1 INTRODUCTION

QGC Limited (QGC), a wholly-owned subsidiary of BG Group plc, proposes to develop a world-scale, integrated liquefied natural gas (LNG) project in Queensland, known as the Queensland Curtis LNG (QCLNG) Project.

Drawing on BG Group's track record of very successful LNG project and market development, the QCLNG Project will make a significant contribution to developing Queensland's large supplies of coal seam gas (CSG) and establish the LNG industry on the east coast of Australia.

LNG is a safe, proven and efficient technology used to deliver supplies of natural gas, the least carbon-intensive of all fossil fuels, to markets around the world. LNG is natural gas that has been cooled to become a liquid, making it easier and more efficient to store and transport.

LNG technology has transformed the energy industry by allowing gas to be economically and safely transported around the world.

The QCLNG Project involves expanding QGC's existing CSG operations in the Surat Basin of southern Queensland and transporting the gas via an underground pipeline to a gas liquefaction and export facility on Curtis Island, near Gladstone, where the gas will be converted to LNG for export to markets in the Asia Pacific region and around the world. Domestically, the Project will help expand the gas market providing opportunities for gas suppliers and increased choice for consumers.

The Project will rank as one of Australia's largest capital investments and generate significant economic benefits for Australia and in particular for Queensland, including more than 4,000 direct jobs at the peak of construction, about 1,000 permanent positions and increased demand for goods and services. In addition, the Project will generate indirect employment (primarily in Queensland) during construction and operation.

The Project is forecast to stimulate an increase in Queensland's gross state product of up to $32 billion between 2010 and 2021, or approximately $2.6 billion per annum.

The Curtis Island facility will rank in the top three of the world's most environmentally friendly LNG facilities with technological innovation which will set a benchmark for LNG facilities.

As the Proponent, QGC will develop the following components of infrastructure for the QCLNG Project:

- **Gas Field Component:** an expansion of QGC's existing CSG fields in the Surat Basin of southern Queensland (refer *Figure ES1*) including management of Associated Water produced
- **Pipeline Component:** a network of underground pipelines, including gas and water collection pipelines, in the Gas Field and a 380 km underground gas transmission pipeline (Export Pipeline) from the Gas Field to the

proposed Curtis Island LNG Facility (refer *Figure ES2*)

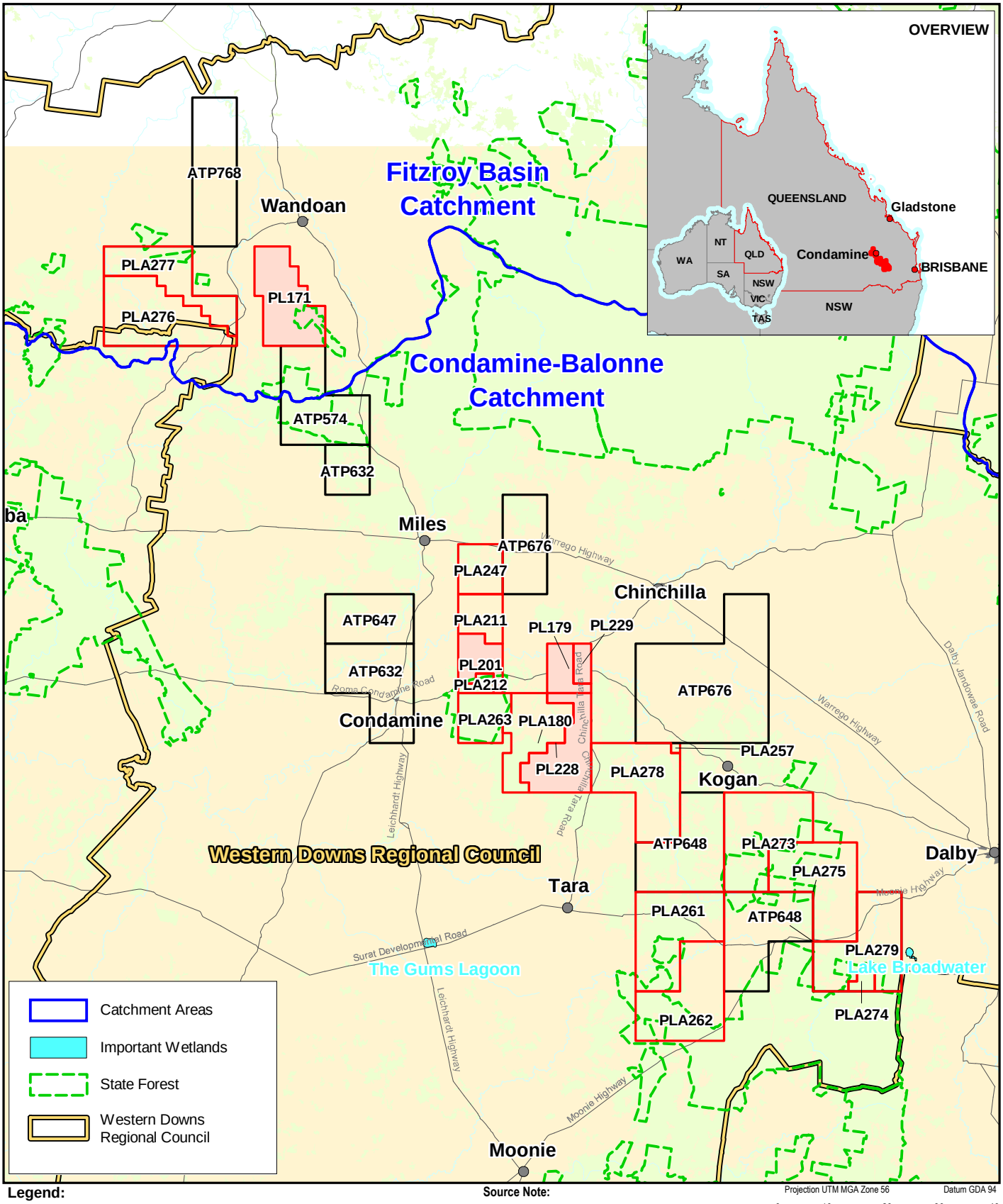
- **LNG Component:** a gas liquefaction facility on the south west coast of Curtis Island. The LNG Facility will initially comprise two processing units, or "trains", with provision for a third train. Nominal production capacity with three trains operating will be up to 12 million tonnes per annum (mtpa) of LNG. This component also includes an export jetty and other supporting infrastructure (refer *Figure ES3*)
- **Shipping Operations:** LNG shipping operations to load the LNG and transport cargoes to global export markets.

A fifth component, a swing basin at the export jetty and new shipping channel from the existing channels in the Port of Gladstone, will need to be developed to access the LNG export jetty. The dredging works required for this Component may be part of a larger shipping channel development program being proposed by Gladstone Ports Corporation (GPC).

This EIS covers the development of the QCLNG Project Infrastructure, specifically the Components listed above.

Several other components of other infrastructure which may be associated with the QCLNG Project may also be constructed and operated by parties other than QGC (Ancillary Infrastructure). Environmental approvals processes separate to this EIS are either underway for some of these components or will be undertaken should these additional components be developed. This Ancillary Infrastructure may include:

- a bridge and roads to provide direct vehicular access from Gladstone to Curtis Island
- a major new development of the Western Basin of the Port of Gladstone, involving dredging of a series of additional shipping channels and land reclamation using the dredged material proposed by GPC
- other off-tenement infrastructure associated with or the transportation and beneficial use of approved or treated associated water from the gas fields
- acquisition or addition of new gas tenements, resources and any new infrastructure required to provide additional reserves to underpin the future expansion of the QCLNG Project.



Legend:

- Gas Fields - Authority to Prospect
- Gas Fields - Petroleum Lease Application
- Gas Fields - Petroleum Lease

Source Note:

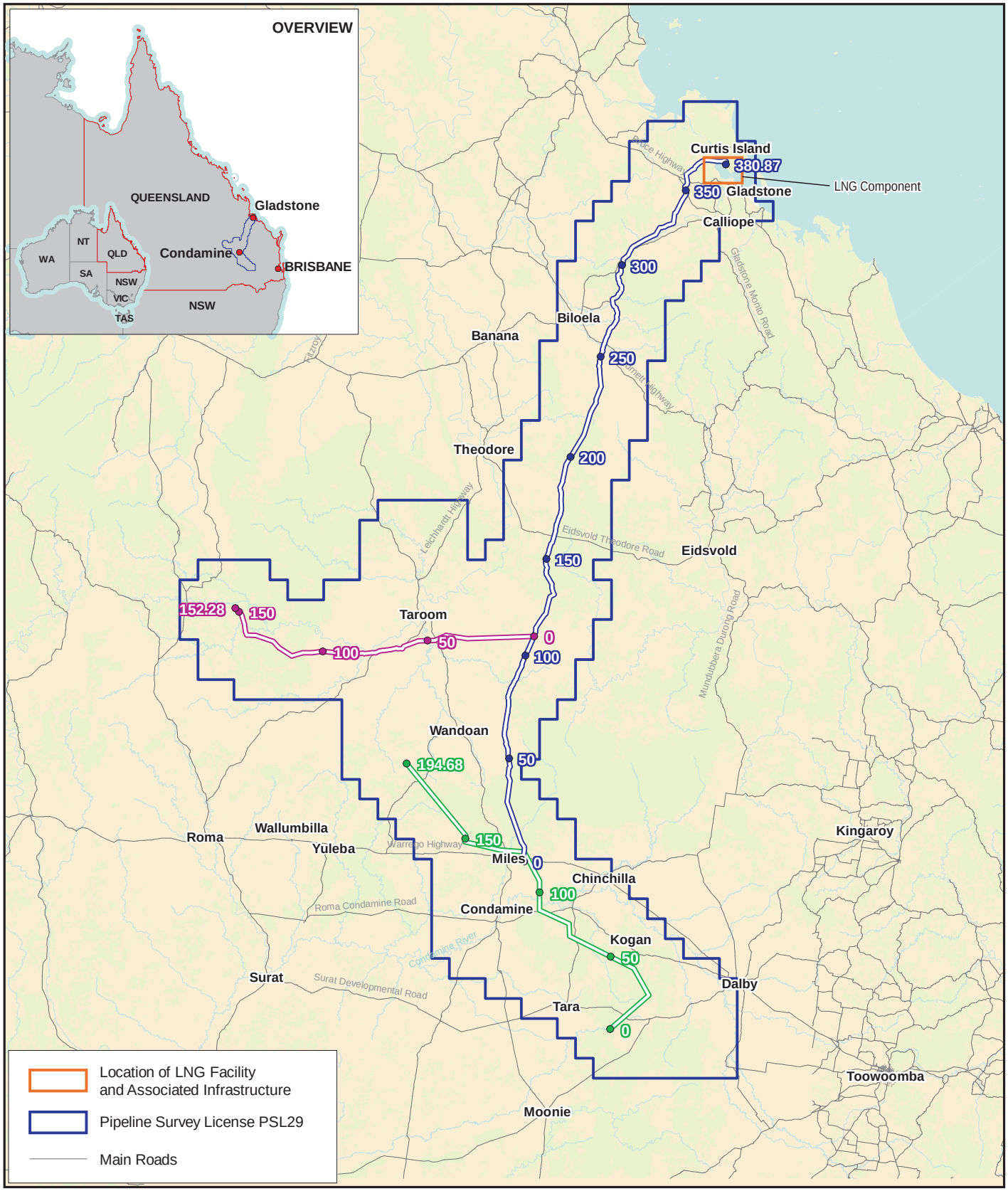
1:250,000 Topographic vector copyright Geoscience Australia
QLD Protected Areas, Catchment Areas and Important Wetlands sourced from Environmental Protection Agency

Projection UTM MGA Zone 56 Datum GDA 94

0 10 20 30 40
Kilometres

N

QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title: **Location of Gas Field Component**
	Client	QGC - A BG Group business	
ERM Environmental Resources Management Australia Pty Ltd	Drawn: Mipela	**Executive Summary Figure ES1**	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: CDP	File No: QC02-T-MA-00128	
	Date: 21.07.09	Revision: A	



Legend:

- Export Pipeline & Kilometre Point
- Lateral Pipeline & Kilometre Point
- Upstream Infrastructure Corridor & Kilometre Point

Source Note:
1:250,000 Topographic vector copyright Geoscience Australia

Projection: UTM MGA Zone 56 Datum: GDA 94

0 50 75 100
Kilometres

N

QUEENSLAND CURTIS LNG	Project	Queensland Curtis LNG Project	Title: Location of Pipeline Components
	Client	QGC - A BG Group business	
ERM Environmental Resources Management Australia Pty Ltd	Drawn: Mipela	**Executive Summary Figure ES2**	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: GB	File No: E05-MA-96213	
	Date: 21/07/09	Revision: 0	

Legend

- Proposed QCLNG Site Boundary
- QCLNG Footprint Plant Layout
- Proposed Export Pipeline
- Indicative Location of Proposed Operations Phase Ferry Terminal
- Construction Phase Logistics Site

Source Note:

Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
StreetPro Australia - Pitney Bowes MapInfo
Curtis Island Bridge/ Road Corridor - Connel Wagner

Projection: UTM MGA Zone 56 Datum: GDA 94

0 0.5 1 2 km

N

QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project	Title: Location of LNG Components
	Client: QGC - A BG Group business	
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JB	Executive Summary Figure ES3
	Approved: GB	File No: 0086165b_EIS_ES_GIS003_FES3
	Date: 21.07.09	Revision: 0

Disclaimer:
Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only.
ERM does not warrant the accuracy of any such Maps and Figures.

1.1 THE EIS PROCESS

1.1.1 Purpose of the Environmental Impact Statement

The purpose of the QCLNG Project Environmental Impact Statement (EIS) is to identify potential impacts and benefits of the Project and to ensure that benefits are maximised and adverse impacts avoided where possible.

Direct, indirect and cumulative impacts are assessed and mitigation measures identified, so that the Project ultimately reflects the best practicable environmental and social outcomes.

This EIS presents the findings of many specific studies. Therefore the EIS is a key tool for decision-makers in the Project approval process. Beyond the approval stage, commitments made in the EIS project approval process will stand as a benchmark against which to measure the ongoing performance of the Project.

The EIS presents measures to maximise benefits and to avoid, minimise, reduce, remedy, offset or compensate for adverse impacts.

The principal objectives of the QCLNG Project EIS are to:

- provide public information on the need for the Project with the likely impacts on the physical, biological, social, cultural, economic and built environments (both positive and negative)
- identify likely interactions of the Project with the physical, biological, social, cultural, economic and built environments
- set out acceptable standards and levels of impact on physical, biological, social, cultural, economic and built environmental values
- assess the potential impacts from the construction, operation and decommissioning of the Project
- describe recommended management strategies and actions to ensure that the defined standards and acceptable levels of impact are not exceeded
- document the process followed for the EIS, including the stakeholder consultation process
- demonstrate the relationship between the EIS and other environmental permitting and licensing processes required in the context of other Queensland and Commonwealth legislation.

1.1.2 Background to the EIS

QGC personnel worked together with external consultants to coordinate the EIS process and prepare the documentation. Specialist input was sought to gather or collate baseline data, assess impacts and recommend management and monitoring measures.

Engagement with Project stakeholders was undertaken as an integral part of the EIS process. This interactive process involved the EIS consultants, the Project planning and design teams, government departments and agencies, other key decision makers and the public. This ensured that QGC took into account the issues and concerns raised by external stakeholders and fed this information into the engineering and design process to maximise benefits and mitigate adverse impacts. In turn, findings and feedback from the process were relayed to stakeholders.

The assessment process involved screening, scoping, baseline data collection and impact assessment (including cumulative impact) of key physical, biological, social, cultural, economic and built environment issues and risks associated with the Project.

1.1.3 Legislative Underpinning for the EIS

It has been agreed by the Queensland Government and Commonwealth Government that this EIS could be prepared to satisfy the requirements of both jurisdictions. At the conclusion of the assessment process, separate decisions will be made by the respective Queensland Government and Commonwealth Government authorities.

Several specific steps in the EIS approval processes were followed by QGC. An Initial Advice Statement (IAS) for the QCLNG Project was prepared by the Proponent and lodged with the Queensland Coordinator-General on 3 June 2008. This initiated the EIS process pursuant to the *State Development and Public Works Organisation (SDPWO) Act 1971* (Qld) for the QCLNG Project. The IAS documented the key environmental, social, cultural and economic issues identified by the Proponent during the initial scoping exercise.

1.1.3.1 *Queensland Government*

On 4 July 2008 the Coordinator-General declared the Project a ‘‘significant project’’ for which an EIS is required in accordance with Part 4, Section 26 (1) (a) of the *SDPWO Act*.

The IAS provided the basis for the Coordinator-General to prepare the Terms of Reference (ToR) which defined the scope of the EIS. The Coordinator-General released the draft ToR for the EIS for public and government agency review and comment on 1 November 2008.

