 3-1 below.

Table 3-1: Land Resource Areas (and soil types)

Land Resource Area (LRA)	Landform	Major Soil Groups
Brigalow Uplands	Gently undulating plains 1-3%, associated with low hills and ranges	Wondolin, Limewood, Eumamurrin, Glenarden, Parmaroo
Bymont	Gently undulating plains to undulating low hills 1-4%	Nimitybelle, unnamed brown and grey cracking and non-cracking clays
Yuleba	Undulating plains 1-5% to scarps and low hills	Unnamed skeletal soils and unnamed deep sands
Merivale	Undulating plains 1-5% in generally narrow valleys	Unnamed skeletal soils, deep uniformed sands and sandy texture contrast soils
Mundell	Rolling to steep low hills	Shallow grey clays Black earths
Glenhaughton	Rolling low hills	Shallow solodics, soloths and lithosols
Nathan	Steep hills and tablelands	Shallow solodics, soloths and lithosols

Source: Land Management Field Manual: Roma District 1987

Potential Environmental Impacts

With Santos proposing to drill and complete approximately 540 development wells prior to 2015 and over 800 wells post 2015 (excluding exploration wells) as well as installing other operationally related infrastructure such as roads, gas gathering, compression and water gathering networks, the gas development area will be subject to typical petroleum exploration and development activities over the project life.

In order to minimise the potential environmental impacts Santos will prepare a field development Environmental Management Plan which will incorporate appropriate environmental controls, including engineering, administrative and monitoring controls. As part of the planning program, the relevant sections of the development area will be surveyed for existing disturbances and any environmentally sensitive areas. Development will also be planned to minimise the environmental footprint of Santos' activities (and hence minimise disturbances to soils and landforms) by incorporating the use of existing disturbances (e.g. access tracks and cleared areas) where possible. In addition, where disturbances to soil occur, the development program will incorporate appropriate controls (such as sediment and erosion controls) to minimise impacts. Specific examples of controls that will be continued to be implemented include:

- Re-establishment of topsoil cover and landforms to a stable state;
- Returning land to a form/use that is consistent with pre-construction productivity;
- Reinstatement of natural drainage patterns; and
- Installation of erosion control measures where required (eg. contour banks, filter strips).

3.4 Topography

3.4.1 LNG Facility

Existing Environment

The proposed LNG facility sites currently being assessed are presently undeveloped and characterised by both mud flats and gently to moderately sloping eucalypt woodland. There are several small drainage lines traversing the interior portion of the proposed sites.

The bridge linking the mainland to Curtis Island will cross the southern extent of “The Narrows”. The eastern end of the bridge will join Curtis Island to the south of Graham Creek, thus avoiding the need for a major creek crossing on Curtis Island. The potential approaches to the western (mainland) end of the bridge are still being assessed, with a number of access options being considered. The area is characterised by intertidal land systems (eg mangroves communities and salt pans) and the environmental sensitivity and geotechnical characteristics of these systems will play an important consideration in the decision.

The proposed access road linking the bridge to the LNG facility site will traverse the western side of Curtis Island on gently to moderately sloping terrain. No major creek crossing will be required.

Potential Environmental Impacts

The orientation of the selected LNG facility site is yet to be determined (and would be dictated by topography of the final selected site); however it is likely that it would be located in close proximity to mangrove fringed mudflat. The potential sites are characterised as having gentle to moderate dipping slopes ranging from flat to approximately 25 percent. The area is covered with moderate vegetation, with mangroves along the mudflats, and eucalypt woodland inland.

Some cut and fill operations would be necessary in order to construct the LNG facility foundations. Therefore, the natural topography of the site would be altered. The Project EMP will incorporate any appropriate environmental controls to minimise soil instability and erosion potential, and accordingly the degree of environmental impact is expected to be low.

3.4.2 Gas Transmission Pipeline

Existing Environment

The proposed transmission pipeline route passes through varying topography including coastal plains, undulating plains and hilly/mountainous terrain areas in the Calliope, Banana, Dawson and Expedition Ranges. Major drainage systems that would be traversed include Calliope River and the Dawson River.

Potential Environmental Impacts

Transmission pipeline construction is a lineal process that comprises a number of stages including access track construction, right-of-way clearing and grading, trenching, pipe laying, trench backfilling and right-of-way re-profiling/restoration. These activities will require vegetation clearing and earthworks, although the intention to align the pipeline route adjacent to an existing Gladstone to Fairview pipeline easement as much as possible will minimise impacts. Detailed route selection studies would be carried out to identify the most appropriate route alignment taking into account topographical constraints. In addition, an environmental management plan would be developed which would detail appropriate controls to be implemented to minimise the environmental impact of transmission pipeline construction activities. This would include such controls as:

- Re-establishment of topsoil cover, landforms and topography to a stable state;
- Returning land to a form/use that is consistent with pre-construction productivity;
- Reinstatement of natural drainage patterns;
- Installation of erosion control measures where required (eg. contour banks, filter strips); and
- Rehabilitation of disturbed habitat.

3.4.3 Gas Fields

Existing Environment

Comet Ridge Project Area

The topography of the Comet Ridge Project Area varies from open valley environments to mountains range country.

The predominant features are the Expedition, Lynd and Carnarvon Ranges. These form an extensive belt of predominately coarse sandstones that comprise the north eastern boundary of the Great Artesian Basin. These ranges are dissected to form undulating to hilly surfaces with areas of steep escarpments.

The Arcadia Valley is dominated by rugged coarse sandstone, with occasional mesas formed from remanent deposits of the Precipice Sandstone. Within the valley are found fertile black to brown cracking clays with some duplex soils.

Roma Area

The topography varies from open to scrubby plain environments to hilly range country to the north.

The predominate feature to the north is Grafton Range, which consists of a Tertiary basalt cap overlying Cretaceous sediments. To the north of the Roma area, the terrain increases in elevation and forms the Great Dividing Range as well as the north eastern margin of the Great Artesian Basin.

Most of the area in the central and southern areas is flat to undulating and contains fertile soils associated with Cretaceous sediments of the Bungil and Wallumbilla Formations.

Potential Environmental Impacts

The gas development area will be subject to routine petroleum exploration and development activities over the Project life. This will require earthworks programs across a variety of terrain. Santos will therefore plan and continue to implement appropriate controls to minimise the potential impact on topography. These will include:

- Re-establishment of topsoil cover;
- Returning land to a form/use that is consistent with pre-construction productivity;
- Re-establishment of landforms to a stable state;
- Reinstatement of natural drainage patterns;
- Installation of erosion control measures where required (eg. contour banks, filter strips); and
- Rehabilitation of disturbed habitat.

3.5 Water Quality

3.5.1 Groundwater

LNG Facility Development

LNG facility development construction and operational activities are likely to have minimal impact on groundwater quality or quantity, with the major impact at this point considered to be associated with any domestic wastewater systems established. However, the nature of existing groundwater systems on the site and an assessment of potential impacts from construction and operational activities will be undertaken as part of the EIS.

Gas Transmission Pipeline

The nature of gas transmission pipeline construction and operational activities will limit any potential impacts to surface waters (refer Section 3.5.2) and marine waters where the transmission pipeline crosses Port Curtis between Curtis Island and the mainland (refer Section 3.5.3). An investigation on impacts to groundwater will be undertaken in the EIS.

Gas Field Development

Existing Environment

Comet Ridge Project Area

Current Fairview development area of the Comet Ridge Project Area is within the recharge area of the Great Artesian Basin (GAB). The GAB is a multi-layered confined aquifer system, with aquifers in Triassic, Jurassic and Cretaceous continental quartzose sandstones (Habermehl, 2002). Intervening confining beds consist of siltstone and mudstone; Cretaceous marine sediments form the main confining unit.

Fairview is located on the eastern margin of the GAB and is part of the regional recharge area for the GAB. Recharge occurs in localized zones beneath surface water systems and from diffuse rainfall. The highest recharge rate is related to surface water systems (Barclay, 2002). Geologically recent alluvium associated with these rivers and streams also provides enhanced recharge to the underlying aquifers.

Regional and local groundwater flow systems exist within the Project area. Most of the individual aquifers are continuous and relatively uniform in their hydrogeological characteristics across large areas, and hydraulically connected across GAB sub-basins (Habermehl, 2002). In the Project area, the major confining units consist of the Rewan Group, Moolayember and Evergreen. Due to the limited potentiometric data, groundwater flow paths and the extent of flow between hydrogeologic units are not well defined.

Roma Area

Roma lies to the south of the recharge zone for the GAB. The GAB consists of a multi-layered confined aquifer system. Most of the individual aquifers are spatially uniform in their hydro-geological characteristics.

The major aquifers of the GAB, including the Mooga and Gubberamunda Sandstones, Hutton Sandstone and Precipice Sandstone, underlie the area. These sandstones outcrop to the north of the development area, Bores in these aquifers produce generally fresh water.

Shallow groundwater is likely to be present in close proximity to surface water features such as flowing creeks or billabongs. It has been recorded at depths of 10 m in selected areas.

The Precipice Sandstone is considered a good aquifer with the capability of supplying potable sub artesian water. This formation often gives rise to perennial mound springs. The Boxvale Sandstone of the Evergreen Formation yields good sub artesian water and some artesian water, contrary to other geological landscapes of this formation. The Hutton Sandstone and coal seams within the Birkhead Formation contain water suitable for stock usage, although salinity can be high to the north. Potable groundwater is found in the Clematis Sandstone but extraction is limited due to the presence of good supplies in shallower aquifers.

Potential Environmental Impacts

The potential impacts to groundwater within the gas field development area include:

- unplanned contaminant releases (predominantly associated water spills);
- associated water seepage from evaporation ponds;
- contaminant releases at Waste Management Facilities (WMF); and

- groundwater drawdown.

Other releases that may impact on groundwater are likely to be on environmental values associated with land. These impacts include:

- potential for evaporation pond releases (other than seepage);
- discharges to flare pits; and
- discharges of sewage effluent through land-based irrigation or disposal within ponds.

The Project's EIS will include a groundwater section that shall include both baseline groundwater studies and impact assessment studies. The resulting Project EMP will incorporate any appropriate environmental controls to minimise the impact of gas field development activities on groundwater.

3.5.2 Surface Water

LNG Facility Development

Existing Environment

There are several small intermittent drainage paths traversing the interior portion of the proposed LNG facility sites being considered. The drainages have been observed to contain only minor areas of scouring; indicating relatively low energy/concentration surface water flows.

The proposed bridge traverses "The Narrows"; the body of water linking the mainland to Curtis Island. This bridge will be located at the southern boundary of a marine park conservation zone.

The LNG facility development and that section of the gas transmission pipeline linking Curtis Island to the mainland is located in close proximity to the Port Curtis area. This area is situated within the Gladstone Port Limits, an area where shipping and harbour operations are administered by the Central Queensland Ports Authority (CQPA).

Port Curtis has a high tidal range which results in significant current velocities in some areas of the bay. These tidal velocities generally assist in maintaining Gladstone Harbour as a natural deepwater Port. The Port Curtis marine environment is a multiple use area comprising port facilities and marine park/conservation zones. The Curtis Coast Study carried out by Gladstone Port Authority in 1994 concluded that the area shows naturally high levels of some water quality parameters, including arsenic and turbidity, and higher temperatures. Nutrient levels (particularly phosphorus levels) can also be elevated in Port Curtis when compared to relevant guidelines.

Potential Environmental Impacts

The proposed location and orientation of the LNG facility sites being considered and access road may impact on a number of intermittent watercourses in the area. This would require a more detailed assessment of impacts as part of any environmental impact assessment process, including an assessment of flora and fauna impacts plus potential water quality impacts to both aquatic and marine waters.

An assessment of potential liquid waste streams (eg. wastewater discharges) from the LNG plant operations will also be undertaken as part of the EIS.

The location of the proposed bridge (in close proximity to the marine park conservation zone) will necessitate detailed marine studies as part of the impact assessment process.

As the development may include jetty facilities, potential dredging activities and pipeline water crossings there is potential for direct impact on marine water quality through disturbance of the marine substrate, inappropriate disposal of marine spoil/sediment and runoff from land-based construction activities. Accordingly, the EIS for the project will consider these potential impacts and appropriate control measure will be detailed in the EMP.

Gas Transmission Pipeline

Existing Environment

The proposed route of the gas transmission pipeline would traverse a number of surface water bodies including:

- “The Narrows” (the body of water between Curtis Island and the mainland);
- Potentially the upper reaches of Calliope River;
- Callide Creek; and
- Dawson River and a number of its tributaries (including Banana Creek and Mimosa Creek).

Potential Environmental Impacts

The design, route alignment and construction of the transmission pipeline will include controls to minimise the potential environmental impact on surface water bodies and prevent any long term modifications to watercourses (although short term impacts can be expected during construction).

A number of watercourse crossings will be required for transmission pipeline construction. The actual locations of the crossings will be dependent on the findings of the EIS studies, cultural heritage studies and engineering design studies. Appropriate construction techniques will be adopted and will be based on the findings of relevant studies (eg. hydrology, geology and soils, ecological). The aim of the construction program will be to minimise impacts during the construction stage and in the longer term such that the need for remediation works post construction is minimised.