Following consultation with advisory agencies, the Commonwealth

Department of Environment, Water, Heritage and the Arts (DEWHA) and the public, the final ToR were issued by the Queensland Government on 26 May 2009.

This EIS has been prepared in accordance with the final ToR and submitted for public exhibition as required by the *SDPWO Act*.

After the statutory public exhibition period for the EIS, the Queensland Coordinator-General will coordinate submissions from the public and advising agencies and provide them to QGC.

QGC will then provide responses to the submissions received on the EIS and may be required to prepare a supplementary EIS to address specific matters raised.

At the end of the EIS phase (including any supplementary EIS process), the Coordinator-General will prepare a report assessing the EIS and other material, in accordance with section 35 of the *SDPWO Act*.

The Coordinator-General's report will be provided to QGC, the Commonwealth Minister for Environment, Heritage and the Arts and any other relevant assessment managers responsible for administering other Project approval processes. It is also made publicly available on the Department of Infrastructure and Planning website.

Where approval is required under another Act the Coordinator-General's report may make recommendations (with reasons) to the relevant assessment manager against approving the Project or impose conditions on its approval.

1.1.3.2 Commonwealth Government

Referrals were prepared under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* for nine Project actions that QGC considered likely to have a significant impact on Matters of National Environmental Significance (MNES). Three of these Referrals, relating to the bridge and associated roads linking Curtis Island and the Mainland, are in the process of being withdrawn as a Marine Transportation Operations option is the preferred Project strategy for access to and from the LNG Facility on Curtis Island.

Upon finalisation of the EIS, the Secretary of the DEWHA will prepare, and provide to the Minister, a recommendation report relating to the actions referred to the Minister. The report will include recommendations on whether the taking of the action should be approved and if approval is recommended, any conditions that should be attached to the approval.

1.2 EIS SUBMISSION PROCESS

Anyone wishing to make a submission in relation to the EIS should do so in writing to:

EIS Project Manager
Queensland Curtis LNG Project (QCLNG)
Significant Projects Coordination Division
Department of Infrastructure and Planning
PO Box 15009 City East Qld 4002 Australia
Fax: +61 7 3225 8282
Email : QCurtisLNG@dip.qld.gov.au

2 THE PROPONENT

2.1 QGC

The Proponent of the Project is QGC Limited. QGC's corporate history is represented below in *Figure ES4*.

Figure ES4 QGC Development Timeline

Founded as Queensland Gas Company Limited, the Brisbane-headquartered CSG explorer listed on the Australian Stock Exchange (ASX) in August 2000 with a market capitalisation of $16 million.

Over the next seven years, the company rapidly developed a strong reserves base in the Surat Basin of southern Queensland, culminating in its first gas sales in the domestic market in 2007.

In February 2008, QGC announced an alliance with BG Group plc (BG Group) via a subsidiary company (BG International Limited) to develop the QCLNG Project.

After an agreed takeover announced in October 2008, BG Group purchased QGC. This acquisition consolidated QGC's extensive CSG expertise and BG Group's international experience in LNG within a single-company structure. In April 2009 QGC was delisted from the ASX and the business now has more than 370 employees located in Queensland.

In addition to LNG, the new QGC is focused on continued expansion of its CSG resource base in Queensland and supply to both domestic and export markets.

QGC has already committed a significant proportion of its fast-growing reserves to meeting Australia's energy needs. These reserves are projected to supply about 20 per cent of Queensland's domestic gas market in 2009. After the QCLNG Project has commenced production, QGC will continue to identify, evaluate and pursue opportunities for domestic gas sales.

2.1.1 Proponent Details

Business details, the nominated person for Project correspondence and the mailing address for this entity are set out in *Table ES1* below.

Table ES1 Proponent Details

Name	QGC (QGC Limited)
ABN/Company No:	ACN 089 642 553
Nominated Contact:	Catherine Tanna Managing Director, QGC and Executive Vice President, BG Group plc
Mailing Address:	GPO Box 3107, Brisbane, QLD 4001

An overview of relevant experience and environmental policies of BG Group and the former QGC is provided below.

2.2 BG GROUP PLC

BG Group plc is a UK-listed energy business with activities on five continents and interests in 27 countries. Although headquartered in Reading, more than 60 per cent of the company's 5,300 employees are located outside the United Kingdom.

BG Group has operations across the energy sector, particularly in natural gas where it has experience throughout the gas chain from exploration to distribution to the customer. BG Group ranks among the largest companies on the London Stock Exchange with a market capitalisation of approximately A$72 billion (as of July 2009). In 2008 BG Group's operating profit was £5.4 billion.

2.2.1 Previous LNG Projects

BG Group's LNG business encompasses liquefaction, shipping, regasification and marketing. In particular, BG Group has relevant industry experience, acquired in conjunction with its operating partners, in the development and operation of:

- numerous gas production fields and delivery pipelines around the world
- a four-train LNG export facility on the south-western coast of Trinidad which commenced operation in 1999 and has a production capacity of more than 15 mtpa and uses ConocoPhillips Optimized Cascade ProcessSM liquefaction technology
- a two-train, 7.2 mtpa LNG export facility in Egypt, which commenced operation in 2005 and uses ConocoPhillips Optimized Cascade ProcessSM liquefaction technology

- development of an initial two-train LNG export facility of around 12 mtpa in Nigeria, with potential for expansion (currently under development with joint venture partners)
- processing capacity in LNG import terminals and regasification facilities in the United States, Chile and Wales, with new capacity currently under development in Italy.

BG Group also has a long history in LNG shipping and was involved in development of both the prototype and the first working LNG carriers in the industry.

In 2008, BG Group managed total LNG volumes of some 13 million tonnes and supplied around 8.4 million tonnes of LNG to customers in the Pacific Basin.

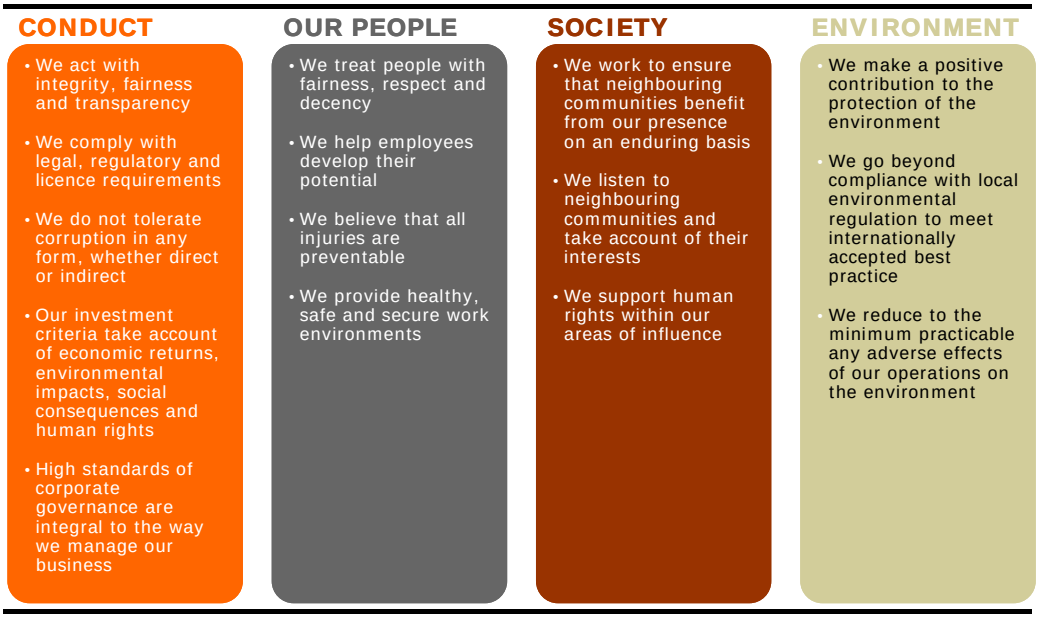
The company believes there is significant potential to further expand its LNG supply activities in the Pacific Basin to meet increasing global demand for natural gas, a less carbon-intensive, more efficient energy. Regionally, BG Group was selected by the Energy Market Authority (EMA) of Singapore to supply up to 3 mtpa of LNG to the Singapore market for up to 20 years.

In May 2009 BG Group signed a LNG Project Development Agreement with China National Offshore Oil Corporation and its affiliates (CNOOC), focused on the QCLNG Project. The agreement involves the purchase by CNOOC of 3.6 mtpa of LNG for a period of 20 years from start-up of QCLNG as well as investments by CNOOC in the Project. BG Group and CNOOC will jointly participate in a consortium formed to construct two LNG ships in China that would be owned by the consortium.

2.2.2 Commitments to Health, Safety, Security and Environment

BG Group aims to be an industry leader in health, safety, security, social and environmental performance and this is reflected in its Business Principles, (*Figure ES5*). As a member of BG Group, QGC is committed to these Business Principles.

Figure ES5 BG Group Business Principles



BG Group considers social and environmental performance integral to the manner in which it conducts business and indicators are reported regularly. Indicators include social investment and reported emissions, environmental discharges, waste and energy usage.

Outstanding business performance requires outstanding performance in the areas of Health, Safety and Environment (HSE). This means ensuring the health and safety of our people and of those affected by our business and protecting our physical assets, reputation and the environment.

BG Group's HSE policy cascades from our Business Principles:

- We believe all injuries are preventable.
- We provide healthy, safe and secure work environments.
- We make a positive contribution to the protection of the environment.
- We reduce to the minimum practicable any adverse effects of our operations on the environment.

2.2.3 Environmental Strategy

BG Group's Environmental Strategy enables the Group to establish and sustain operations in compliance with the company's Business Principles, and to respond to progressively changing external requirements. Full detail on BG's Environmental Strategy, positions on key environmental issues and performance metrics can be found on the BG Group website at: www.bg-group.com.

2.2.4 BG Group's Social Performance Policy

BG Group's social performance aim is to meet and exceed our business objectives by managing our operational risks and aligning objectives with those of host communities and governments. These social performance objectives are met through:

- establishing and maintaining effective relationships with interested and affected stakeholders
- avoiding and minimising negative impacts from our activities
- creating and delivering opportunities to benefit communities.

These key elements of BG Group's social performance are set within a governance framework that includes a Social Performance Standard with associated guidelines, an assurance process, active monitoring, reporting and metrics.

3 THE PROJECT

The QCLNG Project is a priority development for QGC and BG Group. The Project will draw on QGC's extensive local CSG expertise and BG Group's international experience in LNG to help unlock Queensland's vast reserves of CSG at a time of rising demand for a less carbon-intensive, more efficient energy.

3.1.1 Coal Seam Gas

CSG is produced over millions of years as coal is formed deep underground through heating and compressing plant matter.

The gas, which is mostly methane, is trapped in coal seams in the Surat Basin typically at depths of 300-600 metres. The coal seams are usually saturated with water and the pressure of this water holds the gas in place.

CSG is extracted by drilling wells into the coal seams. The water flows to the surface unaided or is pumped out if the pressure within the seam is low, releasing the gas from the coal.

The gas and water are separated at the wellhead and the gas is piped to a compression plant, where it is dried and compressed before it is transported through a pipeline to customers. An advantage of CSG extraction is that it leaves the coal resource intact.

CSG in the Surat Basin of southern Queensland is typically more than 98 per cent methane with only small amounts of nitrogen and carbon dioxide. As such, it requires relatively little treatment before it is turned into LNG.

3.1.2 Liquefied Natural Gas

LNG is natural gas that has been cooled to about -162ºC when it becomes a liquid. In this form it is easily transported and stored. LNG is odourless, colourless, non-corrosive, non-toxic and is transported and stored safely at near atmospheric pressure (not under high pressure).

The first liquefaction plant was constructed in the United States in 1912 and LNG has been shipped commercially around the world since 1959.

Over the years liquefaction has earned a reputation as a safe and efficient technology for transporting the world's vast reserves of natural gas.

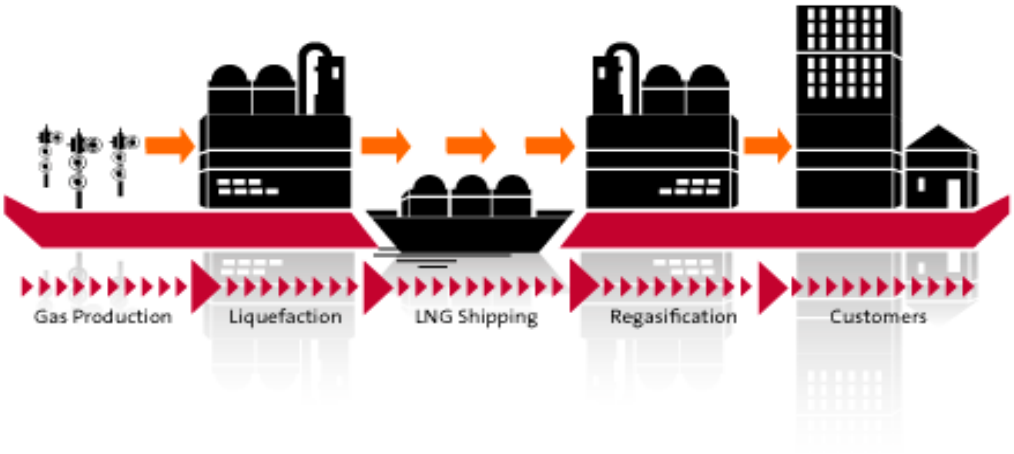
The QCLNG Project will source CSG from the Surat Basin and transport it via an underground pipeline to the liquefaction plant on Curtis Island, near Gladstone. There, impurities in the gas will be removed and the gas cooled using the same refrigeration principles that work in household refrigerators or air-conditioning units.

The natural gas liquefies and reduces to 1/600th of its original volume after it

has been cooled. As a liquid, the gas can be transported safely and economically at near atmospheric pressure in large vessels.

When LNG is returned to ambient temperature, it becomes the same natural gas used to cook meals, warm homes, and power cars, buses and power stations. A simplified summary of the LNG Value Chain is included as *Figure ES6*.

Figure ES6 LNG Value Chain



Increasing the LNG market domestically and internationally will significantly reduce the amount of greenhouse gas emissions where LNG is used instead of other fossil fuels such as coal.

Australia began exporting LNG from the North West Shelf Project in 1989. Since then, Australian operators have built an exemplary record, safely completing more than 2,600 shipments to customers around the world.

In 2007, the global trade in LNG increased by 7.6 per cent to 171 mtpa. It is forecast that by 2020 global demand for LNG will rise to 380 mtpa or 14 per cent of total gas consumption.

As of January 2009, 19 nations were importing LNG with major buyers including Japan, South Korea, China, Spain, the United States, Taiwan and India. The leading exporters include Australia, the Middle East, Indonesia, Algeria, Egypt, Trinidad and Tobago, Nigeria, Equatorial Guinea and Malaysia.

3.2 JUSTIFICATION FOR THE PROJECT

Energy security and fuel diversification policies have played an important role in increasing demand for gas as governments seek to reduce dependence on oil and encourage the use of more environmentally-friendly fuels.

The Queensland Government is encouraging the development of the natural

gas industry through the Queensland Gas Scheme. Under the current scheme electricity retailers are required to source at least 13 per cent of their electricity sales from gas-fired generation. The Government intends to increase this target to 15 per cent in 2010 and allow for further increases up to 18 per cent by 2020.

QGC has already committed a significant proportion of its fast-growing reserves to meeting Australia's energy needs. These reserves are projected to supply about 20 per cent of Queensland's domestic gas market in 2009.

QGC will continue to identify, evaluate and pursue opportunities for domestic gas sales.

New gas extraction and transportation infrastructure developed as part of the Project will help expand the domestic market by offering more opportunities to gas producers, in turn increasing choice for consumers.

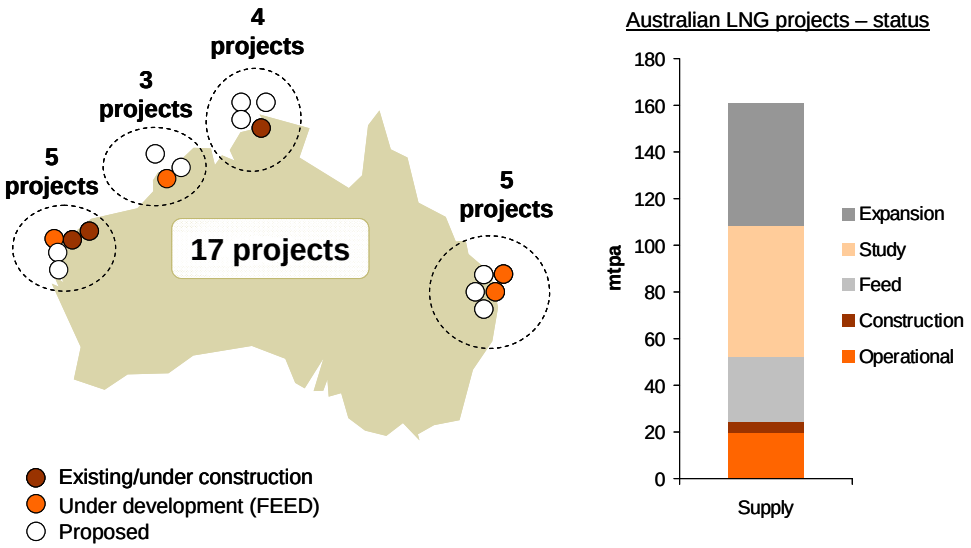
3.3 *NEED FOR THE PROJECT AND TIMEFRAME*

The increasing importance of LNG globally is highlighted by the projected growth of the LNG trade worldwide from 142 mtpa in 2005 to a projected 380 mtpa by 2020.