The EMP developed for the project will outline appropriate environmental controls to be adopted during the project (eg. erosion and sediment controls) and accordingly the degree of environmental impact is expected to be low.

Gas Fields

Existing Environment

Fairview is generally located within the catchment of the Dawson River (upper catchment). Roma is located just south of and down-dip of the Great Dividing Range within the Condamine River catchment. There are a number of ephemeral streams in the area which flow into both the Dawson and Condamine Rivers.

Potential Environmental Impacts

As part of gas field development construction activities there will be earthworks carried out across a variety of terrain. Santos will therefore plan and implement appropriate controls to minimise the potential impact on surface waters (refer Section 3.4.3 for details).

The operational stage of the gas field development program could generate up to 40 mega litres per day (ML/day) of associated water. This water will need to be disposed of and Santos is in the process of assessing a number of beneficial options in addition to expansion of the current disposal into a deep aquifer, including discharge to grade, irrigation and treatment.

These options will be examined in more detail (including economic, social and environmental costs and benefits) within the EIS and preferred options determined. Relevant stakeholders will be consulted as part of this process.

3.6 Air Quality

3.6.1 LNG Facility

Existing Environment

Air quality monitoring is currently undertaken in the Gladstone region by the EPA. Current monitoring sites are operated at Targinie, Clinton and South Gladstone. Measurements include:

- Ozone (Targinie);
- Nitrogen dioxide (NO₂) at all three sites;
- Sulphur dioxide (SO₂) at all three sites;
- Particulate matter (PM₁₀) at all three sites;
- Visibility reducing particles (South Gladstone and Targinie);
- Benzene (Targinie); and
- Toluene (Targinie).

An additional site at Barney Point was operational in 2001 and 2002, and monitored SO₂, NO₂ and PM₁₀. The records show that the existing levels of SO₂, NO₂ and ozone are generally below the relevant EPP (Air) guidelines. Monitoring data for PM₁₀ show that the highest records over this period sometimes exceed the air quality guideline of 150 µg/m³.

Potential Environmental Impacts

Emissions during construction will be minimal, for example vehicle and machinery exhausts and dust. These impacts can be mitigated through use of dust suppression techniques (eg. water trucks) and use of well maintained machinery. Due to the relatively isolated location of the plant area it is anticipated that these air quality impacts will be minimal.

Atmospheric emissions associated with the operation of the proposed gas processing facility may include:

- Carbon dioxide (CO₂);
- Carbon monoxide (CO);
- Nitrogen oxides (NO_x);
- Sulphur dioxide (SO₂);
- Volatile organic compounds (VOCs); and
- Particulates and dust.

Nitrogen oxides and CO₂ will be the principal emissions from the operating LNG facility. Air quality impacts associated with LNG facility operation will be assessed as part of the EIS and management controls developed and documented within the EMP to minimise such impacts.

Greenhouse gas management for the Project will be based on Santos' existing greenhouse management system which is implemented via the Environment, Health and Safety Management System (EHSMS), covered in Section 4. The specific greenhouse components of this system consist of the Santos Greenhouse Policy, Greenhouse Hazard Standard and Energy Efficiency Hazard Standard. Relevant commitments made by Santos under the Greenhouse Policy include:

- A requirement that all operations develop energy efficiency and greenhouse management plans with site-specific targets;
- Identification and promotion of opportunities for natural gas to replace higher greenhouse emitting fuels;

- Investment in energy and process research and development, and to work co-operatively with other parties; and
- Participation in external voluntary greenhouse reduction programs.

The EIS will outline the actions that would be undertaken through the design, installation, commissioning and operation of the Project. To achieve this, the EIS will include:

- The amount of emissions as an absolute figure and as a percentage of the Queensland and Australian emissions.
- A description of mitigation measures including analysis of the likely greenhouse gas reductions as a result of mitigating efforts.

In demonstrating its commitment to greenhouse and energy efficiency management, Santos will incorporate current best practices in thermal efficiency and greenhouse emissions control where practicable.

3.6.2 Gas Transmission Pipeline

Existing Environment

With the gas transmission pipeline route predominantly through rural areas it is envisaged that existing air quality is generally high. No data are available at this stage on baseline air quality.

Potential Environmental Impacts

Gas transmission pipeline construction activities will include vegetation clearing and earthworks associated with trenching operations and access track construction. As a result, emissions are expected to be limited to automotive emissions and dust. Given the generally isolated nature of emission sources (the pipeline will predominantly be routed through rural areas) air quality impacts are expected to be low.

During operation, emissions will be minimal.

3.6.3 Gas Fields

Existing Environment

With the gas field development predominantly located in rural areas it is envisaged that existing air quality is high. No data is available at this stage on baseline air quality data; however survey/s will be conducted as part of the EIS baseline environmental studies.

Potential Environmental Impacts

Atmospheric emissions associated with field development may include:

- Carbon dioxide (CO₂);
- Carbon monoxide (CO);
- Nitrogen oxides (NO_x);
- Sulphur dioxide (SO₂);
- Volatile organic compounds (VOCs); and
- Particulates and dust.

Sources of emissions could include flaring, venting, vehicles, generators and compressor stations.

Air quality impacts associated with field development activities will be assessed as part of the EIS and management controls developed and documented within the EMP to minimise such impacts.

3.7 Noise and Vibration

3.7.1 LNG Facility

Existing Environment

The LNG facility development site will be located on undeveloped land at the south western end of Curtis Island. Existing background noise is likely to be typical of rural areas. The nearest major residential area is the City of Gladstone, approximately four - five kilometres south of the proposed LNG facility site.

There are residential settlements on the mainland approximately two – three kilometres west of the LNG facility, and residences on Tide Island and Witt Island located south of the LNG facility.

There are other remote residential developments on the south east section of Curtis Island approximately five kilometres from the potential sites. A north-south running ridge line separates these settlements from the LNG site.

Potential Environmental Impacts

Construction noise will be characterised by site preparation activities (land clearing and earthworks) and LNG facility/road/bridge construction activities. Noise will also be generated from the transportation of materials and equipment associated with these activities. Operational noise will be characterised by gas processing activities.

Depending on the location of the final site, noise impacts on nearby residential settlements may be possible and appropriate consultation would be necessary to address any issues of concern.

Noise impacts associated with LNG facility development and operational activities will be assessed as part of the EIS and management controls developed and documented in the project EMP. Where required, noise attenuation will be incorporated into the design of noise sources.

3.7.2 Gas Transmission Pipeline

Existing Environment

The gas transmission pipeline will run through predominantly rural areas, with existing noise sources typical of such areas including rural traffic (highways and secondary roads) and local noise sources associated with rural based human occupation.