The QCLNG Project provides a new source of LNG to supply rapidly growing markets near Australia. Intense competition to supply these markets is expected from international and Australian LNG projects (existing and potential new projects).

A total of 17 LNG projects are in various stages of planning and development in Australia – see *Figure ES7*. The total potential supply from Australia and elsewhere is significantly greater than the available uncontracted demand. Given that there are also projects outside of Australia competing for this Pacific Basin market, it is unlikely that all but a few projects will proceed as the market cannot absorb the total volume of possible new Australian LNG supply. Therefore, a key success factor for a new LNG project is the ability to meet market demand in the 2014-2015 timeframe, and pending the relevant approvals, QGC is on track to commence commercial operation of the QCLNG Project in early 2014.

Figure ES7 Australian LNG Projects



Source: BG Group data: public reports, Wood Mackenzie

3.3.1 Domestic Supply

The CSG industry in Australia is relatively small with current production around 138 PJ Queensland and New South Wales for the year ending March 2009. CSG resources are abundant with Australia's total CSG resources estimated at in excess of 250,000 PJ. Only 20 per cent of these total resources need to be recovered to meet Queensland's and New South Wales' gas needs for a minimum of 40 years. Approximately 500 PJ per year of CSG will supply the initial two LNG processing trains.

The QCLNG Project will provide significant new gas extraction and transportation infrastructure, offering greater opportunities for gas producers and increasing choice for consumers.

3.3.2 Economic Benefits

The QCLNG Project is estimated to stimulate an increase in Queensland's gross state product of up to $32 billion between 2010 and 2021, or approximately $2.6 billion per annum. The benefits of the Project will extend well beyond this period as it will have at least a 20 year life.

The Project will provide a direct multi-billion dollar capital injection during the primary construction phase and generate substantial benefits including employment and value-added activity in regional economies. Based on economic modelling, up to half the Project's capital expenditure during 2010-2013 will be spent within Australia, including more than 18 per cent in the Fitzroy and Darling Downs regions.

In addition, it is expected that up to 80 per cent of the Project's expenditure during 2014-2021 will be within Australia (based on economic modelling).

The Project will generate benefits including:

- approximately $2.4 billion in value-added activity in Queensland during the construction phase (2010 to 2013)
- approximately $29.5 billion in value-added activity in Queensland during the operations phase (2014 to 2021)
- annual average royalty income for Queensland of between $150 million and $330 million and annual average tax income for the Australian Government of between $600 million and $1.1 billion, depending on oil prices.

Direct economic benefits include increased employment and purchasing of goods and services from local businesses. Indirect benefits include the flow-on effects of increased spending and employment.

During the construction phase the Project will create direct economic benefits through significant capital expenditure; the number of employees directly required (more than 4,000 people at peak); and the demand for supplies and services from local businesses.

The Project's operating phase will also provide a number of direct regional and state-level benefits from the annual revenue generated; the direct creation of approximately 1,000 jobs; and significant royalties and tax revenues over the life of the Project (at least 20 years).

Mitigation strategies have been identified to maximise benefits and minimise adverse economic impacts from the Project, including supporting local business, building capacity in the local labour market, minimising use of agricultural land and impacts on local property.

Overall, the QCLNG Project will provide a very significant capital injection to the economy that will generate economic activity and employment and boost Queensland's balance of trade, helping to offset the impacts of the current global economic downturn.

The potential economic impact of the QCLNG Project is consistent with the development of a robust and well-balanced economy. The QCLNG Project will increase demand for regional goods and services, boost employment opportunities and promote the stability of employment in key industries. The Project will also diversify the regions' economies and reduce their dependence on mining and agriculture, and support regional growth through sustainable, long-term stimulus to local and regional economies.

Between 2014 and 2021 labour demand across the Project is estimated to be highest for occupations including professionals, technicians and trade workers, managers, and clerical and administrative workers. This is likely to draw labour from sectors such as construction, transport and storage, electricity, gas and water, and agriculture, forestry and fishing, as well as less skilled manufacturing industries.

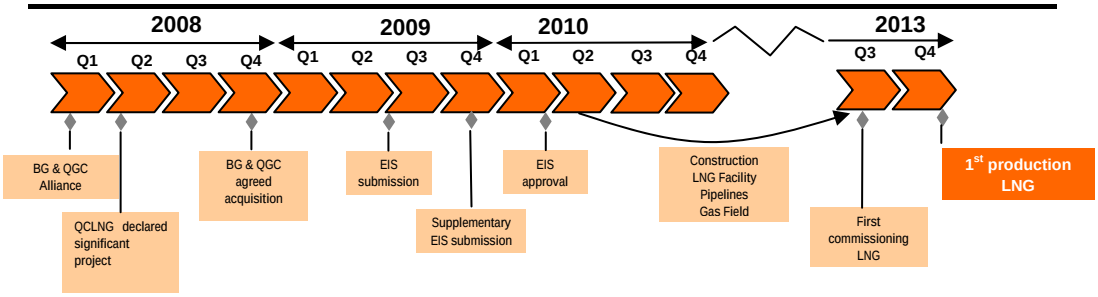
It is expected that GST revenues would increase as a result of the Project.

Quantifying the additional revenue is complex due to allowable exemptions. However, based on an assumed effective tax rate of 4 per cent (accounting for exemptions) on additional output, annual GST revenues are estimated to increase by approximately $210 million per annum due to additional transactions as a result of the development of the QCLNG Project.

3.3.3 *Project Approval and Construction Program*

A high level breakdown of the indicative timeframe for achieving production of LNG (subject to obtaining relevant permits and approvals) is presented in *Figure ES8*.

Figure ES8 Indicative Approval and Construction Program for the QCLNG Project



3.4 *CONSEQUENCES OF NOT PROCEEDING*

A standard approach to weighing alternatives for a project as a whole is to consider potential environmental, social and economic consequences if the project does not proceed.

The investment case for the QCLNG Project involves a multi-billion dollar investment in Queensland's CSG industry that will provide thousands of jobs and generate significant royalties and tax revenues for the Queensland and Australian Governments. It will also provide new supplies of natural gas, in the form of LNG, at a time when countries are seeking cleaner, more efficient supplies of energy.

The development of CSG projects (such as the QCLNG Project) for supply to power stations represents a preferred option from an environmental emissions perspective over construction of additional coal-generated power – both in Australia and in countries to which the LNG will be exported and utilised. CSG-to-LNG projects effectively monetise a significant potentially stranded hydrocarbon resource of Queensland and Australia.

Therefore, QGC believes that this EIS helps demonstrate that the "no project" option would not only significantly disadvantage Queensland and Australia but also potentially encourage the greater use of coal-fired power, and lead to an increase in greenhouse gas intensity and emissions as a result.

CSG extraction technology is well understood and tested. It is a simple and effective method for utilising the CSG resource. In addition, the coal seam remains intact following CSG extraction, and could therefore be exploited at a later date when, and if, future economic and technological options make this viable. QGC's (and other companies') domestic gas operations illustrate that CSG extraction is financially viable.

4 PROJECT COMPONENTS

The Project comprises the following:

1. Gas Field Component
2. Pipeline Component
3. LNG Component
4. Shipping Operations
5. Swing Basin and Channel Component

4.1 GAS FIELD

The Gas Field Component of the QCLNG Project encompasses the expansion of QGC's CSG operations in Queensland which currently supply domestic gas markets to allow for the export of LNG.

The Project is anticipated to have a life of at least 20 years. Over this timeframe the Gas Field expansion comprises development of:

- approximately 6,000 gas production wells over the life of the project with initially up to 1,500 wells across the Gas Field by mid-2014. The remaining wells will be phased in over the life of the project to replace declining wells
- associated surface equipment, such as wellhead separators, wellhead pumps, telemetry devices and metering stations
- gas-gathering systems
- gas processing and compression infrastructure
- field infrastructure such as access tracks, warehouses, camps (both construction and operations), office and telecommunications
- water-gathering and water management infrastructure and water treatment facilities.

The aim of design, location and operation of gas-gathering, transportation and processing infrastructure is to minimise any environmental and social impacts.

The primary constraint to forecasting precise locations for field infrastructure, gas- and water-gathering systems, gas processing, and compression infrastructure is variability in production rates across the field development. QGC proposes a flexible approach to well location and design to manage actual production rates across its acreage.

The basis for the Project design is the delivery of 1,360 million standard cubic feet per day (mmscfd) of compressed CSG to the LNG Facility via the Export Pipeline and its associated infrastructure for supply to the first two LNG trains. Central Processing Plants (CPPs), which receive, process and supply gas to the Export Pipeline, require a constant flow of gas from Field Compression Stations (FCSs).

The location of CPPs and FCSs is based on exploration and appraisal results which confirm reserve estimates within a particular area of the Gas Field Component. From this, the construction of FCSs and delivery rates or flows to CPPs can be scheduled to meet the constant flow requirements over the life of the Project.

QGC will progressively establish approximately 6,000 commercial production wells over the life of the Project. The exact location of these wells will not be known until exploration activities are conducted in each tenement. The design life of a well is in excess of 25 years. Typically, the operating life of a well is between 15 and 20 years.

Wells are monitored continuously and maintained on a regular basis. Gas and water levels and pressures of the wells are recorded as are the gas and water volumes produced from the well bore. Gas engines, gas-gathering lines, flares, separators and pump drive units in the field are regularly inspected and maintained. A telemetry system provides real-time monitoring of performance to allow trending for maintenance planning. QGC maintains surplus equipment and materials for the maintenance and repair of equipment at warehouse facilities.

QGC negotiates land access agreements with landholders prior to the development of each well, construction of gathering systems and access tracks, and the installation of well site equipment. In these discussions and during the QGC planning process, account is taken of environmentally or culturally sensitive locations, landholder requirements and safety requirements.

4.1.1 Associated Water

The Gas Field Component also includes the management of Associated Water, which is water produced in the CSG extraction process on the production tenements.

QGC is considering options for Associated Water management which are at a conceptual stage. Detailed environmental and social impact assessments of the conceptual Associated Water management systems have not been conducted. As these concepts are developed, the environmental and social impacts will be identified and mitigation measures presented in the Supplementary EIS.

Current estimates predict the total volume of Associated Water generated over the life of the Project to be approximately 1,200,000 ML. The volume of Associated Water generated is projected to peak at approximately 180 ML per day in 2013/2014, with average production in the order of 160 ML per day between 2015 and 2025.

From the wellhead, water flows to a gas and water separator, from here water flows through a network of gathering pipes and pumps to a storage pond, connected to a water treatment facility.

Gas flows via gathering pipes to compressor stations. A minor volume of water (less than 1 per cent of total volumes) will be pumped from the compressor stations to their own smaller evaporation ponds.

The majority of Associated Water is saline and will require some treatment prior to beneficial use. The preferred option is for desalination of a proportion of Associated Water followed by concentration and evaporation of brine produced through the desalination process. In the short to medium term evaporation ponds may be used for the disposal of Associated Water. Longer term, the preferred set of beneficial use options include tree cropping, supply of water to mines, or reinjection.

Water treatment facility specifications have not been finalised. An indicative water treatment facility consists of a desalination plant, brine processing unit and brine evaporation ponds. There are likely to be three Associated Water treatment facilities across the Gas Field tenements.

Access to the general area will be via existing roads and tracks wherever practicable. Access to infrastructure will be limited to authorised personnel.

4.1.2 Construction Summary

The Gas Field Component requires the construction of several distinct elements, namely wellhead skids, FCSs, CPPs, water treatment facilities and water- and gas-gathering systems. The development and expansion of the Gas Field Component, including associated well site construction activities, will continue for at least 20 years, over the life of the Project.

Compressors and other major facilities materials will most likely arrive in the Port of Brisbane from overseas suppliers for transportation to site by road. Any material supplied from interstate will likely be handled in a similar nature.

Field infrastructure will require hardstand areas for construction as well as laydown and assembly areas. Areas that may be contaminated such as where engines, transformers, oil and chemicals are stored will be bunded and drains will be directed to an oily-water separator.

The construction phases and activities of the Gas Field Component are described in *Table ES2* below.

Table ES2 Gas Field Component Construction Summary

Phase	Activity
Pre-construction	Commercial well development
	- Selection of well sites, including land access
	- Drill site preparation
	- Drilling
	- Site clean-up and rehabilitation
Construction	Associated surface equipment and gas gathering
	- Assembly of well site equipment
	- Gas-gathering pipelines
	- FCSs, including flares
	- CPPs, including flares, TEG units

Phase	Activity
	Associated Water infrastructure
	- Water-gathering pipelines
	- Ponds
	- Water treatment facilities
	Other Infrastructure, including:
	- Accommodation camps, administration buildings and warehouses
	- Transport
	- Waste
	- Energy
	- Storage
Commissioning	Construction testing, handover, system planning, transfer of custody and, scheduling
	- Ramp-up gas

For the Gas Field Component there will be approximately 2,100 construction personnel of whom 350 will be involved in drilling and well establishment, supervision, administration and support. Approximately 1,750 construction personnel will be housed in temporary camps of approximately 250 to 300 personnel at six to seven locations between Woleebee Creek and Tara. Local contractors and service companies will be involved with the construction phase where possible.

4.1.3 Rehabilitation and Decommissioning

The Gas Field Component area will be progressively rehabilitated as core exploration, appraisal and production wells and associated infrastructure are no longer required. Partial rehabilitation will also be carried out following construction of infrastructure, such as well lease areas and pipelines, where a portion of the well lease area and Right-Of-Way (RoW) used during construction will be restored.

Any rehabilitation of facilities will be conducted in accordance with the following processes:

- surfaces will be profiled to be stable with minimal erosion potential
- topsoil will be ameliorated
- photo-monitoring points will be established
- flora species appropriate to the land use will be established.

Prior to the decommissioning phase of the Gas Field Component, a decommissioning and rehabilitation plan will be prepared. Details within this plan will be based on landholder requirements, experience of any previously decommissioned structures, recent environmental audits, infrastructure registers, current Environmental Authority (EA) conditions, legislative requirements and best practice at the time. The potential for recycling or reuse options by the landholder or a third party, and the nature of the environment in which the equipment or facility is located, will also be taken into account.

4.2 PIPELINE

The Pipeline Component of the QCLNG Project includes:

- a 380 km Export Pipeline from the area of the QGC Gas Field Component in the Surat Basin of southern Queensland to the LNG Facility in Gladstone, including crossing of The Narrows
- potentially a 150 km Lateral Pipeline which enables the connection of additional CSG fields to the Export Pipeline
- a 200 km Collection Header – a central pipeline located in an Upstream Infrastructure Corridor (UIC) to collect gas from centralised compressor facilities for delivery to the Export Pipeline.

Pipeline Component operational activities include general maintenance, gas metering, prevention of third-party damage, and maintenance of corrosion protection systems.

Operation and maintenance of the pipeline will be managed from a centre based at the CSG fields. The centre includes a Control Room for transmitting and receiving data and controlling remotely-operated equipment. The data collection system is accessible by field staff and QGC headquarters in Brisbane. Dedicated and trained personnel are assigned to 24 hour monitoring of the system.

As the pipelines are buried, landholders may resume using surface land provided that activities do not include excavation beyond a depth of 300 mm.

The Pipeline Component of the Project will temporarily affect approximately 1,260 ha of land classified as Good Quality Agricultural Land (GQAL) – as defined by *State Planning Policy 1/92 (Development and Conservation of Agricultural Land)*. However, pipelines are not expected to have any long-term impacts on existing agricultural activities. Cropping activities would only be affected during construction and could resume once the land is reinstated. There will be limited short-term impacts on grazing activities from pipeline construction and operations.

Pipeline development will require clearing of approximately 1,460 ha of native vegetation. It is QGC's intention to either rehabilitate bushland during Project decommissioning or engage in biodiversity offset agreements.

Once pipeline routes are established, restrictions would apply to the future use of easements. Registration of the pipeline easements ensures that any future development takes into account the presence of the pipeline.

4.2.1 Construction Summary

Construction of the pipelines is anticipated to take approximately 18 months from establishment of the first camp to final clean-up, reinstatement and commissioning.