Potential Environmental Impacts

Gas transmission pipeline construction will include easement preparation activities (vegetation clearing and earthworks), trenching and pipe laying activities. These activities will include operation of earthmoving machinery and transport of materials and equipment to the work site. The impact of such activities is expected to be low as the pipeline is likely to be remote from residential and other sensitive receptors and the duration of such activities will be short-term.

Impacts during transmission pipeline operations are expected to be low, short in duration and predominantly associated with occasional maintenance programs and potentially intermediate pumping station operations. Such issues can be managed in consultation with effected landholders to ensure timing of such activities and establishment of any necessary noise attenuation devices is implemented to minimise any noise impacts.

The project EIS will assess anticipated noise impacts associated with transmission pipeline construction and operational activities and management controls documented in the project EMP.

3.7.3 Gas Fields

Existing Environment

The gas field area is located in a predominantly rural area, with existing noise sources typical of such areas including rural traffic and local noise sources associated with rural based human occupation.

Potential Environmental Impacts

Gas field development will require drilling and earthworks programs across a variety of terrain. The generation of noise will occur from a variety of sources including vegetation clearing activities, earthworks associated with site preparation works and drilling activities. Given the rural based setting and relatively short term nature of these activities the impact is expected to be low.

Operation of the gas field will generate noise from such sources as drilling activities and compressor stations.

Effective consultation with landholders will be undertaken to identify any potential impacts before they occur and management controls adopted to minimise such impacts.

3.8 Terrestrial Ecology

3.8.1 LNG Facility

Existing Environment

Commonwealth Department of Environment and Water Resources Matters of National Environmental Significance (MNES)

An on-line interactive map search of the MNES database was carried out to identify any potentially occurring threatened species under the commonwealth legislation. The search was conducted for a search area using a 5 km vicinity search. The search area covers all the potential LNG facility sites being considered.

The MNES database search identified a number of potentially occurring threatened species in the search area. It is important to note that the Department of Environment and Water Resources (DEWR) database has inherent limitations based on the accuracy of geographic data for some matters. In particular, confirmation of the presence of threatened or migratory species at a given site is not possible from the database, as data presented are for potential occurrences of species within a general area, rather than for known occurrences at a specific site. The relative reliability of this database must be born in mind as species highlighted by this search do not necessarily correlate to an actual observation. Species are highlighted by the database if their currently known distribution overlaps with the search area by one degree of latitude/longitude (approximately 100km). As part of the Project EIS ground truthing terrestrial surveys will be undertaken to confirm the presence of absence of such species.

The Database search also indicates that Curtis Island is situated adjacent to the Commonwealth Great Barrier Reef World Heritage property, and the Mackay/Capricorn State Marine Park.

A referral to the Commonwealth Minister of Environment and Water Resources may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Regional Ecosystem Mapping

The Queensland Department of Natural Resources and Water (DNRW) uses Regional Ecosystems (RE's) to describe the relationships between major floral species and the environment at the bioregional scale. RE's are mostly derived from linking vegetation mapping units recognised at a scale of 1:100,000 to land zones that represent major environmental variables, in particular geology, rainfall and landform.

The Queensland Herbarium has developed a program for explicitly mapping RE's across Queensland, however it should be noted that there are inaccuracies inherent in RE mapping at a scale of 1:100,000 and that these maps only provide an indication of what is potentially present. Further on-site vegetation mapping (ground truthing) would be required to confirm the presence of any RE's.

Further ground truthing to confirm the presence and define the extent of these communities would enable an assessment for any potential loss of significant vegetation and overall impacts to regional biodiversity.

Flora and Fauna Species of State Significance

A record extract from of the Queensland EPA Wildnet database for a 10 km search area around the proposed LNG facility area has identified a number of threatened flora and fauna species for the search area as listed under the Queensland Nature Conservation Act, 1992. A record extract of the EPA herbarium database (HerbRecs) for the same search area also indicates a number of threatened flora species listed under the Nature Conservation Act as potentially occurring in the area.

Further studies would be required to ascertain the presence of any of these species or their habitat on the final proposed site. If State listed species were utilising habitat on site, suitable mitigation measures would be required to be developed to conserve these species.

Potential Environmental Impacts

Potential impacts on the terrestrial ecology of the LNG facility development area during construction include vegetation clearing and resultant fragmentation of habitat and "edge effect" related disturbances. As part of the EIS studies, flora and fauna surveys will be conducted on the site to ground truth and confirm the results of desktop database searches with suitable mitigation measures required to conserve these species.

3.8.2 Gas Transmission Pipeline

Existing Environment

A Commonwealth EPBC database search of the proposed gas transmission pipeline route has been undertaken (note that the search coordinates are preliminary at present and may vary following final transmission pipeline route alignment). Search results show thirty seven threatened species as potentially occurring within the broad pipeline alignment (1 km buffer). These include eleven vulnerable and three endangered fauna species and nine vulnerable / three endangered plant species under the EPBC Act. Also potentially occurring are three threatened vegetation communities with endangered conservation significance under both Commonwealth and State legislation. These communities include:

- Bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregion;
- Brigalow (*Acacia harpophylla*) dominant and co-dominant; and
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions.

Potential Environmental Impacts

Potential impacts on the terrestrial ecology during gas transmission pipeline construction include vegetation clearing and resultant fragmentation of habitat and “edge effect” related disturbances. As part of the EIS studies, flora and fauna surveys will be conducted on the proposed pipeline route to ground truth and confirm the results of desktop database searches.

It should be noted that it is proposed to locate the pipeline adjacent to the existing Queensland Gas Pipeline easement between Wallumbilla and Gladstone as much as possible. This would confine the construction activities to previously disturbed ground and minimise the need to clear additional habitat.

Where additional vegetation clearing is necessary, controls would be put in place including adoption of best practice techniques associated with easement width and soil disturbance.

3.8.3 Gas Fields

Existing Environment

A Commonwealth EPBC search of the gas field area has been undertaken. Search results show 30 seven threatened species as potentially occurring within the broad gas field area. These include 11 vulnerable and two endangered fauna species (not the same as above), and five vulnerable / three endangered plant species under the EPBC Act.

Also potentially occurring are four threatened vegetation communities with endangered conservation significance under both Commonwealth and State legislation, consisting of the above listed communities as well as a community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.

Also note that existing search results for the Comet Ridge area identify forty threatened plant species under the State Nature Conservation Act, as occurring in the area including three Endangered, seven Vulnerable and thirty Rare plants. Search results also identify seventeen threatened fauna species as occurring in the area including four Endangered, three Vulnerable and ten Rare animals.

Further database searches (to be undertaken as part of EIS terrestrial studies) will reveal more accurate records of significant communities and flora/fauna species for the areas.