The pipe will be transported by extendible semi-trailers (and/or by rail) in 12 m or 18 m lengths. Pipe will be delivered to site on a daily basis throughout the construction phase.

Generally the required easement width for the Export Pipeline and potential Lateral Pipeline will be 40 m to allow safe construction and achieve sound rehabilitation outcomes. This area may be extended to accommodate additional areas for main line valves (MLVs), temporary work areas and truck turn-around areas for construction activities. The truck turn-around areas are typically up to 50 m in width and negotiated on an as-needs basis. The UIC will require an easement width of 100 m to accommodate the Collection Header and other infrastructure services, such as the water Collection Header.

Crossing of The Narrows to Curtis Island will be considered as a special section of the works and will be undertaken concurrently with the Export Pipeline construction.

The construction phases and activities of the Pipeline Component are contained in *Table ES3* below.

Table ES3 Pipeline Component Construction Summary

Phase	Activity
Pre-construction	Geotechnical studies
	Centreline surveys, including temporary fencing and gate crews
	Establishing lay down areas and campsite locations
	Establishing new access tracks.
Construction	Clear and grade
	Trenching
	Stringing and bending
	Welding, inspection and joint coating
	Lowering in and backfilling
	Watercourse crossings
Commissioning	Hydro-testing and drying
	Clean up and restoration
	Weed management

It is anticipated that up to 500 direct jobs will be created during construction of the Pipeline Component of the Project. Local contractors and service companies will be involved with the construction phase of the proposed pipeline and associated facilities where possible.

The bulk of the construction workforce for pipeline construction will be accommodated in dedicated temporary construction camps to be established along the pipeline routes, and in QGC Gas Field Component camp accommodation.

4.2.2 Rehabilitation and Decommissioning

In the event that any of the pipelines are no longer required they will be decommissioned in accordance with the legislative requirements of the day and the Australian Pipeline Industry Association (APIA) code current at that time. The most likely options are:

- mothballing
- abandonment.

Mothballing would involve depressurising the pipeline, capping it and filling it with an inert gas such as nitrogen and maintaining the cathodic protection system to prevent the pipe corroding.

If a pipeline was to be completely abandoned it would be disconnected from all above ground structures, including the cathodic protection systems and purged of gas. All above ground facilities would be removed and disposed of and materials recycled where practicable. The pipe would then be left in-situ. At critical locations such as under a railway line or major highway pipe may be filled will a stable material (e.g. concrete) to prevent potential future subsidence.

Removing the pipe from the ground is not an environmentally or commercially viable option.

Following decommissioning of the pipeline, the RoW will be fully rehabilitated.

4.3 LIQUEFIED NATURAL GAS

The LNG Component of the Project comprises development, construction and operation within the Curtis Island Industry Precinct of the Gladstone State Development Area (GSDA) of a LNG processing plant with production capacity up to 12 mtpa, nominally comprising three LNG processing units or "trains" each with up to 4 mtpa production capacity. *Figure ES9* is a photomontage representation of the LNG Facility as would be seen from the Targinie foreshore.

Figure ES9 Photomontage of LNG Facility from Targinie Foreshore

The LNG process comprises gas pre-treatment, liquefaction and subsequent storage, as outlined below:

- **Gas pre-treatment** Raw gas (or feed gas) from the Gas Field Component is piped to the LNG Facility where it is cleaned to remove any impurities.

  Gas received from the Export Pipeline is metered at the inlet to ensure there are no gas leaks throughout the pipeline and for custody transfer.

- **Liquefaction** The treated gas is cooled through a cryogenic process undertaken in parallel trains, using the ConocoPhillips Optimized Cascade Process^{SM}. At this low temperature the gas becomes a liquid. Essentially, liquefaction technology makes it more economical to safely store and transport natural gas.

  QGC plans to commission Train One in late 2013 and Train Two approximately six to 12 months later. A third parallel train (covered by this EIS) is planned.

  The average production capacity of each train is approximately 3.68 mtpa as it takes into consideration the expected average feed gas-flow rates and long-term availability of the processing equipment.

- **LNG Storage** Following the liquefaction process, the LNG is stored in specially designed, fully contained storage tanks. QGC proposes to initially construct two LNG storage tanks each with capacity up to 180,000 m^3. A third tank of similar capacity will be constructed and commissioned when the third LNG train is built. One tank with capacity of approximately 100,000 m^3 may be used to store propane for use in spiking LNG if required to achieve a higher heating value (HHV) to meet market and consumer demands for natural gas with a specific HHV.

  The LNG storage tanks chosen for the QCLNG Project are full containment tanks with a 9 per cent nickel-steel inner container and a pre-stressed concrete outer container. In normal service the inner, primary container will provide liquid containment and prevent ingress of LNG into the space between the primary and secondary containers.

  The outer, secondary container is a self-supporting tank with a domed concrete roof. This is designed for vapour containment and to hold the thermal insulation of the primary container.

Active measures such as a fire and gas detection system, firewater system, and overpressure protection are included in the design.

In addition to the LNG process and storage components outlined above, the LNG Facility on Curtis Island includes:

- LNG loading and propane unloading facilities, including jetty and docking facilities
- utilities and supporting services which include:
- a Pioneer Dock (primarily to facilitate early works and construction access)
- general utilities and site infrastructure including fuel and chemical storage

and handling, fire protection and safety systems, flaring and venting systems, process control, general utilities, offices and administration buildings, etc.

- Materials Offloading Facility (MOF) used to facilitate personnel movement and for the offloading of large and/or heavy equipment shipped directly to the site. It will also permit waste removal services from the LNG Facility during the operation phase.

In addition to the LNG Facility on Curtis Island, ferry terminals and staging areas on Gladstone mainland will be developed for transit to and from the Facility by ferry and/or water taxi. This infrastructure will also allow for the ongoing transit of personnel, plant, materials and equipment to the LNG Facility and waste removal from the Facility. The terminals and staging areas will have roll-on roll-off capability to allow rapid embarkation and debarkation transport of trucks and mobile equipment. Auckland Point will be the primary ferry terminal and staging area for the construction phase of the Project. For operations, the ferry terminal and staging area is proposed along the shoreline behind the existing RG Tanna Coal Terminal.

Operational workforce for the LNG Facility is anticipated to consist of a total permanent workforce of approximately 160-170 workers, plus additional Project personnel based in Brisbane. The LNG Facility will operate 24 hours per day.

4.3.1 Construction Summary

Construction of the LNG Component will be undertaken in five main stages as outlined in *Table ES4* below.

Table ES4 LNG Component Construction Summary

Phase	Key activities
Site preparation	Establishment of an initial beachhead to allow mobilisation of personnel and equipment to site early in the Project and in advance of MOF construction
	Fencing
	Clearing of vegetation
	Bulk earthworks
	Construction of the MOF
Civil work, foundations and structures	Concrete batching for foundations and tanks
	Construction of marine facilities (i.e. LNG jetty)
Mechanical and electrical fit-out	Installation and testing
Systems integrity	Installation and testing
Energisation and introduction of hydrocarbons	Pre-commissioning and start-up

Peak numbers for direct and indirect personnel for the construction of the initial two-train facility will vary across the LNG Facility construction schedule. Total peak construction workforce (craft and field non-manual personnel) will be approximately 1,500 personnel, plus additional craft supporting indirect work and other QGC supervisory personnel.

Construction personnel engaged from within the Gladstone region will continue to live in their current residences and commute daily to the Curtis Island construction site, staging out of Auckland Point. For non-local personnel, a temporary construction camp on the Curtis Island site is planned. It is expected that approximately 400 persons will use this facility. However, due to the possibility that a lower percentage of local labour may be available than currently anticipated, the camp is to be sized for expansion to accommodate up to 1,200 personnel.

4.3.2 *Rehabilitation and Decommissioning*

Each LNG train of the LNG Facility has a design life of at least 20 years, with potential operation well beyond this. Given this timeframe, a range of factors will impinge on decommissioning methodology, including:

- available technology
- the prevailing legal and regulatory regime
- social and political conditions affecting the subsequent land use of the LNG Facility site
- economic conditions that may impact on the extent to which plant and equipment will be reused or recycled.

Some decommissioning will be required at the completion of the construction phase. This will include the return of the Auckland Point staging area to GPC control at completion of lease and removal of buildings and associated infrastructure not required for ongoing operations at the LNG Facility site.

Detailed planning for decommissioning will commence no later than five years prior to the scheduled end of the LNG Facility's life as determined during the life of the QCLNG Project. Negotiations with relevant stakeholders, and in particular the Department of Infrastructure and Planning (DIP) as the regulator of the GDSA, will be undertaken to determine whether any items of infrastructure are to remain for subsequent users of the site.

4.4 *SHIPPING OPERATIONS*

Typically shipping of LNG out of the Port of Gladstone will be undertaken by BG Group, with LNG ships being a combination of vessels owned by BG Group, BG Group associated companies and vessels contracted by BG Group to carry cargo. On occasions throughout the Project life, vessels not contracted by BG Group may also be used.

The planned LNG production rate suggests that approximately 60 LNG vessels will be loaded per year per LNG process train (i.e. approximately 180 LNG vessels per year with three trains operating, with some variation due to variation in ship capacity).

Movement of LNG tankers through the Great Barrier Reef Marine Park (GBRMP) will be within approved shipping zones and conducted under Australian Maritime Safety Authority (AMSA) approved shipping operations.

All LNG vessels used will have double hulls and primary and secondary containment systems.

Shipping outside the bounds of the Port of Gladstone within Australian Territorial Waters will be undertaken within approved shipping channels. Within the bounds of the GBRMP shipping will be limited to the transit of ships through designated channels (Capricorn and Curtis Channels) to shipping channels outside GBRMP.

Within the Port of Gladstone shipping will be along existing shipping channels under the guidance of Gladstone Regional Harbour Master and pilots.

4.5 QCLNG PROJECT SWING BASIN AND CHANNEL

Dredging and dredged material handling works required for the QCLNG Project include:

- development of dredged channels to the MOF for construction and operations support vessels involved in the construction of the LNG Facility
- development of dredged channels, swing basins and berth pockets for the LNG shipping operational requirements of the Project
- options for disposal or use of the dredged material.

4.5.1 Dredged Material Volumes

Dredging for the MOF may require excavation of approximately 3 million m^3 of seabed.

Dredging for the QCLNG shipping channel and swing basin requirements is estimated to produce a total of approximately 13.5 million m^3 in 2011. Some of this latter volume may be common to the shipping channel requirements of the proposed Santos/Petronas GLNG project (GLNG) if the works are conducted in the same dredging campaign.

Dredging for the QCLNG and GLNG shipping channel and swing basins comprises Stage 1a of the works contemplated under the Western Basin Strategic Dredging and Disposal (WBSDD) Project proposed by Gladstone Ports Corporation (GPC).

Works for some of the other stages and areas described in WBSDD may also be undertaken contemporaneously with that required for QCLNG. Therefore, the cumulative impact assessment undertaken for QCLNG in this EIS has taken into account the following projects already approved and others which are likely to be undertaken within the same timeframe of QCLNG:

- Wiggins Island Coal Terminal Project – EIS Approved. Works not yet commenced
- Fisherman's Landing 153 hectare Reclamation Project (FL153) – EIS being undertaken
- Santos/Petronas GLNG Project – EIS currently on public display
- dredging of Stage 1b of WBSDD (for Liquefied Natural Gas Limited's Gladstone LNG Project) – pre-approved dredging works to be undertaken by GPC
- dredged material placement works required for Stages 1a and 1b of the Western Basin Reclaim (described in GPC's WBSDD Project) – EIS being undertaken.

Cumulatively, these projects constitute dredging and dredged material management works of approximately 30 million m^3.

4.5.2 Dredging Methods

Most of the dredging is expected to be conducted with cutter suction dredges. A combination of backhoe dredges and trailer suction dredges might also be employed. Geological information available to date suggests that neither drilling nor blasting will be necessary for the Project.

4.5.3 Dredge Spoil Disposal Options

QGC has explored reclamation, ocean disposal and on-land containment as disposal options for material from the proposed dredging requirements for the Project. At this stage, subject to the volume restrictions noted below, disposal options in order of preference are:

4.5.3.1 MOF Channel Dredging and Disposal

Part MOF Channel

- GPC's current offshore disposal site located at the mouth of the Port of Gladstone
- bunded containment on the site of the QCLNG Facility
- the proposed FL153 reclamation (currently undergoing an EIS due for submission by GPC in July 2009)
- bunded containment at Laird Point.

Full MOF Channel

- the proposed FL153 reclamation
- the proposed Western Basin Reclaim to be developed by GPC under its WBSDD Project
- bunded containment at Laird Point.

4.5.3.2 Curtis Spur Channel Dredging and Disposal

- the proposed FL153 reclamation
- the proposed Western Basin Reclaim to be developed by GPC under its WBSDD Project
- disposal in a new offshore disposal site.

4.5.4 Relationship to GPC Activities

It is proposed that GPC may undertake the development of the dredging and reclamation works required for development of the Project. The GPC has currently lodged an IAS and proposes to undertake an EIS for its WBSDD Project. The dredging required for QCLNG may constitute one of the first components in the five overall stages of GPC's dredging plans, as described for the WBSDD Project.

Approvals for dredging works under the QCLNG Project EIS may be transferred to GPC to undertake the dredging and reclamation works. Conversely, should GPC's WBSDD Project EIS receive approvals prior to the QCLNG Project approvals, QGC may withdraw its *EPBC Act* referral from consideration by the Commonwealth Minister for the Environment, as well as those components relating to the dredging works from its Queensland *SDPWO Act* EIS, in favour of GPC approvals.

5 ALTERNATIVES CONSIDERED

In developing the QCLNG Project a wide range of options have been assessed for various aspects of the Project. Key areas where a range of options were considered include:

- Export Pipeline routes from the Gas Fields to the LNG Facility
- routes and techniques for crossing of The Narrows from the mainland to Curtis Island by the Export Pipeline
- locations for the LNG Facility and shipping arrangements
- options for construction and operations access to the LNG Facility on Curtis Island
- options for accommodation of the LNG Facility construction workforce
- LNG Facility technology
- options for management of Associated Water from the Gas Field.

5.1 EXPORT PIPELINE ROUTE OPTIONS

Alternatives to the preferred Export Pipeline on the mainland to west of The Narrows, including all areas below the highest astronomical tide separating the mainland from Curtis Island, were assessed using a five-stage methodology involving:

1. Development of potential route options: A review of mapping and aerial photography was conducted for a wide area between Miles and Gladstone and across the QGC production lease areas. This preliminary review determined, based on physical, environmental and commercial viability constraints, that a 40 km corridor around a line between Miles and Gladstone (i.e. 20 km each side of a centre line) was the preferred location for more detailed studies for the Export Pipeline and Lateral Pipeline
2. Desktop studies: Desktop studies were then conducted to broadly investigate the environmental constraints located in the Gas Field Component and between Miles and Gladstone. Key environmental constraints to the selection of an economically and technically viable pipeline route were also identified. This included topographic constraints that could affect the constructability of the pipeline.
3. Field review: Field reviews of the study corridors were then conducted by vehicle to understand the general terrain in relation to constructability constraints. No detailed field studies or surveys were conducted at this initial stage. The routes traversed in the field review were restricted to public roads and tracks. No private properties were accessed at this stage.
4. Selection of a preferred route for detailed study: A preferred route was selected based on the assembled data and selection criteria that included: corridor length; environmental impacts, approvals and land access complexity; community impacts; constructability (principally terrain);

proximity to prospective CSG regions; long-term pipeline protection and operability; and future expansion potential.

5. Assessment of pipeline route options: For the Export Pipeline a number of potential route options were selected within the 40 km corridor. Each route option was reviewed in detail and assessed against the route selection criteria, to determine the preferred route. Detailed studies, including in-field surveys, were then conducted to refine three route options for the Export Pipeline. The EIS studies, along with negotiations with landholders and regulatory authorities, were used to further refine the proposed pipeline routes to their current configuration. Ongoing negotiations with landholders and Traditional Owners may further refine these routes.

On the basis of the above, the preferred route for the Export Pipeline was selected. This route runs predominantly in a straight line north-east from the area of the Gas Field Component to Gladstone.

5.2 *ROUTE SELECTION (THE NARROWS CROSSING)*

Between the mainland at Gladstone and the LNG Facility on Curtis Island, the Export Pipeline will require a marine crossing of the tidal passage known as The Narrows. A range of options remain under consideration, including:

- Route options. All options commence in the vicinity of Phillipies Landing on the mainland side of The Narrows. Site visits and survey data gathering operations are ongoing to determine the various disadvantages and advantages associated with each. Based on this data, an assessment will be conducted and the route finalised.
- Crossing techniques, including: conventional offshore pipe lay where pipe is welded together on a lay vessel and lowered to the seabed; open-cut pipeline installation; trenchless techniques (e.g. horizontally directional drilling or tunnelling); and offshore or onshore pull-in pipeline installation where a section of pipeline, either pre-strung or welded together on a lay vessel, is pulled into final position using a winch from either onshore or an offshore platform.

These routes and construction techniques are subject to ongoing assessment and detailed engineering based on a comprehensive site investigation and survey data gathering program. The routes under consideration may also employ a combination of the above techniques to facilitate pipeline construction. The pipeline crossing technique will be decided during the detailed design phase.

5.3 *LNG FACILITY SITE SELECTION*

A site selection investigation for the LNG Facility was undertaken according to:

- an assessment of minimum site requirements

- BG Group's business, environmental and social principles and guidelines
- review of relevant government policies, input and direction
- detailed assessment of desktop information, database searches, Geographic Information Systems (GIS) analysis and limited field work.

A multi-criteria analysis was then applied to inform site selection. These criteria were applied in a two-staged site selection process.

The first stage involved a regional screening assessment of potential LNG Facility locations within Queensland considering available sites. The outcome of this first stage was the selection of the Gladstone area as the preferred location. This was in line with other studies undertaken by the Queensland Government identifying Gladstone as the area for an LNG Precinct.

The second stage involved a more detailed analysis of the available local sites in the Gladstone area (including Port Alma and Sea Hill on North Curtis Island) and Bundaberg to identify a preferred site for the LNG Facility. Site-selection investigations were undertaken by a multi-disciplinary team to:

- evaluate engineering and construction challenges to design, build and operate an LNG export facility
- collate historical and engineering, marine and environmental data
- provide an overview of the environmental and social issues associated with the potential sites
- identify any potential fatal flaws that may be associated with the sites under review, including site size and geotechnical challenges, marine access, environmental or social performance issues and other potential risks
- summarise potential risks and impacts associated with the potential sites
- provide a ranking of individual sites and identification of a preferred option
- provide an overview of the legislative and approvals framework associated with the Project components.

Environmental desktop information, database searches, GIS analysis and limited fieldwork identified issues and risks, including:

- regional ecological and cultural values
- potential impacts on listed protected flora and fauna, including migratory species and terrestrial and marine species, in the vicinity of the sites
- marine facilities and shipping – potential for siltation, water turbidity, tidal reach and height, ship turning area
- land resources – issues relating to contaminated land, cultural heritage, native title and hydrogeology
- infrastructure – issues relating to construction camp, proximity to infrastructure and feed gas supply, and export lines

- social baseline and community issues
- other issues potentially impacting on site selection, including air quality, noise, and visual impacts.

On this basis the Curtis Island site was selected for the LNG Facility. It was deemed appropriate for: technical and commercial reasons; the geographical location which provides a natural buffer zone between the proposed site and existing residents; and preliminary assessment of environment impacts which indicated that impacts on protected flora and fauna species could be minimised. The selected site is consistent with Queensland Government policy, given that the Queensland Government has designated south-western Curtis Island as part of the GSDA.

5.4 *LNG FACILITY SITE ACCESS ALTERNATIVES*

Once the LNG Facility site was selected, two main alternatives for LNG Facility site access were considered: marine transport; or Curtis Island Bridge and Road.

Alternative 1 – Marine Transport

QGC's preferred option is to transport personnel, equipment, materials and all associated items to and from the LNG Facility site during construction and operations by means of marine transport from Gladstone to Curtis Island. This is the option assessed in detail in this EIS.

During the construction and operations phase the marine transport alternative would entail vessels transporting personnel, equipment, materials, waste and all associated items from the Gladstone mainland to the MOF on Curtis Island. Auckland Point will be the primary ferry terminal and staging area for the construction phase of the Project, from land leased from GPC. During operations, a ferry terminal and staging area is proposed along the shoreline behind the existing RG Tanna Wharf with access via Alf O'Rourke Drive.

Alternative 2 – Curtis Island Bridge and Road

DIP has investigated the development of a bridge and road linking the mainland to Curtis Island (i.e. the Curtis Island Bridge and Road). The Curtis Island Bridge and Road therefore presents a site access alternative which has been considered in this EIS, although QGC is not the Proponent of this infrastructure.

The development of the Curtis Island Bridge and Road would provide vehicular access to Curtis Island from the mainland north of Fisherman's Landing via a road bridge crossing The Narrows. This would allow personnel, equipment, materials and waste to be transported to and from the LNG Facility by road but it could not be constructed in time for construction of the LNG processing plant.

The alignment proposed by DIP for the Curtis Island Bridge lies in close proximity to the northern boundary of the Port of Gladstone and the southern boundary of the Great Barrier Reef Coast Marine Park (GBRCMP).

Reasons for Selection of Marine Transport as Preferred Option

After assessment of these two options, marine transport was selected as the preferred option due to commercial, technical (including ability to offer access to the LNG Facility site early in the construction phase) and environmental and social reasons. Environmental and social considerations included the proximity of the proposed Curtis Island Bridge to the GBRCMP and The Narrows.

5.5 *LNG FACILITY CONSTRUCTION WORKFORCE ACCOMMODATION ALTERNATIVES*

Four initial options for the LNG Facility construction workforce accommodation were considered. These included:

- Options A and B: Two potential construction camp sites on the mainland, with daily transport to and from the LNG Facility by bus to and from the construction camp to Auckland Point, and ferry between Auckland Point and the LNG Facility site. Local personnel not living in the construction camp would arrange their own transport to and from Auckland Point to their homes.
- Option C: A construction camp on Curtis Island (within the boundary of the LNG Facility site), with all construction personnel living in the camp and transiting to and from Gladstone only at the end of shift rotation.
- Option D: A construction camp on Curtis Island (within the boundary of the LNG Facility site) with non-local personnel based in the construction camp and local personnel utilising their existing accommodation arrangements in the Gladstone Region. Local personnel would transit to the LNG Facility daily via ferry from Auckland Point, with non-local personnel transiting at the completion of shift rotation.

Following assessment of options, a variation of Option D (refined to reflect further detail on workforce numbers and construction methodology and scheduling) was selected for social and environmental reasons.

5.6 *LNG FACILITY TECHNOLOGY*

In assessing air quality and greenhouse impacts associated with the Project, a range of potential technologies were assessed to minimise emissions from the LNG Facility. A Best Available Techniques (BAT) assessment and justification was undertaken to identify air emissions associated with the LNG process and review potential for reductions.

Based on the options selected, the Project will have one of the least greenhouse gas intensive LNG facilities in the world.

5.7 ASSOCIATED WATER MANAGEMENT OPTIONS

Approximately 1.2 million ML of Associated Water will be produced by the Project. In general, Associated Water is saline and has a high sodium absorption ratio. This presents both challenges and opportunities for the management of Associated Water. QGC is reviewing a range of options for beneficial use of Associated Water, based on the following criteria which have been used to provide a preliminary qualitative evaluation of each beneficial use option:

- environmental impacts, encompassing a broad range of impacts on soils; land contamination; waste management; surface water; groundwater; air; noise and biodiversity
- social impacts, including changes in existing land use; disruption to communities; community and individual access to water and perceptions by communities
- technical constraints, which depend on the availability and reliability of technology proposed to manage water for each beneficial use
- economic constraints, encompassing water quality and distribution network requirements
- commercial constraints, encompassing the volume of water that is demanded by the beneficial use and the degree of reliance placed on third parties to whom water may be supplied
- regulatory constraints based on the preferred Associated Water management methods of regulators.

The volume that can be received by any beneficial user is a critical constraint. Options that do not have demand equivalent to the estimated supply have to be supplemented by other options.

5.7.1 *Preferred Beneficial Use Options*

Based on the above qualitative impacts and constraints ranking, the preferred set of beneficial use options is:

- tree cropping
- supply of water to mines
- reinjection.

Both tree cropping and reinjection offer the possibility of supplying the majority of Associated Water for beneficial use. The potential social and environmental impacts of these options will be investigated to determine the magnitude of potential impacts and the mitigation measures required to reduce those impacts.

Supply of water to mines offers a low environmental and social impact option with low economic and technical constraints, but will only result in the supply of a small percentage of Associated Water produced.

5.7.2 Water Treatment Options

Where water treatment is required the preferred method involves: pre-treatment, including ultra filtration; desalination through reverse osmosis; brine concentration and brine evaporation.

6 IMPACT ASSESSMENT FINDINGS

The following is a summary of the findings of the impact assessment on the construction and operation of the each core component for the Project. The environmental factors are briefly described and the key findings presented.

6.1 GAS FIELD COMPONENT

6.1.1 Climate and Climate Change

The climate of the Surat Basin is characterised by hot summers with mild-to-warm dry winters. Climate change is not expected to significantly affect the region of the Gas Field Component during the life of the QCLNG Project. Nevertheless, Gas Field Component infrastructure design, construction and operation will incorporate predictions about existing climate and climate changes.

6.1.2 Land Use and Infrastructure

The Gas Field Component covers approximately 468,000 ha, with 95 per cent of the area zoned rural and the remainder rural and/or residential. Pastoral activities occur on approximately 72 per cent of the land while 12 per cent is used for cropping, 11 per cent state forest and 5 per cent rural residential.

There is potential for moderate impacts on land use and infrastructure, particularly cropping lands and state forests, due to the dispersed nature and multiple locations of Gas Field Component wells and associated infrastructure. This may reduce the ability of the landholder to access all areas of productive land. Mitigation measures have been proposed, including landholder consultation and engineering solutions.

The Gas Field Component is covered by mining tenements, predominantly for coal. There are no major industrial developments, other than power stations and infrastructure corridors. QGC intends to avoid infrastructure routes and has proposed engaging with mining lease holders and infrastructure owners where tenements overlap.

6.1.3 Geology and Soils

The Gas Field Component contains approximately 184,000 ha of GQAL. Construction and ongoing production activities will occur on GQAL. Mitigation measures will be implemented to avoid significantly diminishing the productivity of GQAL.

Soils in the region of the Gas Field Component of the QCLNG Project are

susceptible to erosion. QGC will implement mitigation measures to minimise erosion from the Gas Field Component of the Project. Topsoil will also be effectively managed to ensure successful rehabilitation.

6.1.4 *Topography and Geomorphology*

The Gas Field is located on the western slopes of the Great Dividing Range. The terrain in the region is predominantly flat with gentle slopes and undulating plains and rises. The development of the Gas Field Component will require minimal modification of landforms.

6.1.5 *Associated Water*

QGC will produce approximately 160 ML per day of Associated Water, generated in the extraction of coal seam gas. There are a number of options for putting Associated Water to beneficial use, each requiring different levels of water quality. This in turn creates the need for alternative technologies for water treatment. Water treatment itself produces brine waste, which will be managed to minimise impacts on land.

The preferred treatment option is desalination complemented by brine concentration and brine evaporation. Concentrated brine waste will be disposed of in specially constructed landfills.

The preferred option for management of Associated Water in the short term is evaporation ponds and for the long term, irrigation of tree crops and/or reinjection. Both short- and long-term options will be supplemented by supply to industry and QGC petroleum activities. Other options have not been discounted.

QGC will undertake further detailed investigations of Associated Water management options. Investigations will focus on determining the likely impact of beneficial use options on environmental and social values.

QGC will weigh environmental, social, economic, technical, commercial and regulatory considerations to develop an optimal combination of beneficial uses.

6.1.6 *Groundwater Resources*

The Gas Field Component lies in the eastern portions of the Great Artesian Basin. Groundwater resources in the region have been identified and a conceptual groundwater model assessing potential impacts on groundwater resources from the extraction of Associated Water has been developed.

Based on the conceptual groundwater model, the proposed development and operation of the Gas Field Component of the QCLNG Project is expected to have a minor-to-moderate impact on neighbouring bore users with limited inter-aquifer transfer from the Precipice and Hutton formation aquifers is predicted.

Based on current data, predicted drawdown effects are expected to exceed nominated trigger levels within the Gas Field and, for the Springbok Sandstones, potentially outside of the Gas Field.

Water quality changes are not considered likely.

The risk of inter-aquifer flows caused by bore design or poor bore construction techniques is very low.

A negligible to insignificant impact on shallow aquifers and hence on ecosystems depending on these is predicted. This is reinforced by aquifer connectivity limitations and there being no identified groundwater dependent ecosystems within the Gas Field. Consistent with this finding, there is unlikely to be any significant impact on the baseflow to local river systems, particularly the Condamine River.

Changes have been proposed to the current monitoring program to provide better data to enable more accurate modelling and the implementation of appropriate mitigation measures, if required.

6.1.7 Land Contamination

A risk-based approach to land contamination that considers the most likely contaminants and their likely locations has been adopted. At this stage no potentially contaminated areas have been located. Any potentially contaminated sites will be identified and appropriately managed as gas fields are developed.

There is potential for QCLNG Project activities to contaminate land through the accidental release of chemicals, waste, fuel and Associated Water. QGC will implement management strategies to reduce and mitigate the potential for land contamination.

6.1.8 Surface Water Resources

The Gas Field Component is located largely within the Condamine and Balonne river catchment. Two nationally significant wetlands as listed in the Directory of Nationally Important Wetlands, Lake Broadwater and The Gums Lagoon, occur within the vicinity of the Gas Field Component (refer *Figure ES1*). The Gas Field is located outside of the catchment of The Gums Lagoon, whilst only a small portion of one production area is upstream of the Lake Broadwater catchment.

Field studies and hydrochemical analysis indicated that surface waters flowing through the Gas Field Component area have been degraded to varying degrees by anthropogenic activities such as land clearing, grazing, cropping and irrigation.

Appropriate mitigation measures have been incorporated in the management of Associated Water and of surface water flows to ensure potential impacts on surface water are minimised.

6.1.9 Aquatic (Freshwater) Ecology

Although there are no records of endangered, vulnerable and rare (EVR) aquatic flora species within the Gas Field, two (*Eleocharis blakeana* and *Fimbristylis vagans*) are known to occur in the neighbouring Lake Broadwater, immediately east of the Gas Field. Under the right seasonal conditions, there is potential for these two EVR species, as well as the Queensland Lace Plant (*Aponogeton queenslandicus*) listed as Rare under the *Nature Conservation Act 1992* (Qld) (*NC Act*), to occur within freshwater pools in watercourses, farm dams and weirs within the Gas Field.

The Murray Cod (*Maccullochella peeli peeli*), is listed as vulnerable under the *EPBC Act*. Additionally, the Southern Purple-spotted Gudgeon (*Morgurnda adspersa*) is listed as Priority Taxa under Biodiversity Assessment and Mapping Methodology (BAMM) Criteria H (EPA 2008b). Either species may occur within freshwater pools in watercourses within the Gas Field.

QGC will not develop non-linear, or standalone, infrastructure in freshwater wetlands and watercourses within prescribed buffer areas. In a small number of instances, linear infrastructure, such as pipelines, will transect watercourses. Subject to mitigation measures, there is a low potential for Gas Field Component activities to significantly affect aquatic ecology within or downstream of the Gas Field Component.

6.1.10 Terrestrial Ecology

Remnant vegetation occurs in approximately 171,225 ha or 36 per cent of the Gas Field Component. There are two endangered threatened ecological communities listed under the *EPBC Act.* Under the *Queensland Vegetation Management Act 1999* (*VMA*) there are seven listed Endangered Regional Ecosystems (REs) and six listed Of Concern REs. Based on field survey results, these Endangered and Of Concern remnants generally occur as long, narrow and degraded fragments.

From desktop assessment, a possible 48 EVR flora species were believed to occur in the Gas Field Component area. Field surveys recorded eight of these and a further 25 with potential habitat. Of a possible 33 EVR fauna species believed to occur in the Gas Field Component area, field surveys recorded eight.

Fauna habitats on most rural lands and roadside verges in the Gas Field Component area are fragmented and substantially degraded. Nevertheless, some areas, particularly riparian zones, have significant fauna habitat values.

QGC has developed a zoning scheme that prescribes different levels of environmental constraints to Gas Field Component development, based on the conservation value of an area. Areas zoned as having very high constraints include Gurulmundi State Forest, areas north-west of Gurulmundi State Forest, EPBC-listed ecological communities and the Queensland Department of Environment and Resource Management (DERM) defined Category B Environmentally Sensitive Areas.

Linear infrastructure associated with the Gas Field activities will avoid very high ecological constraints zones wherever possible. It is recognised that in a small number of instances linear infrastructure may intersect linear vegetation remnants and watercourses of significant ecological value (i.e. very high constraints zones). Unavoidable impacts will be minimised and/or compensated for by offset initiatives, and with mitigation and rehabilitation measures proposed, there is a low potential for the Gas Field Component activities to significantly impact terrestrial ecology.

6.1.11 Air

Modelling of airborne emissions from the Gas Field Component, including nitrogen dioxide, carbon monoxide, hydrocarbons, ozone and particulates, indicates that emissions will be below air quality limits. Cumulative impacts on nitrogen dioxide levels from other existing and proposed projects in the region are not expected to exceed air quality limits.