Potential Environmental Impacts

As previously mentioned, there is a petroleum exploration and development program planned which will require earthworks programs across a variety of terrain which would in turn require a level of vegetation clearing.

As part of EIS studies an understanding of the status of remnant ecosystems will be developed and environmental controls developed to minimise impacts (eg. avoidance of Commonwealth protected areas and areas listed as “endangered” and “of concern” under Queensland legislation, use of previously disturbed areas as much as possible, minimising well lease footprint areas).

3.9 Marine Ecology

3.9.1 LNG Facility and Gas Transmission Pipeline Component

Existing Environment

Marine Parks and World Heritage Areas

The Port Curtis area is situated within the Gladstone Port Limits, an area where shipping and harbour operations (including dredging) are administered by the Central Queensland Ports Authority (CQPA).

Port Curtis lies outside the Mackay/Capricorn Marine Park and the Great Barrier Reef Marine Park, however all of its waters below the mean low water mark lie within the Great Barrier Reef World Heritage Area, an area administered by the Great Barrier Reef Marine Park Authority (GBRMPA) in association with the Environmental Protection Authority. A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Principal marine habitats in Port Curtis include:

- Lower intertidal mudflats;
- Upper intertidal mudflats;
- Mangroves; and
- Seagrass beds.

Appendix A provides a schematic distribution map of these habitats.

Fish Habitat Reserves

The closest declared fish habitat areas are located east of Curtis Island in Curtis Channel, which is not in close proximity to the potential LNG facility sites. Marine plants and habitats within these declared areas receive formal legislative protection with special permits or licenses required for most types of development. However, there are areas adjacent to the proposed development sites that have been proposed by the Department of Primary Industries (DPI) as potential declared fish habitats or intertidal wetlands of significance. This is likely to trigger a requirement for DPI approval under the Fisheries Act.

Other Conservation Zones

The Gladstone Industrial Land Study has identified marine resources within Port Curtis warranting protection, including those in the estuarine reaches of the Calliope River system. However, the Port Curtis area also supports extensive inter-tidal and shallow sub-tidal seagrass beds. The most extensive beds are reported to occur along the western and southern shorelines of the island. These seagrass beds provide protection and foraging areas for the juveniles of a number of commercial and recreational finfish and prawns and are regularly utilised as a food source by a number of herbivorous marine fauna species.

Port Curtis south of the entrance to The Narrows is listed in the Directory of Important Wetlands in Australia. This area has been identified for its extensive range of marine wetlands encompassing seagrass beds, mangrove forest and intertidal mud flats that provide habitat for a range of significant migratory water birds, reptiles and mammals.

Appendix B provides details on Marine Parks, Conservation Areas and Wetlands areas in the Port Curtis region.

Threatened Species

Based on the Commonwealth Department of Environment and Water Resources database, *Directory of Important Wetlands*, a number of threatened marine fauna species have been recorded or predicted to occur in the Gladstone region.

Significant Species

A number of significant species (covered by the marine provisions of the *Environment Protection and Biodiversity Conservation Act 1999*) have been identified as potentially occurring in the Gladstone region.

Potential Environmental Impacts

Earthworks in inter-tidal areas including clearing of mangroves for installation of jetty facilities and construction of an access road approach to the western abutment of the proposed bridge may be required as part of site development works. The clearing of mangroves communities may trigger specific approval requirements, including the granting of specific permits which may include specific obligations/conditions on the siting and dimensions of such facilities.

Seagrass bed distribution information (refer Appendix A) indicates that this community is mainly situated in the southern and western sections of Port Curtis, with a community in relatively close proximity to the Boatshed Point site jetty facility. There may be siting and dimension implications associated with this facility, although this would need to be confirmed.

Other potential impacts on the marine ecology are associated with proposed shipping activities (eg. discharge of ballast water and introduction of marine pests), dredging operations, runoff and other discharges from the LNG development site.

The EIS will include specific marine ecology studies to assess the potential impacts of construction and operational activities and develop mitigation measures to minimise these impacts.

3.10 Visual Amenity

3.10.1 LNG Facility

Existing Environment

Curtis Island is largely undeveloped at present and provides a natural backdrop to Gladstone.

Potential Environmental Impacts

Development of the Curtis Island site will cause a visual change to the landscape, although the undulating topography on the island combined with considered site selection would be expected to mitigate this impact. There are also privately owned islands in the area and with the LNG facility potentially being the first project on Curtis Island there may be concern from these island landowners.

The EIS will assess the extent of visual impacts (including lighting impacts) and develop mitigation strategies.

3.10.2 Gas Transmission Pipeline

Existing Environment

The gas transmission pipeline will be located in predominantly rural areas.

Potential Environmental Impacts

The gas transmission pipeline will be buried for its entire length with only aboveground marker posts and cathodic protection markers being visible. Boost compressor facilities may be installed at intermediate locations on the pipeline.

The intention to locate the gas transmission pipeline adjacent to the easement for the existing Queensland Gas Pipeline will significantly reduce the potential visual impact of this component of the project. By constructing the transmission pipeline adjacent to an existing easement the need for significant right-of-way (ROW) clearing of vegetation and construction of additional access tracks for operational or maintenance purposes will be greatly reduced. In areas where additional vegetation clearing may be required there will be visual impacts, and these will be most noticeable where works are visible from roads or landholder residences.

However, by ensuring that ROW preparation, trench excavations, transmission pipeline installation and ROW rehabilitation works are carried out in accordance with industry best practices then the visual impacts are expected to be minimised and short term.

3.10.3 Gas Fields

Existing Environment

The gas field area is predominantly rural and includes freehold, leasehold and crown land. Land use comprises freehold and leasehold cattle properties (both individually owned and pastoral/grazing company owned); National Parks and State Forests. Topography varies from flat open valley environments, undulating hills and low plateaux to mountainous range country.

Gas field infrastructure is currently present in the area associated with oil and gas exploration activities (eg. seismic lines, exploration well leases and campsites) and production activities (eg. access tracks, production well leases, pipelines, plant and satellite facilities and associated water disposal operations).

Potential Environmental Impacts

The gas development area will be subject to petroleum exploration and development activities over the Project life and this will have a visual impact. Visual impacts will occur from a variety of sources including vegetation clearing activities, earthworks associated with site preparation works, drilling activities and field infrastructure.

Given the rural based setting and relative remoteness of these activities the impact is expected to be low. Effective consultation with stakeholders (including landholders) will be undertaken to identify any potential impacts before they occur. This combined with the application of accepted industry practice (including adoption of environmental management controls for field development activities) will minimise such impacts.

3.11 Cultural Heritage

3.11.1 LNG Facility

Existing Environment

A number of cultural heritage surveys have been conducted in the area and cultural sites have been identified on Curtis Island, including shell middens, stone artefact scatters, quarry sites, scarred trees and earthen arrangements.

Potential Environmental Impacts

Any proposed development of the Curtis Island facility site, road and bridge alignments would require detailed cultural heritage surveys to be conducted as part of the EIS process. These surveys would need to be undertaken in close consultation with local Aboriginal people.

3.11.2 Gas Transmission Pipeline

As it is proposed to construct the gas transmission pipeline adjacent to the existing Queensland Gas Pipeline easement the extent of new ground to be disturbed is expected to be minimal. A review of previously conducted cultural heritage survey studies (undertaken as part of the original pipeline impact assessment and approvals process) will be carried out and a transmission pipeline project Cultural Heritage Management Plan (CHMP) developed. This CHMP will be used to develop a specific plan for the proposed transmission pipeline.

3.11.3 Gas Fields

Existing Environment

There are several cultural heritage sites within or in close proximity to the gas field development area. These sites are either listed in the Santos Geographic Information System (GIS), Register of the National Estate (RNE), the Queensland Heritage Register, and/or the Aboriginal & Torres Strait Islander Cultural Heritage Database.

Potential Environmental Impacts

Gas field development activities will disturb land surfaces and therefore may have the potential to impact on cultural heritage places and materials, particularly artefact scatters and scar trees.

The identification and protection of Aboriginal cultural heritage in the existing project area has been comprehensively addressed in either the existing Indigenous Land Use Agreements and the Cultural Heritage Management Agreements (CHMAs) or other arrangements which have been established with the relevant aboriginal parties. These CHMAs detail the methodology to be adopted for the identification and protection of Aboriginal cultural heritage in the claim area during exploration and development activities.

As part of any gas field development planning phase the relevant CHMAs will be reviewed and amended as required in consultation with the appropriate Aboriginal parties.

3.12 Socio-Economics

3.12.1 LNG Facility

Existing Environment

Statistics for the Gladstone region indicate a population in 2005 of approximately 62,500. The demographics of the region indicate a median age of 32 (for Gladstone City Council area) and 35 in Calliope Shire. It has been forecast that the demographics of the region will change over the next 20 years with median ages increasing to 35 and 38 respectively. A summary of employment by occupation includes:

- | | |
|----------------------------------|-------|
| • Management and Administration | 9.8% |
| • Professionals | 11.6% |
| • Associate Professionals | 10.7% |
| • Tradespersons | 17% |
| • Clerical/Sales/Service Workers | 15.2% |
| • Labourers and related workers | 33.8% |
| • Not stated/inadequately stated | 1.9% |

Existing facilities include:

- Gladstone General Hospital (98 beds) and a private hospital wing;
- Variety of pre-schools; primary, special and high schools plus tertiary education facilities including TAFE and a campus of the Central Queensland University. Approximately 9,000 school pupils are enrolled in the region.
- Airport with regular flights to Brisbane, Mackay, Rockhampton, Townsville and Cairns.

Recent population growth has been linked to an increase in major industrial developments in the region, including manufacturing and wholesale/retail.

The south-west coast of Curtis Island includes popular fishing and anchorage locations for yachts, launches, cabin cruisers and small "run about" fishing boats, particularly near the mouths of the creek systems and on the north-west side of selected islands such as South Passage Island and Tide Island where it is reasonably protected from the south east winds. Development impacts on these areas and activities would need to be closely assessed.

Potential Environmental Impacts

The social impacts of any development proposal will need to be assessed in detail. This would include assessment of impacts on employment and housing, provision of educational and medical services, tourism and recreational activities.

3.12.2 Gas Transmission Pipeline

Existing Environment

The gas transmission pipeline will traverse a number of local authority areas including Gladstone City, Calliope Shire, Banana Shire, Duaringa Shire, Bauhinia Shire, Bungil Shire and Taroom Shire. The majority of the shires are rural and mining or petroleum based communities supported by a number of small towns and larger regional service centres.

Major land use / economic activities within these shires include cattle grazing, grain cropping and coal mining. The region also includes a number of state forests and national parks/conservation reserves, typically in areas unsuitable for clearing and grazing.

Potential Environmental Impacts

It is anticipated that the social impacts of the transmission pipeline project will include impacts on facilities such as accommodation, recreation, health and education. Due to the relatively remote location of parts of the pipeline route and the potential shortage of accommodation along the route it is anticipated that the workforce will be accommodated in dedicated camps. However, there is the potential for the workforce to utilise community facilities in and around population centres.

The potential impacts on accommodation and other facilities will be investigated in detail during the EIS process and will take into account facility availability and capacity to service the expected workforce.

3.12.3 Gas Fields

Existing Environment

The gas field development will be located in a predominantly rural zoned area and overlap a number of local authority areas including Bendemere, Bauhinia, Bungil, Duaringa and Taroom Shires. Major population centres within these shires include Roma, Injune and Rolleston. Roma has a community of 7000 people, lies 479 km west of Brisbane and is a major service centre for the western region of the Darling Downs. Roma was the site of Australia's first petroleum discovery in 1900, and is now the heart of a rich sheep and cattle grazing area. Injune is a small service town originally established as a coal-mining town. Rolleston has a population of 70 people, and is located 70 kilometres east of Springsure in the Bauhinia Shire of Queensland's Central Highlands.

The dominant land uses in the region include agriculture, pastoral (livestock) activities and cereal cropping. Land use across the development area primarily comprises beef production on cleared paddocks with unimproved native pasture species. Native hardwood forests are a valuable resource and are harvested for domestic and commercial use by some property owners.

Potential Environmental Impacts

The socio-economic impact of gas field development activities upon the community is anticipated to be minor as most of the personnel working in the area (whether permanent employees or drilling crews) will be housed and messed in either permanent or temporary camps or live locally in townships.

Specific details on workforce numbers and accommodation requirements are not known at this point and will be influenced by the timing and intensity of field development activities. As part of the EIS a comprehensive socio-economic assessment of the development area will be conducted and measures identified to minimise any potential negative impacts (eg. compliance with any relevant State Government building and construction contract training policies).

3.13 Transport and Infrastructure

3.13.1 LNG Facility

Existing Environment

The proposed LNG facility development sites are undeveloped and used for cattle grazing purposes. There is no existing infrastructure on the sites except for a few unsealed bush tracks. Accesses to the sites are via boat/barge.

Potential Environmental Impacts

Construction and operation of the LNG facility will require provision of all required transport and infrastructure including:

- Access roads;
- A bridge linking Curtis Island to the mainland;
- Power, telecommunications and potable water supplies; and
- Other supporting infrastructure such as accommodation camps.