Further air quality modelling will be undertaken to predict cumulative impacts of other existing and proposed projects on carbon monoxide, hydrocarbons, ozone and particulate levels once infrastructure locations have been confirmed. Modelling indicates that there will be no exceedences of air quality objectives for oxides of nitrogen and carbon monoxide, ozone or hydrocarbons.

6.1.12 Noise and Vibration

The primary potential source of noise from the Gas Field Component is the operation of compressors. A night-time noise limit of 28 dB(A) has been adopted across the gas field. A group of compressor stations will exceed this adopted noise level for a distance of approximately 4 km to 5 km.

At worst, and without mitigation measures, approximately 350 sensitive receptors, such as residences, may experience noise levels above night-time noise limits. With mitigation measures, noise levels at sensitive receptors should decrease by between 10 and 40 dB(A), with a substantial decrease in the number of noise-affected sensitive receptors, to less than five.

Other noise sources are not expected to affect sensitive receptors due to the limited duration or low noise levels of the source. Mitigation measures will be introduced where the level of noise does exceed limits at a sensitive receptor, including the location, design of infrastructure, consultation with potentially affected receptors and construction of noise abatement structures.

No sources of vibration are predicted to exceed the relevant limits.

6.1.13 *Transport*

A preliminary transport impact assessment assumes all transport will be by road, as this would result in the worst case impacts. Rail may be an option and this will be considered in a further logistics study.

The assessment has shown that if all materials for the Gas Field Component were transported by road, there may be moderate to major impacts on the road pavement of the Leichhardt, Warrego and Moonie highways and the Surat Developmental, Dalby-Kogan, Kogan-Condamine, Jackson-Wandoan and Dalby-Jandowae Roads.

The transport impacts are not expected to reduce the level of service on any of these roads. Pavement impacts are also expected on regional council roads, the majority of which are unsealed.

QGC will work with the relevant road authorities to develop mitigation and management measures that minimise impacts on road pavements and the safety of road users.

6.1.14 *Visual Amenity*

With the appropriate positioning of infrastructure, the Gas Field Component is expected to have a generally low to negligible visual impact on the surroundings. Mitigation measures to minimise impacts have been proposed, including the use of screening vegetation and infrastructure location in the landscape.

6.1.15 *Waste Management*

The main sources of waste, by volume, are Associated Water and wastewater. Wastewater from accommodation camps and other amenities will be treated on site in a sewage treatment plant. Treated wastewater will be used for irrigation and residual waste sludge disposed of at a licensed facility. A comprehensive waste management plan, including waste minimisation, reuse and recycling, will be implemented for all other waste sources.

6.1.16 *Hazard and Risk*

A quantitative risk assessment was undertaken for the unplanned release of gas from Gas Field Component infrastructure. A number of scenarios were considered, relating to the type of equipment and the size of the hole from which gas was released and were assessed as having negligible risk of fatality. Moderate injury risk criteria are highly unlikely to be exceeded at distances greater than 16m from the release point used in the model. Comprehensive emergency management plans, including establishment and maintenance of adequate safety zones for each infrastructure type, will ensure that the risk to human health is as low as reasonably practical.

Other potential hazards were identified and assessed using a qualitative risk assessment process. For hazards assessed qualitatively, those with the greatest residual risk are related to transport incidents. Further control measures are proposed to minimise transport risks.

6.1.17 *Cumulative Impact*

Projects that have commenced or completed an EIS process but have not yet commenced operation were screened for relevance for the cumulative impact assessment. Those projects that overlap, are adjacent to the Gas Field Component, or are geographically separated but have potentially significant impacts on the same environmental values, were included in the cumulative impact assessment.

The environmental values with the greatest potential for cumulative impacts are terrestrial ecology, groundwater resources, air, noise and road transport. These are variously assessed as being negligible to potentially major. Management strategies to mitigate significant impacts have been developed and form an integral part of the project planning. These are detailed in the relevant sections of the EIS.

6.2 *PIPELINE COMPONENT*

6.2.1 *Climate and Climate Change*

QGC will design and construct Pipeline Component infrastructure to cope with the existing climate and potential climate change. Pipelines will be buried to a sufficient depth to prevent exposure from storm or flood events. Also, QGC will monitor short-term and long-term weather predictions to ensure contingency measures can be put into place in a timely manner and that an Emergency Response Plan prepared for the Pipeline Component addresses flood, fire and cyclones.

Climate change within the life of the QCLNG Project is not anticipated to significantly affect construction, operation and decommissioning of the Pipeline Component.

6.2.2 *Land Use and Infrastructure*

The Pipeline Component occurs within predominantly freehold rural lands. Grazing is the primary land use in these areas. Approximately 252 km of the combined pipeline routes (equating to approximately 1,260 ha) is considered GQAL.

The Project should have no long-term impact on these land uses. Pipelines will be buried with an appropriate level of cover as set by the key pipeline standard; Australian Standard (AS) 2885 *Pipelines – Gas and Liquid*

Petroleum. The minimum level of cover will be 900 mm but in cropping land this can be increased. Above-ground structures, primarily marker posts, will be limited.

Pipeline construction through areas of state forest (mostly within existing cleared areas) will be subject to further negotiation with DERM. Installation of the pipeline in the GSDA is compatible with the intended use of the GSDA.

6.2.3 *Geology and Soils*

Erosion is the most significant potential soil issue for the Pipeline Component, with management of topsoil required to ensure successful rehabilitation of pipeline routes following construction. Some areas of saline subsoil have been identified, the exposure of which can lead to further erosion and impact on the success of rehabilitation measures.

Acid sulfate soils have been identified at the Gladstone and Curtis Island sections of the Export Pipeline. QGC will mitigate this potential impact through geotechnical studies and, if required, the implementation of an acid sulfate soil management plan.

Specific mitigation measures have been proposed with the primary objective of:

- preserving topsoil quantity and quality
- limiting the area of disturbance
- controlling overland water flows around disturbed areas
- minimising the potential for erosion and sedimentation, particularly associated with sodic subsoil
- maintaining the cropping productivity of the area.

Post the implementation of mitigation measures, the Pipeline Component is anticipated to have a minor impact on soils and geology in the short term and a negligible impact in the long term.

6.2.4 *Topography and Geomorphology*

Proposed pipeline routes generally pass through level or gently sloping country. QGC selected the routes to avoid or minimise impacts associated with land and terrain constraints. Measures such as erosion control, slope management and revegetation will be identified during the construction phase to ensure that impacts are temporary and limited to the immediate construction area.

6.2.5 *Terrestrial Ecology*

Proposed pipeline routes have been selected to traverse mainly cleared areas. Corridors transect small areas of communities and species habitat listed under the *EPBC Act* and the *VMA*.

Pipeline routes do not directly impact any Category A environmentally sensitive areas (as defined in the *Environmental Protection Act 1994*). However, the preferred pipeline route across The Narrows will be within 1 km of the GBRCMP.

The proposed mitigation and rehabilitation measures will result in a moderate impact on terrestrial ecology in the short-term due to the loss of mature vegetation during pipeline construction. However, the long-term impact is anticipated to be minor due to the potential for re-growth and the use of biodiversity offsets to compensate for the loss of native vegetation.

6.2.6 *Land Contamination*

QGC has proposed management strategies, such as consulting with landholders to ensure the pipeline routes do not intercept any past cattle dips or waste disposal sites, to minimise the potential for contamination.

Project activities have minimal potential to cause land contamination, through release of chemicals, waste, fuel and effluent.

6.2.7 *Surface Water Resources*

The Pipeline Component will traverse the river catchments of the Condamine–Balonne, Dawson–Fitzroy, and the Burnett–Calliope. Numerous watercourses will be intersected.

Construction activities, which will include open cutting of the watercourses, can potentially increase or create soil erosion and scouring, temporarily interrupt drainage patterns and create turbidity through the mobilisation of sediments. For this reason, watercourse crossings have been selected to minimise impacts on riparian vegetation and to ensure that, as far as practicable, crossings points are located at stable bank locations.

With the implementation of proposed mitigation measures, long-term adverse impacts on any watercourses are not expected and the overall impact of the construction and operation of the Pipeline Component has been assessed as minor.

6.2.8 *Groundwater Resources*

Desktop studies have identified 196 DERM-registered shallow bores within the Pipeline Component study area.

Excavation and burial of pipelines is expected to occur above the top of any aquifer. Therefore, existing groundwater resources will not be affected. The key areas for potential interaction between the Pipeline Component and groundwater are shallow aquifers which would mainly occur in alluviums associated with watercourses.

As there is a low probability of intercepting groundwater during pipeline construction due to the shallow depth of trenches, QGC does not anticipate any adverse impacts to groundwater. The overall impact on groundwater has been assessed as negligible.

6.2.9 Aquatic Ecology

With the implementation of mitigation measures the Pipeline Component will not have a significant impact on aquatic ecology values in, or downstream of, the proposed activities.

6.2.10 Air

Dust, during construction and emissions from an in-line compressor during operation, represents the main source of air emissions from the Pipeline Component.

Dust generated by construction activities will be managed through measures including speed limits on unsealed areas and the use of water to damp down travel routes in windy conditions. It is anticipated that neither construction of pipelines nor the later operation of an in-line compressor on the Export Pipeline will create any adverse air quality conditions. The overall impact on air has been assessed as negligible.

6.2.11 Noise and Vibration

Construction machinery used in earth-moving activities represents the primary source of noise associated with the Pipeline Component. Given the rural location of the pipeline routes, which have been specifically selected to avoid residences, noise is not expected to create any long-term impacts.

QGC has conducted generic noise modelling, identifying buffer distances between the construction RoW and any noise sensitive receptor (e.g. residence). The modelling has shown that noise impacts should not create nuisance at distances greater than 1.5 km from the pipelines.

Night-time construction is not anticipated. However, some activities once commenced must continue to completion, such as the transportation of pipe to avoid interference with daytime road users.

Pipeline construction activity is relatively intensive at any one point along a route. These characteristics mean that impacts are short term. The construction contractor will liaise with the affected community to advise the

likely duration of noisy activities and, in certain circumstances, undertake particularly noisy activities (e.g. rock hammering) at periods less likely to cause nuisance to nearby residents.

The overall impact of noise on sensitive receptors has been assessed as minor in the short term and negligible in the long term.

6.2.12 Transport

Transport logistics have not been completed at this early stage of the Project. Transportation of the pipe from the port of entry to the pipeline RoW will require road transport either directly from the port or from a rail line. The preliminary transport impact assessment is a conservative assessment as it has assumed that all transport will be by road (the worst-case scenario).

Depending on transport strategies to be implemented and the final transport corridors selected, the preliminary assessment suggests a moderate impact on the road network. However, once transport options are better defined during the detailed design phase and roads identified in consultation with relevant government departments and agencies, it is expected that the impact on roads from transport related to the Pipeline Component will be minor to negligible.

6.2.13 Visual Amenity

Pipeline Component infrastructure is generally of low height and scattered widely across a vegetated landscape.

Pipelines will be buried with only limited infrastructure installed above ground. The primary visual impact will be construction activity. However, the RoW will revert to existing land use post-construction, thereby minimising any potential for long-term visual impacts.

QGC will keep construction areas to the minimum required and the pipeline routes have been located away from residential areas as far as practical.

The Pipeline Component's overall impact on visual amenity has been assessed as minor in the short term and negligible in the medium-to-long term.

6.2.14 Waste

Pipeline construction and operation will generate only small volumes of waste and in the case of construction this is for a limited time. Therefore, the overall impact of waste from the Pipeline Component on the environment has been assessed as minor.

6.2.15 Hazard and Risk

A quantitative risk assessment was undertaken for the unplanned release of gas from the Collection Header and Export Pipelines and associated infrastructure.

Establishment and maintenance of adequate safety zones for all Pipeline Component infrastructure will ensure that the risk to human health is as low as reasonably practical. Overall, the level of impact is considered negligible.

6.2.16 Cumulative Impact

The cumulative contribution of other projects in the region was assessed at a high level based on best-available information. The main cumulative impacts associated with the Pipeline Component of the Project relate to roads and transport corridors used for the Project construction and other proposed projects in the area. Appropriate management strategies are being developed to reduce this impact including negotiating scheduling times for the transportation of goods and services within this Project and with other projects. The minor-to-moderate impacts identified in this risk analysis are both short-term and temporary.

6.3 LNG AND SHIPPING COMPONENTS

6.3.1 Climate and Climate Change

The Gladstone region has a sub-tropical climate, averaging a mean annual rainfall of approximately 750 mm. Heaviest rainfall typically occurs during the northern tropical monsoon season (December to February).

QGC considered climate and potential climate change in assessing potential impacts on the LNG Plant capacity and operation. This included potential change in precipitation and temperature over the Project life which is not expected to significantly impact site operations. Plant structural elements will be designed and constructed to account for cyclonic regional wind speeds applicable to Gladstone. Mitigation measures include designing marine facilities with allowance for potential storm surge, sea level rise and potential wave action.

6.3.2 Topography and Geomorphology

The LNG Facility is located along the south-west coast of Curtis Island north of China Bay, in an area characterised by undulating terrain. The elevation across the site increases from the coastal boundary of the LNG Facility, rising to an elevation of more than 80 m within the site near the eastern boundary.

Development of the site requires bulk earthworks which will alter the existing

topography across the LNG plant footprint to facilitate construction.

No evidence of seismic activity or landslides has been observed within the LNG Facility boundary or immediate surrounds. An initial assessment found the risk of landslide at the LNG Facility site and in the area of associated pipeline and infrastructure was acceptable.

The assessment of topography indicates that there are no significant issues with the potential to impact construction and operation of the LNG Facility.

6.3.3 Geology and Soils

The main geological unit underlying the LNG Facility is the Wandilla formation, which consists mainly of mudstones and arenite, with subordinate chert and minor limestone.

The potential for soil erosion at the LNG Facility site, as it currently exists, is considered low due to the shallow depth of the soil profiles, the presence of extensive colluvium cover, vegetation coverage and the relatively gentle topography of the site. Erosion and sediment control measures will be implemented during construction.

Acid sulfate soils were identified in areas on Curtis Island and Friend Point on intertidal to supratidal sediments. An acid sulfate soil management plan will be implemented during construction.

An assessment of land suitability determined the LNG Facility site has a suitability of Class C3 – Pasture land (land suitable for light grazing of native pastures in inaccessible areas). As Class C3 is not considered GQAL, the use of the land as an LNG Facility will not result in the loss of GQAL.

6.3.4 Land Use and Infrastructure

The establishment of an LNG Facility on Curtis Island represents a change in historical and existing land use on Curtis Island. However, the construction and operation of the LNG Facility is consistent with the strategic planning direction in the Gladstone region. The expansion of the GSDA to include the Curtis Island Industry Precinct sets a clear framework for future industrial land use and investment on Curtis Island, and the proposed LNG Facility is one of several LNG projects proposed to locate within the precinct. The GSDA's Environmental Management Precinct will provide a significant buffer between the new industrial precinct and the remainder of Curtis Island.

Existing infrastructure in Gladstone has sufficient capacity to accommodate the anticipated direct and indirect impacts of Facility construction and operations. The operational LNG Facility will be self sufficient for power, water and waste water disposal and will not have a direct impact on infrastructure in mainland Gladstone.

6.3.5 *Land Contamination*

Results of site investigations indicated that the only prior potentially contaminating activity at the LNG Facility site was a former cattle dip. Soil sampling was undertaken and analytical results reported concentrations below relevant commercial and/or industrial criteria.

Management measures will be implemented to prevent contamination arising from Project activities.

6.3.6 *Terrestrial Ecology*

Biodiversity at the LNG Facility site is typical of coastal Queensland environments. Due to ongoing disturbance (the presence of feral species and historic land-use), habitat condition is considered to be degraded and contains few native species of conservation significance.

Construction and operation activities at the LNG Facility site will result in the clearing of approximately 40 ha of Endangered RE (Blue Gum open woodland on alluvial plains), which equates to approximately 5 per cent of that which occurs within a 10 km buffer of the study area. Approximately 15 ha of Of Concern RE would also be cleared, representing less than 2 per cent of the total area each of these RE types occurring within a 10 km buffer of the study area. Offsets of Endangered and Of Concern RE are proposed as a mitigation measure.

Two fauna species of regional significance (Yellow-bellied Glider and Beach-stone Curlew); four bird species of state significance (Squatter Pigeon, Beach Stone-curlew, Eastern Curlew and Powerful Owl) and four migratory bird species of national significance (Bar-tailed Godwit, Eastern Curlew, Whimbrel and Common Greenshank) were recorded within the vicinity of the LNG Facility.

No terrestrial plants, amphibians, reptiles or mammals of state or national conservation significance are expected to occur within the LNG Facility site.