There may be minor impacts from delivery of plant equipment, building materials and other supplies which will be transported to the site either by road or ship/barge.

The operational workforce is anticipated to be housed on the mainland therefore there are expected to be impacts on roads as a result of employees getting to the worksite.

Export of LNG is to occur by LNG ships, therefore there will be increased marine traffic during operations.

Figure 2-2, 2-3 and 2-4 provide a schematic of the LNG development site including the location of possible access roads and the bridge.

The potential impact of this infrastructure development will be assessed within the various specialist studies to be conducted as part of the EIS and mitigation measures undertaken to minimise these impacts.

3.13.2 Gas Transmission Pipeline

Existing Environment

The nominated gas transmission pipeline route is to follow adjacent to the existing Queensland Gas Pipeline easement from Wallumbilla to Gladstone. The route is from Gladstone in a south westerly direction towards Callide and Bauhinia Downs then in a southerly direction towards the gas field development area. The initial section of the transmission pipeline follows closely the Dawson Highway. The western section of the transmission pipeline is through more remote country, although there are a number of roads in the region including the Fitzroy Development Road, Leichhardt Highway, Carnarvon Development Road plus a number of secondary rural roads.

As the nominated route is adjacent to an existing gas pipeline easement there are a number of access points already existing.

Potential Environmental Impacts

Transport and traffic issues associated with the construction phase of the transmission pipeline project will include transport of major items and equipment (eg. pipe, construction plant and equipment, camp accommodation and workforce movements).

The number of transport movements has not been determined at this stage and will depend on exact access locations, size of selected pipe, location of the construction camps and size of workforce. Typically pipe is transported on semi-trailers in 12-18 metre lengths (depending on pipe diameter), with the number of semi-trailer trips required dependent on the diameter of the pipe and size of the semi-trailers.

The EIS will include a review of existing transport infrastructure, transport requirements and the anticipated impacts on existing infrastructure (eg. potential damage to existing road surfaces). The EIS will also propose mitigation measures to minimise the anticipated impacts.

3.13.3 Gas Fields

Existing Environment

With the predominantly rural based land use of the gas field development area, transport infrastructure is minimal with a number of rural secondary roads linking the major regional road network. Existing gas field developments have resulted in the construction of a number of gas field access roads (predominantly unsealed secondary roads).

Potential Environmental Impacts

The gas field development is expected to result in transport and infrastructure facilities being constructed, including roads, gas gathering and water gathering networks. The EIS will include an assessment of the impact of this additional transportation and other infrastructure on both the natural and social environments. Proposed control measures will be identified to minimise these impacts including effective consultation with stakeholders (including landholders) and the application of accepted industry practices including adoption of environmental management controls for field development activities.

3.14 Waste Streams

3.14.1 LNG Facility

Waste generated during construction will include a combination of domestic and putrescible wastes, paper and timber packaging, scrap steel, grey water, sewage, waste oils and fuels and vegetation waste from clearing activities.

The identification and assessment of these waste streams will be undertaken as part of the EIS study and appropriate controls developed and implemented in the site EMP. Examples of controls to be considered include:

- Purchasing policies that consider packaging issues and efforts to purchase in bulk to reduce waste;
- Development of a culture and practices that focus on waste segregation to support recycling and appropriate disposal of waste materials off-site;
- Use of recyclable materials where possible;
- Separate storage and disposal of any regulated and hazardous wastes; and
- Appropriate awareness training for employees and contract personnel in waste management practices.

These above controls will be applied in accordance with waste management hierarchy principles of reduce, reuse and recycle.

In addition, the EIS will also assess the anticipated waste streams generated as a result of LNG facility operations and propose a series of control measures to manage environmental impact.

3.14.2 Gas Transmission Pipeline

Waste generated during construction will include a combination of domestic and putrescible wastes, paper and timber packaging, scrap steel, grey water, sewage, waste oils and fuels and vegetation waste from clearing activities.

The EIS will include a section on waste management and an EMP will be developed that outlines appropriate environmental controls.

3.14.3 Gas Fields

Santos has developed an Eastern Queensland Gas Waste Management Plan for its operations and any gas field development program would be managed in accordance with this plan. The primary objectives of this document are to ensure operations are carried out in accordance with legislative requirements and accepted industry practices to protect identified environmental values relevant to the area including:

- Use and management of resources;
- Surface water and groundwater contamination; and
- Soil contamination.

The waste management plan provides a framework for addressing relevant aspects of waste management and to ensure that waste management practices are supportive of sustainable development and comply with Santos policies, industry standards, legislative obligations and license conditions.

The Environmental Management Plan for the Project will take into account controls identified in the waste management plan and any additional issues/impacts identified in the EIS will be considered in the EMP, with amendments to the waste management plan being made if necessary.

3.15 Risk Assessment

As part of EIS studies an independent safety and security assessment will be undertaken to identify the risks associated with construction and operation of the project. The assessment will include the production, storage and transport of LNG and study both individual and societal potential risks. The results of the risk assessment will include development of appropriate controls to minimise risks.

4 Project Environmental, Health and Safety and Social Management

4.1 Introduction

Santos is committed to minimising the environmental risk of the Project through a rigorous planning, assessment and management process. This will include consideration of environmental issues and adoption of appropriate controls at the design, planning approval, construction and operational stages of the Project in accordance with Santos' Environmental Health and Safety Management System requirements.

4.2 Santos' Environmental, Health and Safety Management System

Santos has developed an Environmental, Health and Safety Management System that applies to all Santos operations within Australia.

The framework has been developed to ensure compliance with Australian Standard 4801: 2000 Occupational Health and Safety Management Systems – Specification with guidance for use, and AS/NZS ISO 14001:1996 Environmental Management Systems – Specification with guidance for use.

4.3 Santos' Greenhouse Policy

At Santos we recognise one of our key environmental responsibilities is to pursue strategies that address the issue of greenhouse emissions. We believe that as a global stakeholder in the energy business, we have a responsibility to constantly strive for improvements in our business, our overall contribution to greenhouse emission reduction and energy efficiency.

We are committed to achieving effective emission reduction targets, to the pursuit of energy efficiency strategies and to the identification and implementation of opportunities to use either less greenhouse emitting or renewable sources of energy.

4.4 Project Environmental Management

Santos is committed to conducting activities associated with the proposed Project in an environmentally responsible manner; and intends to implement best practice environmental management as part of a program of continuous improvement. This will be achieved by addressing issues systematically, consistent with accepted standards and the Santos Environment, Health and Safety Management System.

An important element of this systematic approach will be the development of detailed environmental assessment and management procedures to guide construction, commissioning, operation and emergency response activities.

Project environmental management will apply throughout the entire life of the project, from design through to planning approval, construction, and operational stages.

4.4.1 Construction Stage

The construction phase of the project will involve site clearing, civil works, erection of steel work, installation of machinery and equipment and the integration of management and process systems. During the construction of the project, measures will be undertaken to ensure that all environmental risks are minimised. All construction materials and practices will be in accordance with relevant Australian and/or international standards.

The project construction manager will be responsible for the development and implementation of a construction phase environmental management plan to achieve the above objectives.

4.4.2 Operational Stage

Aspects of the Project's operational phase will be undertaken on a continuous 24 hours per day/365 day per year basis with periodic scheduled shutdowns for routine preventative maintenance. The design philosophy will incorporate the need to minimise inventories of materials and the minimum use of chemicals and reagents with a high environmental impact. The project components will also be designed to minimise the generation of solid, liquid, and gaseous wastes.

An operational phase environmental management plan will be developed to manage risks identified during the EIS process.

4.4.3 Decommissioning

Decommissioning of Project components and infrastructure has not been planned at this early stage of the project development. However, decommissioning will be undertaken as/when required and will be done so in accordance with accepted industry practices, stakeholder and regulatory requirements.

4.5 Community/Social Management

Santos is committed to open and accountable processes that encourage stakeholder engagement throughout all stages of the Project. As such, Santos will establish an extensive and ongoing Stakeholder Engagement Plan. The broad ranges of stakeholders that will be consulted include a diverse cross-section of government, industry and community representatives.

4.6 Health and Safety Issue Management

Protection of the public and workforce health and safety during both construction and operations is paramount to Santos. Utilising expert personnel and the Santos Environment, Health and Safety Management System (EHSMS), the potential health and safety hazards and risks will be identified and assessed, then the subject of substantial planning, organisation and procedural/facility development.

The LNG facility will be designed to include spill containment systems, fire protection systems, multiple gas, flame, smoke and low- and high-temperature detectors and alarms, and automatic and manual shut-down systems. The efficiency and stability of operations will be maximised by the use of a high level of automation, regular preventative maintenance, and safeguards such as back-up systems and the provision for safe emergency shut-downs.

Prior to project commissioning, all personnel will be required to undertake an extensive training program to ensure safe operating practices. The training program and subsequent regular refresher programs will involve issues covering operations, hazards, safety and emergency procedures and environmental management.

4.7 Monitoring

Santos proposes to establish a comprehensive environmental monitoring program to measure and record project environmental performance. The program will place emphasis on the release of contaminants, discharges and incidents. This will be to confirm that discharges and emissions comply with all relevant environmental licence and approval conditions.

Regular environmental audits will be undertaken. These audits will help Santos management assess the efficiency and effectiveness of the project's operation from an environmental, safety and community view and to take appropriate corrective action as necessary.

5 References

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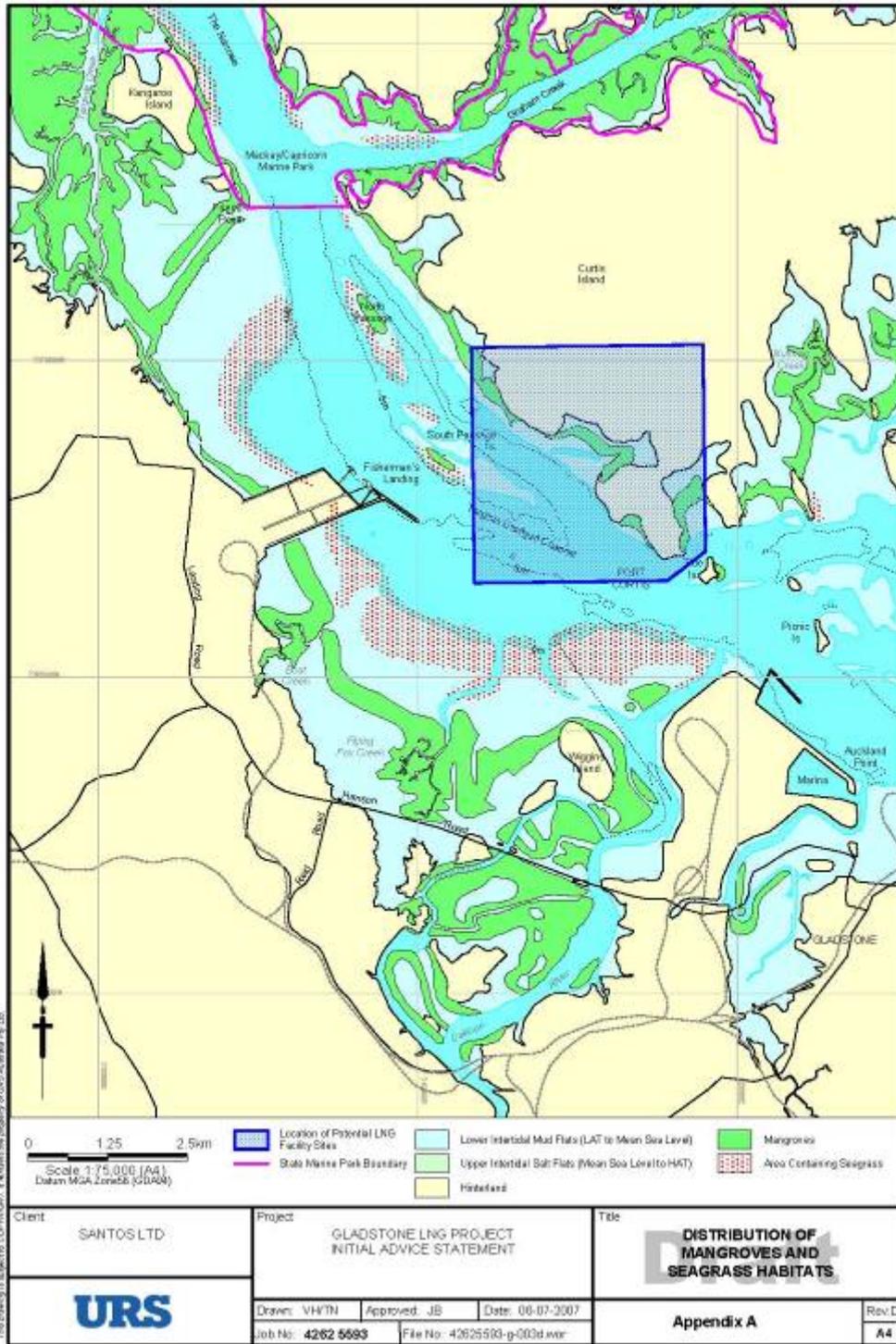
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Appendix 1: Distributions of Mangroves and Seagrass Habitats



Appendix 2: Marine Conservation Parks in the Port Curtis Area