The Powerful Owl is known to inhabit the LNG Facility site and the cumulative impact of this and other adjoining proposals will remove a substantial area of potential foraging habitat and potential nest and roost sites for the species. Several breeding pairs of Beach Stone-curlews use habitat within and immediately adjacent to the LNG Facility site. Small numbers of Squatter Pigeons were recorded along the proposed mainland access road, although no potential Squatter Pigeon habitat was recorded within the LNG Facility site on Curtis Island.

Management measures have been designed to provide strategies for minimising the direct and indirect impact of the Project on the ecology of the area, and to limit adverse impacts on significant species. Implementation of management and mitigation measures including offsets, and ongoing environmental management, will result in the direct, indirect and cumulative impacts being localised.

6.3.7 *Marine Ecology*

The Port of Gladstone is located in proximity to the southern end of the GBRMP, within the Great Barrier Reef World Heritage Area (GBRWHA), but is situated outside State and Commonwealth marine parks.

There are no Ramsar wetlands in the vicinity of the proposed LNG Facility.

Three nationally listed wetlands occur in the Port of Gladstone area: The Narrows; the Port of Gladstone and the Colosseum Inlet-Rodds Bay area (approximately 30 km south-east). The Narrows is a declared habitat protection zone of the GBRCMP. These wetlands support a diverse range of flora and fauna and are the preferred feeding ground of several listed migratory birds protected under CAMBA, JAMBA, ROKAMBA and the Convention on Migratory Species (Bonn Agreement).

Extensive mangroves extend along the Curtis Island coastline from Graham Creek to Hamilton Point to the south beyond the Project area. Mangroves have the potential to be impacted during the construction and operation phases, attributed to vegetation clearing for the marine infrastructure.

The Narrows, south of Graham Creek and east to Facing Island, encompassing the majority of Southern Curtis Island waters, comprise the Rodds Bay Dugong Protection Area.

Seagrass meadows in the Project area are important feeding grounds for dugongs (*Dugong dugon*), a species listed as vulnerable under Queensland legislation and "marine and migratory" under Commonwealth legislation. Potential impacts to seagrass will primarily occur during the construction phase due to seabed disturbance. The seabed disturbances has the potential to not only directly alter the seagrass density, but suspended sediment may smother the seagrass or reduce light availability in the water column.

There are no known turtle-nesting beaches close (within 5 km) to the proposed LNG Marine Facilities. Green turtles have been regularly observed within the seagrass meadows particularly on Pelican Banks (eastern side of Curtis Island).

Direct impacts with potential to occur during the construction phase arise largely from dredging and reclamation to prepare and install infrastructure and dispose of dredge material. Dredging impacts are discussed separately.

The increased presence of vessels and frequency of vessel movements during both construction and operations phases pose a risk to marine fauna, and may have some local direct impact on water quality from standard vessel discharges, the deployment and retrieval of anchors and chains and the use of propellers and thrusters. However, the Project is within the limits of the Port of Gladstone and all vessel movements and activities will be undertaken in accordance with the requirements and procedures of the Port of Gladstone.

Similarly, given that the Port of Gladstone has been an operational port for

many years, the existing marine receptors that use the port's waters for feeding, breeding and transiting are already doing so amid the disturbed conditions typical of a large port.

The Project will have direct impact on intertidal areas and will result in the removal of marine plants with local and regional value. Mitigation measures will be developed in consultation with DERM and the Department of Employment, Economic Development and Innovation to maintain the overall ecological values of the Port of Gladstone and intertidal area.

6.3.8 Surface Water Resources

Existing drainage lines across LNG Facility site exhibit variable degrees of erosion, with the upper reaches showing higher erosion than the lower reaches. Construction and operational activities will alter the existing surface water flows, and have the potential to impact on fresh and marine water quality. During construction, potential contaminants that could be mobilised include sediments and acid sulfate soils, both of which can have direct impact on the receiving environment. Draft management and mitigation measures addressing these issues have been developed.

6.3.9 Groundwater Resources

QGC does not propose to extract groundwater during either the construction or operational phases of the LNG Facility. The cumulative impact of construction and operational activities on groundwater resources is expected to be minor.

6.3.10 Coastal Environment

The Curtis Coast Regional Coastal Management Plan (CCRCMP) identifies Areas of State Significance that could be affected by the Project, including coastal wetlands, intertidal mangrove, saltmarsh areas along the coastline of Curtis Island and at Laird and Friend Points, as well as Endangered RE. Aspects of the LNG Component also fall within various key coastal sites defined within the CCRCMP. The LNG Component of the Project is compatible with the management intent of the CCRCMP and is unlikely to negatively impact on the current and future functioning of the area.

The LNG Facility largely avoids areas of high conservation significance (e.g. Areas of State Significance, natural resources), with the exception of some areas of coastal vegetation and marine plants.

There will be an increase in shipping movements in and out of the Port of Gladstone once the LNG Facility is operational. Once all three LNG process trains are operational, approximately 180 LNG vessels and possibly approximately 12 LPG vessels per year will be loaded or unloaded at the LNG Facility. This will represent an increase of 12.5 per cent on 2008 cargo vessel

visits to the Port of Gladstone, and an approximate 15 per cent increase in Port of Gladstone total cargo throughput.

The location of the proposed LNG Facility on Curtis Island will minimise direct impacts on neighbouring urban communities, and other recreational uses of the foreshore that exist elsewhere in the Project area.

Key findings from a water quality assessment suggest impacts to hydrodynamics and marine water quality from the Project will be short term (related to construction stages), with major local impacts from the dredging works. These increases are within the bounds of natural variability of the system and are not expected to have any significant direct impacts on marine water quality.

6.3.11 Air

An air quality assessment of the LNG Facility operations indicated the following:

- The predicted maximum 1-hour and annual average ground-level concentrations of NO_2 at any sensitive receptors for the LNG Plant during normal operating conditions are below the Environmental Protection Policy (Air) air quality objectives.
- The maximum concentrations of carbon monoxide are below air quality objectives across the modelling domain under normal operation conditions including background.
- The predicted maximum 24-hour average ground-level concentration of PM_{10} at any location within the modelling domain due to the Project, under normal operating conditions, in isolation is 1.8 µg/m^3. With the inclusion of the background the maximum is 30.8 µg/m^3, which is 61.6 per cent of the EPP (Air) air quality objective of 50 µg/m^3.
- None of the hydrocarbon species associated with emissions from the LNG Facility exceed the ambient air quality objectives at the most sensitive receptor.
- The contribution of the Project to photochemical activity in the Gladstone region is, at worst, minor and unlikely to be of any concern.
- Predicted maximum 1-hour average concentration of odorous compounds, from the LNG Facility in isolation, at the most affected sensitive receptor is well below both the odour threshold and the ambient air quality objective.
- Similarly, EPP (Air) air quality objectives will not be exceeded at any sensitive receptor as a result of Project activities under non-normal operations. Non-normal operations include: plant operations with an LNG ship at berth; plant operations with dry gas flare upset conditions; and plant operations with marine flare upset conditions.

6.3.12 *Noise and Vibration*

The site selected for the LNG Facility is approximately five kilometres from the nearest sensitive receptor (defined as residences for the purposes of the noise assessment). The natural terrain (a ridge running north to south) provides shielding to the eastern side of Curtis Island.

Construction of the proposed LNG Facility should be inaudible at residential receptors under most meteorological conditions during the day and under all conditions during night time works. Predicted worst-case noise levels from construction barges and ferries indicate noise levels will be inaudible at all noise assessment locations other than Tide Island, the closest receptor to the proposed LNG Facility. However, the levels will be below existing average L_{10} noise levels and will be transient.

Road traffic generated during construction will include vehicles travelling to a laydown area at Auckland Point, located among existing rail and industrial areas. The main access road is the Port Access Road which is designed as a heavy vehicle route. Impacts from road transport will be negligible.

Predicted operational noise levels at sensitive receptors are below the relevant DERM criteria under neutral and typical weather conditions.

Under adverse conditions (temperature inversion and calm winds), predicted operational noise levels are below the relevant criteria for all sensitive receptor locations except Tide Island, the closest sensitive receptor to the LNG Facility. The exceedence of 5 dB(A) under adverse conditions is expected to occur only occasionally as temperature inversions infrequently form over water and winds are calm for only 14 per cent of the time. As this is less than the 30 per cent referred to in the DERM EcoAccess Guideline Planning for Noise Control, this exceedence is not expected to be significant.

In future, noise from the proposed LNG Facility may well be masked on Tide Island by noise from other industry, including the proposed Wiggins Island coal terminal.

Predicted worst case noise levels (based on noise levels for ships under full power) for LNG vessels indicate noise will not impact on sensitive receptors other than Tide Island. However, the impact will be transient and hence shipping traffic is not expected to have a significant direct noise impact on the residence at Tide Island.

6.3.13 *Road, Rail, Air and Public Transport*

A detailed Road Impact Assessment (RIA) showed the LNG Facility will not impose a significant direct impact on the state or local controlled road or rail networks, or to transport infrastructure, facilities or services. All transport related impacts associated with the LNG Facility are considered manageable, subject to outlined mitigation measures.

6.3.14 *Shipping Transport*

The number of ship movements will be highest during the construction phase of the Project, including daily movement of personnel from Gladstone to Curtis Island. However, this is a necessarily limited period of time and much of the activity (for personnel transport) will be undertaken by low draught, high speed and manoeuvrable vessels, which will be able to operate without major impact on other harbour users.

Once all three LNG process trains are operational, approximately 180 LNG vessels and up to 12 LPG vessels per year (subject to vessel size and commercial export requirements) will be loaded or unloaded at the LNG Facility. This will represent an increase of 12.5 per cent on 2008 cargo vessel visits to the Port of Gladstone, and an approximate 15 per cent increase in Port of Gladstone total cargo throughput. These vessels are of a similar size to the Capesize coal ships which currently frequent Gladstone harbour. The proposed LNG and LPG shipping represents appropriate operations for the current and future configuration of the Port of Gladstone as a strategic industrial port.

LNG vessels will use the outer route along the Great Barrier Reef, with access to Gladstone via the existing Capricorn and Curtis shipping channels.

6.3.15 *Visual Amenity*

The LNG Facility is not expected to have a significant direct impact on views from local residences.

The LNG Facility is expected to impact on landscape values of major significance on Curtis Island. However, the impact on the GBRWHA is already attenuated in this location by the presence of the Port of Gladstone in the viewshed. Further, the designation of the Curtis Island Industry Precinct as an extension to the GSDA reflects the intent of the Queensland Government to develop the area as an industrial precinct. Given this, the landscape and visual impact of the proposed LNG Facility is consistent with the designated land use and general expansion of industry around the Port of Gladstone.

6.3.16 *Waste Management*

Waste minimisation, reuse and recycling policies and procedures will be implemented during construction and operation to minimise the direct impact of the Project. Construction and operations wastes will be transported and disposed of by an appropriately licensed contractor.

6.3.17 *Hazard and Risk*

Hazard Identification and Environmental Hazards Identification studies were

conducted to identify hazards within the proposed LNG Facility site that could pose a risk to the public, operating personnel, the environment or property. The overall intent of this approach is to ensure that hazards are eliminated, minimised or controlled.

A quantitative risk assessment (QRA) was undertaken to determine risk contours for operation of the LNG Facility. Examination of risk contours indicated that the criterion for industrial land use is contained within the Project site onshore boundaries. The QRA indicated some extension of these risk contours into marine areas immediately surrounding the LNG jetty.

The QRA outcomes indicate negligible risk to other facilities and the public from LNG Facility operations.

A shipping transit risk analysis and assessment concluded that routes to be used both within the port and during GBRMP transit were extremely safe. Navigational features, support systems, rules, guidelines, control measures and redundancy all contribute towards a low risk of an incident during LNG transit. The risk assessment estimated the frequency of release of LNG cargo due to collision or grounding to be up to 5.40×10^{-6} (5.4 in a million) per ship year for single hull vessels and less than 1.62×10^{-7} (1.62 in 10 million) per ship year for double hull vessels. It is noted that the frequencies for release of cargo from double hull LNG carriers are at least one order of magnitude lower, showing the benefit of double hull construction.

A bushfire hazard assessment was undertaken and buffer zones will be implemented around key infrastructure.

6.3.18 Cumulative Impact

Projects that have commenced or completed an EIS process within the Gladstone region, but have not yet commenced operation, were screened for relevance for the cumulative impact assessment.

The environmental values most likely to be significantly impacted by the cumulative effect of the LNG Facility, together with other projects considered within the scope of the cumulative impact assessment, are terrestrial and marine ecology, noise, road transport (during construction) and visual amenity.

These are variously assessed as being minor to potentially major, depending upon which potential Project proceed, the scheduling of construction, and the management and mitigation measures put in place by the various proponents. QCG has developed management strategies applicable to the QCLNG Project to mitigate significant impacts, and these form an integral part of the project planning. These are detailed in the relevant sections of the EIS.

6.4 SWING BASIN AND CHANNEL CONSTRUCTION

6.4.1 Climate and Climate Change

Climate change mitigation measures including allowances for potential storm surge, a rise in sea level and increased wave action have been incorporated into the design of the Swing Basin and Channel.

6.4.2 Topography and Geomorphology

Creation of the Swing Basin and Channel will change the seabed topography within Gladstone Harbour. However, as much of the harbour is a working port, the seabed topography has already been modified extensively by previous dredging to create a network of shipping channels, swing basins and berths.

The coastal geomorphology of the shoreline in the area north of Fisherman's Landing will be modified considerably by the potential reclamation of additional areas using dredge spoil.

6.4.3 Land Use and Infrastructure

The dredging of a new channel to service the LNG Facility will add to the existing channel infrastructure of the Port of Gladstone.

The reclamation of additional areas north of Fisherman's Landing will potentially provide land for future development. However, other reclaimed areas in the port have often been developed to include open space and recreational areas.

6.4.4 Land Contamination

Reclamation of new areas using dredge material which has been contaminated can cause future land contamination issues. However, extensive testing of the material to be excavated for the Swing Basin and Channel has indicated that the material is clean and uncontaminated, and therefore contaminated land will not be created by reclamation using this material.

6.4.5 Terrestrial Ecology

Reclamation of additional areas north of Fisherman's Landing may involve the removal of some areas of coastal vegetation. As disposal of dredge material taken for the development of the Swing Basin and Channel is likely to be within either the FL 153 development or WBSDD development the assessment of impacts on terrestrial ecology is more appropriately discussed in the EISs for those projects.

6.4.6 Marine Ecology

The most significant impacts from development of the QCLNG Project Swing Basin and Channel will potentially be on aspects of marine ecology.

6.4.7 Coastal Environment

The creation of the Swing Basin and Channel will result in additional shipping traffic in the Port of Gladstone and in the area adjacent Curtis Island. This additional traffic potentially increases risks to the coastal environment. However, risk assessment undertaken for shipping activities has indicated no significant increases in the risks from oil spills or release of hazardous materials in the port or adjacent areas of the GBRMP. The dredging activities involving large dredges and support vessels will also increase overall traffic in the harbour. However, as the Port of Gladstone is a high-volume shipping traffic area and the dredging activities will be only for a relatively short time, the potential impacts have been assessed as minor.

6.4.8 Noise and Vibration

The most significant potential noise and vibration impacts from the development of the Swing Basin and Channel will occur from the reclamation works associated with management and placement of the dredge material. These reclamation works will involve heavy earthmoving equipment, pumps and some vessels which will generate localised noise profiles. However, as the reclamation areas most likely to be used for placement of the dredge material excavated are FL 153 and the proposed Western Basin Reclaim, which are located in industrial areas and well away from residential receptors, the impact has been assessed as negligible.

6.4.9 Visual Amenity

The presence of large dredges and the potential development of reclaim areas will have localised effects on visual amenity. However, the presence of dredges in a working harbour for a relatively short duration will not change the visual amenity of the harbour.

The development of new reclaim areas north of Fisherman's Landing will change the visual landscape of the area. While landscaping and revegetation will soften the potential impacts on visual amenity, the future development of this land may ultimately significantly change the local landscape. However, the newly created and adjacent areas are within land zoned for industrial development.

6.4.10 Hazard and Risk

The development of the Swing Basin and Channel may pose a hazard to

marine species and the ecology of Gladstone Harbour. However, a detailed Dredge Management Plan designed to minimise harm to the marine ecology, in particular sensitive species, will be developed for the dredging activities. This plan will require approval from Queensland and Commonwealth environmental regulators prior to any dredging activities commencing.

6.4.11 Cumulative Impact

The potential cumulative impact of dredging and dredge material placement from the contemporaneous development of WICT Project, GLNG Project and Stage 1b of the WBSDD Project with the QCLNG Project has been assessed. Impacts from dredging activities may be minimised by implementation of individual Dredge Management Plans and, if required, a more comprehensive and integrated management plan for multiple dredging activities.

7 GREENHOUSE GAS MANAGEMENT

Greenhouse gas emissions were considered for the Gas Field, Pipeline and LNG Components of the Project, considering sources within the Project boundary and as a result of Project activities covering the construction, commissioning and operations phases of the Project.

Table ES5 details the emissions estimation per annum from each of the Project phases and for each of the Project components. This table shows that for all Project components, the operational phase generates the largest emissions. Data presented in this table is representative of the current design of the Project.

Table ES5 Summary of Maximum Annual Greenhouse Gas Emissions Associated with the Project

Project component	Construction[1] (tCO_2-e/annum)	Commissioning[2] (tCO_2-e/annum)	Operation[3] (tCO_2-e/annum)
Gas Field[4]	38,979	-	1,600,604
Pipeline	16,439	-	39,479
LNG Facility	10,303	112,348	2,856,914

1. Construction emissions from each Project component are anticipated to occur concurrently. Construction of the LNG Facility is anticipated to commence in 2010 with construction of the first two trains lasting approximately 45 months. Construction of Gas Field and Pipeline Components will commence in 2011 lasting approximately 18 months (excluding well development which continues throughout the life of the Project). Data presented in this table are indicative of emissions over a 12-month period, not annual average emissions.
2. Commissioning of each train is anticipated to last seven months; as such annual emissions presented in the table will occur only over a seven-month period.
3. Operational emissions for Project components occur concurrently. Data presented in this table are representative of a three-LNG-train operation. All three trains are expected to operate from 2021 onwards.
4. For a two-train Gas Field Component only

Estimated emissions from all components of the Project during peak operation of the three LNG trains is approximately 4.5 million tonnes CO_2-e per annum (on the basis of a two-train upstream development). The major emissions sources are the LNG Facility, Field Compression Stations and Central Processing Plants in the Gas Field Component of the Project.

The Project design will employ advanced and efficient technology, including aero-derivative gas turbines in the LNG Facility. Technology options selected lead to a 27 per cent reduction in greenhouse gas emissions intensity from concept to current design. The LNG Component will be one of the most greenhouse gas emissions efficient LNG projects in the world.

8 SOCIAL, CULTURAL AND ECONOMIC IMPACT ASSESSMENT

8.1 SOCIAL

QGC and its parent company BG Group aim to contribute to the socio-economic aspects of sustainable development in regional communities in the Project area. QGC's commitment to social sustainability is expressed in these fundamental principles:

- establishing and maintaining effective relationships with stakeholders
- avoiding or mitigating negative impacts on social values
- enhancing Project benefits and community development throughout the Project area.

The Project will provide significant benefits to communities within the Project area and to Queensland. The following positive changes are expected:

- increased employment security in areas where resource sector employment is being lost
- decreased unemployment, including for indigenous people and young people, throughout the Project area
- increased workforce capacity and skill levels in specialised construction and operational occupations
- population growth and stability in the project area
- enhanced community cohesion due to population stability and investments in social infrastructure.

The Project's proposed mitigations are designed to avoid or minimise:

- further alienation of indigenous people from economic and social participation
- reduced community cohesion due to fragmentation of land use and drawing labour from local businesses
- reduced housing affordability in the Gladstone and Dalby regions
- incremental increased demand for social infrastructure
- constraints on the activity levels and cohesion of recreational boating communities in Gladstone
- impacts of increased traffic on amenity and safety
- social division regarding the treatment and use of coal seam water.

Indirect and cumulative impacts could also occur without mitigation, and include:

- demand on social, health and housing systems due to population growth from indirect employment creation

- recreational boating, commercial and recreational fishers' environmental concerns as a result of dredging to accommodate LNG projects
- fragmentation of rural land due to cumulative pipeline and coal seam gas (CSG) infrastructure placement
- reduced housing availability due to cumulative impacts of Project developments in Dalby and Gladstone regions.

Social Environment Management Plans (SEMPs) are being developed by the Project for the construction and operational periods, to provide a framework for the mitigation of impacts on social conditions throughout the Project area. Management Plans are being developed to minimise impacts and maximise benefits for:

- social values
- social infrastructure
- housing and accommodation
- community health and safety
- employment and training
- business, recreation and tourism
- cultural heritage
- land use and water re-use.

The SEMP will form an annex to QGC's Social Performance Plan, which provides the framework for the Project's relationships with communities. The Social Performance Plan includes planning with Indigenous Peoples, community engagement strategies and social investment strategies which will link to and encompass strategies outlined in the SEMP.

8.2 INDIGENOUS CULTURAL HERITAGE

The Port Curtis, Central Queensland and Darling Downs regions contain a wealth of Indigenous cultural heritage, and a number of places of significant heritage have been identified and recorded throughout the region.

Aboriginal cultural heritage areas or objects are a record of the past occupation of the landscape by Aboriginal people.

The principal legislation in Queensland with regard to Aboriginal cultural heritage is the *Aboriginal Cultural Heritage Act 2003* (Qld) (*ACHA)* which states that a person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage (the 'cultural heritage duty of care').

Material culture findings in the Project area were predominantly artefact scatters or isolated artefacts, however other findings included scar trees, campsites, and ochre and stone quarries. Typically the findings are adjacent

to watercourses, reflecting the importance of water and the associated faunal and floral resources. Places of cultural significance to Aboriginal peoples were also identified, but are not included in the EIS to protect cultural knowledge.

A detailed process has been developed and is being implemented to ensure that indigenous cultural heritage is identified and managed in accordance with legal requirements and in a respectful manner to Aboriginal communities and traditions.

Cultural Heritage Management Plans (CHMPs) are being developed with each of the Traditional Owner groups. Key steps in the cultural heritage process adopted by the Project, in accordance with the *ACHA*, include: identification of parties for potential inclusion in negotiation; endorsement of Aboriginal parties; execution and approval of CHMP agreements; and implementation.

For ground-breaking or other potentially intrusive activities undertaken prior to the agreement and implementation of CHMPs, Traditional Owners are consulted and appropriate management and mitigation measures are agreed and implemented with the involvement of Traditional Owner representatives.

Potential impacts on cultural heritage as a result of the pipelines, gas compression infrastructure, LNG Facility, water treatment and other Project works could include damage to shallow artefacts, subsurface material and significant vegetation (e.g. scar trees) as a result of clear and grade and trenching activities and general site preparation works.

Impacts could also include disturbance to story places and other non-physical cultural heritage. CHMPs are in the process of agreement, for all sections of the Pipeline route, Gas Field and LNG Facility site. These plans are of a similar overall nature and will be implemented immediately prior to construction.

Cultural heritage management requires negotiated strategies that are deemed appropriate by the Traditional Owners and which are technically feasible.

Appropriate construction management protocols will be developed, in consultation with affected Traditional Owner and/or native title claimant groups, during the detailed design phase.

QGC will conduct a comprehensive environmental and cultural heritage induction program. The program will include an introduction to heritage values along the route and management plans to be implemented. These activities are already embedded in the operation of the Gas Field.

8.3 NON-INDIGENOUS CULTURAL HERITAGE

Non-indigenous or historical cultural heritage includes significant buildings, places and artefacts of European origin. According to the *Queensland Heritage Act 1992*, the cultural heritage significance of a place or feature of a

place means it has '*aesthetic, architectural, historical, scientific, social, or other significance, to the present generation or past of future generations*'.

This study has identified a number of places within the Project area. Potential exists for impacts on heritage places, such as disruption, damage caused by vibrations of heavy machinery close to heritage places, and looting and vandalism to sites as a result of increased traffic in the area.

As the site for the LNG Facility contains a number of movable heritage items (e.g. pieces of machinery and metal artefacts), there is the opportunity for a salvage exercise to be undertaken, potentially in co-operation with a local historical society who may be interested in displaying or storing the artefacts. If there is no interested party, significant items should be gathered, catalogued and stored in a suitable keeping place.

Within the Gas Field, there are a number of known and potential heritage sites that have potential to be impacted upon in the future. The precise location of some future development in the Gas Field is unknown. Locations of potential heritage places are taken into consideration when planning Project facilities, pipelines, gas production and associated development such as access tracks. Field surveys and walkovers will be undertaken prior to construction of facilities and pipelines to ensure the Project mitigates impacts on cultural heritage.

Once the Gas Field, Pipeline and Facility have been established, it is unlikely that there will be any further impacts on identified heritage features.

8.4 ECONOMIC

Growth in both the Darling Downs and Fitzroy regions has been solid in recent years through an exposure to the resources sector. The study area includes extensive agricultural and pastoral land.

Agriculture was the largest industry in the Darling Downs by value, and the Fitzroy region also accounts for a significant proportion of the state's agricultural production. These regions produce a diverse range of agricultural products but the most valuable are livestock (particularly meat and cattle) and crops such as wheat and sorghum.

For the Darling Downs, mining, in value terms, was the second largest industry in the region in 2006-07. Mining is the largest industry in the Fitzroy region, contributing approximately $4 billion to gross regional product (GRP) in 2006-07. Coal is the main commodity.

Reflecting the relatively skilled workforce in the Fitzroy region and tightness of the labour market, average weekly incomes were higher in 2006 than the Queensland average. In contrast, average weekly incomes were lower in the Darling Downs region than the state average. Skills shortages could be a risk for the Fitzroy region if several projects are undertaken at the same time.

The Project is expected to deliver a significant increase in output for the Darling Downs and Fitzroy, particularly in the manufacturing and mining industries. In both regions, total output is on average expected to be higher for all other industries between 2010 and 2021, reflecting the flow-on benefits from the Project. The exception is agricultural production in the Darling Downs, which is expected to contract modestly, mainly as a result of competition for labour.

Economic modelling indicates that the total contribution to Darling Downs region GRP from the Project will be approximately $14.1 billion between 2010 and 2021, with continuing contributions to regional GRP throughout Project life. This equates to an annual average increment to GRP in the Darling Downs region of approximately $1.2 billion per annum, which is equivalent to an increase of approximately 11.1 per cent in total Darling Downs GRP when compared to 2006-07.

In the Fitzroy region, the Project is estimated to provide a total increase in GRP of approximately $13.4 billion between 2010 and 2021, equating to approximately $1.1 billion per annum on average over the period. This is equivalent to an increase of approximately 7.7 per cent in total Fitzroy GRP when compared to 2006-07.

The Project is estimated to generate direct and indirect employment of approximately 60,000 full-time equivalent (FTE) years during the first 12-year period including construction to steady-state production of a two processing unit, or “train”, project. This overall employment comprises:

- approximately 19,000 FTE employee years in Queensland during the construction phase (2010 to 2014), equating to an annual average of 4,720 FTE employee years
- approximately 41,000 FTE employee years in Queensland for the period 2014 to 2021, equating to an annual average of 5,100 FTE employee years.

This would include an estimated 22,000 FTE employee years generated by the Project in the Darling Downs between 2010 and 2021, and 15,000 FTE employee years in the Fitzroy region. Associated with this increase in employment is an additional $950 million in wages and salaries between 2010 and 2021 in the Darling Downs, $700 million in the Fitzroy region and approximately $1 billion in the rest of Queensland.

It is estimated that during the construction phase the Project will draw considerable labour from other sectors that have similar skill sets. Industries likely to be impacted include those with a relatively high proportion of occupational categories such as technicians and trade workers, labourers and managers.

For both the Darling Downs and Fitzroy regions, net employment creation as a result of the Project is projected to be largest for technicians and trades workers, professionals and management occupations. A large construction workforce is required in both regions and temporary skills shortages could be

experienced for some trades. Skills shortages may occur as a result of cumulative impacts.

The local workforce required for the Project is likely to benefit from training programs delivered as part of the proposed Project. This would produce a permanent lift in the skills of these workers and the capacity of regional labour forces to respond to future industrial projects.

9 CONSULTATION

Consultation and public disclosure are core components of QGC's business. Consultation is a two-way discussion process between QGC and stakeholders. Key objectives are to:

- inform stakeholders and interest groups about the Project, and provide regularly updated information
- explain the impact assessment methodology and provide an understanding of the regulatory approval process
- seek local information, an understanding of stakeholder concerns, and input to the assessment of project impacts and benefits
- develop mitigation strategies with cognisance to stakeholder views and objectives
- demonstrate how public input has influenced the EIS and its findings.

This consultation fulfils statutory requirements for consultation as a core component of environmental impact assessment activities under the *SDPWO Act* and the EIS ToR, including:

- information and consultation opportunities accompanying public exhibition of the draft ToR
- targeted consultation with stakeholders to support baseline assessment, impact assessment and mitigation strategy development
- consultation with affected and interested persons regarding their views on the Project and its impacts and benefits
- information and consultation opportunities during the public exhibition of the EIS
- reporting of the consultation process and outcomes.

QGC has adopted a consultation program aimed at building long-term, mutually beneficial relationships with stakeholders, avoiding consultation fatigue, and providing timely and readily accessible information.

The consultation program included pre-EIS engagement, a staged process for obtaining input to assessment and mitigation, and planning for ongoing engagement throughout the Project's construction and operation.

By the end of June 2009 more than 3,000 stakeholders had been engaged during the EIS assessment process. Key stakeholder groups included:

- residents and community groups within the Gladstone, Banana and Western Downs local government areas
- indigenous community representatives
- landholders within the gas tenement and pipeline corridor areas
- Gladstone, Western Downs, Banana and North Burnett Councils

- non-government organisations
- Queensland Government Departments and Agencies
- Commonwealth Government Departments and Agencies.

A comprehensive consultation and negotiation program with indigenous communities was conducted throughout the region. This included representatives of Traditional Owner groups and other indigenous groups in a process that integrates consultation on ethnographic connections, native title interests and cultural heritage, as well as the Project's benefits and social impacts with regards to indigenous people. This consultation is ongoing.

Landholders identified as potentially affected by the Project have been contacted to ensure they are aware of the Project and were invited to participate in consultation. Meetings have also been held with landholders where priority exploration is required to negotiate land access.

Stakeholder consultation to date has provided valuable knowledge and information about environmental, social and economic issues relevant to the areas in which QGC proposes to operate. This has allowed issues and concerns raised by stakeholders to be proactively addressed through design, mitigation and management measures.

Consultation will be ongoing throughout the construction and operation phases of the QCLNG Project, as a critical element of the business.

Ongoing engagement will be required to further develop mitigation and social benefit measures, form partnerships for implementation, and monitor the Project's environmental and social performance.

10 ENVIRONMENTAL MANAGEMENT PLANS

Draft Environmental Management Plans (EMPs) have been prepared for construction and operations phases of the Gas Field, Pipeline and LNG Components of the Project. These contain mitigation and management measures presented in the EIS prepared for public consultation under the process set down by the *SDPWO Act*.

11 CONCLUSION

Queensland Curtis LNG (QCLNG) is a world-scale scale Project promising economic and environmental benefits sustainable over many years.

These benefits have been measured, analysed and reported in this QCLNG EIS, comprising more than 9,000 pages of studies, benefits, impacts and mitigations.

The Project has world-class backing. It is being developed by a BG Group business, QGC – a leading Australian explorer and producer of CSG.

BG Group is a United Kingdom-listed energy business with activities on five continents, interests in 27 countries, and a successful LNG business encompassing liquefaction, shipping, regasification and marketing.

The Project will rank as one of Australia's largest capital investments and provide a considerable boost to the Queensland economy, and a significant boost to a number of regional economies.

Studies conducted for the EIS found that the Project will generate jobs for more than 4,000 people directly employed to work at the peak of construction. Permanent jobs will be generated for about 1,000 people who will be directly employed to help operate the Project.

The Project will provide a multi-billion-dollar capital injection during the primary construction phase of its core components, Gas Field, Pipeline, LNG Facility and Shipping Operations.

Almost $30 billion in value-added activity is expected to be generated in Queensland during the first eight years of the operations phase of QCLNG from 2014.

Economic stimulus will come from LNG exports, additional expenditure by government as a result of royalties and taxes paid, wages and salaries paid to employees, demand from QCLNG for goods and services, and additional demand for goods and services as a result of flow-on industry and household expenditure.

The Project will deliver a sizeable lift in output for the Darling Downs and Fitzroy regions, particularly in the manufacturing and mining industries.

The Project will make a significant contribution to developing Queensland's large supply of CSG and establishing the LNG industry on the east coast of Australia.

Environmentally, the Project will produce one of the cleanest of all fossil fuels. Natural gas has lower carbon intensity than oil or coal and is widely regarded as a transition fuel as the world increasingly looks to renewable energy.

LNG is increasingly important as a cleaner energy source throughout the world. Global trade in LNG is projected to grow to almost 400 million tonnes a year in 2020.

QGC and BG Group are committed to the development of QCLNG, a priority project for both businesses.

Environmental and social impact assessments, including cumulative impact assessments have been undertaken for the Project. Draft management and mitigation measures have been proposed for areas where the potential for significant impacts resulting from Project activities has been identified. The implementation of management and mitigation measures, in conjunction with further assessment, monitoring, and ongoing refinement of design and construction methodology will ensure that the Project does not result in unacceptable environmental and social impacts.