1 INTRODUCTION

Volume 4 of this Environmental Impact Statement (EIS) assesses impacts of the Queensland Curtis LNG (QCLNG) Project Pipeline Component across its various parts, comprising an Export Pipeline, Lateral Pipeline and Collection Header.

Potential adverse and beneficial impacts of the Pipeline Component are assessed against environmental values identified by QGC based on the EIS Reference Case described in *Volume 2, Chapter 2.* In particular, the volume addresses how adverse impacts may be mitigated and benefits maximised. Cumulative impacts of the Pipeline Component, together with the impacts of other projects identified in *Volume 1, Chapter 2 and Appendix 1.6* are also addressed in this volume.

The methodology for determining impacts on environmental values is defined in *Volume 1, Chapter 3*. A risk matrix summary for impacts prior to and post the implementation of mitigation measures is detailed at the end of this volume in *Chapter 18.*

1.1 BACKGROUND

The broad scope of the environmental values reflects the diversity of the environments in which Pipeline activities will occur, from the Surat Basin of southern Queensland to Gladstone Harbour and Curtis Island on the east coast. The process for determining environmental values was guided by *Section 9* of the *Environmental Protection Act (EP Act)* (Qld) which defines an environmental value as:

(a) a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or

(b) another quality of the environment identified and declared to be an environmental value under an environmental protection policy or regulation.

Aspects of the environment assessed to determine environmental values and impacts from the Project were:

- climate and climate change
- topography and geomorphology
- geology and soils
- land use and infrastructure
- land contamination
- terrestrial ecology
- aquatic (freshwater) ecology
- surface water resources

- groundwater resources
- Associated Water
- air
- noise and vibration
- transport
- visual amenity
- waste management
- hazard and risk assessment.

1.2 *OVERVIEW OF PIPELINE COMPONENT*

- The Pipeline Components involves development, construction, operation and decommissioning of a gas pipeline network of approximately 730 km to link the Gas Field Component and other nearby coal seam gas (CSG) resources to the LNG Facility. The pipeline network includes:
- a 380 km Export Pipeline from QGC's Gas Field Component 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 activities that may be affected by, or impact upon, the environment include:

- clearing pipeline construction corridors, referred to as Right of Way (RoW), for installation of pipes
- excavation of pipe trenches
- restoration of the RoW
- erecting and operating temporary accommodation camps and administration facilities
- installing in-line compression facilities which comprise compressors, a vent for pressure management, power generation facilities and a water management system, including an onsite evaporation pond
- transport of plant, equipment and materials
- maintenance and surveillance activities during operations.

Construction will occur over 18 months between 2011 and 2013.

Further details about the operation and construction of the Pipeline Component are described in *Volume 2*, *Chapter 8* and *Volume 2*, *Chapter 12* respectively.

1.3 STUDIES

Studies for the Pipeline Component involved assessment of two route options for the Export Pipeline. These routes were evaluated against a set of standard criteria that considered:

- land ownership and land users
- environmental and social considerations
- transportation
- construction constraints or benefits
- operational constraints or benefits
- outcomes of cost/benefit and feasibility studies
- other investment and general operational criteria.

As part of the assessment, existing data was gathered on land ownership and land uses, the environment (contained in government information and planning information), site assessments, route design and analysis and cost determination and variance.

In instances where desktop assessments were undertaken, a conservative (precautionary principle) approach was adopted (i.e. all values that could occur in an area have been assumed to occur). Prior to finalisation of the preferred alignment, further detailed ecological field investigations will be conducted. QGC will also consider public submissions on the Environmental Impact Statement (EIS) to ensure that the impact of the Export Pipeline route on people, infrastructure and the environment is minimised.

For identified environmental values, protection objectives and associated measurable indicators were established. Where applicable, strategies for managing and mitigating impacts have been identified and described.

Volume 4 provides the key findings of the environmental assessments for the Pipeline Component. The full reports of studies conducted are provided in *Appendices 4.1* to *4.5, Appendices 3.5, 3.6 and 3.9 and Appendices 5.1 and 5.2*. A summary of the findings is provided below.

1.4 SUMMARY OF FINDINGS

1.4.1 Climate and Climate Change

The Project environmental objective for climate and climate change is to ensure that Project infrastructure design and proposed management strategies incorporate consideration for climatic extremes and future climate change.

The design and development of the Pipeline Component will consider the existing and potential climate in the region. It is not expected that forecast

climate change over the 20-year life of the Project will significantly impact construction, operation or subsequent decommissioning of the Pipeline Component.

A summary of the impacts associated with climate is provided in *Table 4.1.1*.

Table 4.1.1 Summary of Impacts for Climate

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Cumulative
Impact duration	Short term
Impact extent	Local
Impact likelihood	Unlikely

Overall assessment of impact significance: negligible.

1.4.2 Topography and Geomorphology

The Project environmental objective for topography and geomorphology is to maintain a stable landform that does not result in uncontrolled erosion.

The proposed routes of the pipelines, comprising the Pipeline Component, were selected to avoid or minimise impacts associated with land and terrain constraints. The proposed pipeline routes generally pass through predominantly level or gently sloping country. However, some areas of steep topography will need to be traversed particularly around Callide.

The implementation of appropriate control measures during construction will ensure that any impacts are of a temporary nature and limited to the immediate construction area.

A summary of the impacts associated with topography and geomorphology is provided in *Table 4.1.2*.

Table 4.1.2 Summary of Impacts for Topography and Geomorphology

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: negligible based on the successful implementation of the proposed mitigation measures.

1.4.3 Geology and Soils

The Project environmental objective for geology and soils is to protect soils from contamination and erosion arising from Project activities.

The geology and soil characteristics of the pipeline routes have been identified. The potential for soil erosion, combined with variable topsoil thickness and low fertility, means that the management of topsoils and rehabilitation practices will require significant control measures. In addition, some areas of saline subsoil occur, the exposure of which can impact on the success of rehabilitation measures. Specific mitigation measures have been proposed with the primary objective of:

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

It has also been identified that approximately 252 km of the combined pipeline routes is considered Good Quality Agricultural Land (GQAL). Based on a RoW width of between 40m and 80m, this equates to approximately 1260 ha of cleared area within GQAL. However, this area would only be impacted during construction, and agricultural practices can then be resumed. Mitigation measures have been proposed to reduce the potential impacts on current cropping land within pipeline easements.

A summary of the impacts associated with geology and soils is provided in *Table 4.1.3*.

Table 4.1.3 Summary of Impacts for Geology and Soils

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term (limited to construction phase)
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: minor in the short term, negligible in the long-term based on the successful implementation of the proposed mitigation measures. In coastal areas around Gladstone and on Curtis Island Potential Acid Sulfate soils (PASS) could be disturbed during construction of

the Export Pipeline. Impacts will, however, be localised and risks and impacts can be avoided or reduced through the implementation of the Acid Sulfate Soil (ASS) Management Plan.

1.4.4 Land Use and Infrastructure

The Project environmental objectives for land use and infrastructure are to:

- minimise impacts on existing townships and infrastructure
- minimise impacts on agricultural or rural activities and potential long term uses of land.

The pipelines occur within an area that is principally rural, with grazing the primary land use. However, there are also areas of state forest, protected areas and lands subject to mining and petroleum tenures.

QGC has endeavoured to minimise impacts on existing land use and infrastructure through the route selection process. Pipelines will be buried for their entire length with only limited above-ground infrastructure. Route planning has also minimised impacts to mining and petroleum tenures.

A summary of the impacts associated with land use and infrastructure is provided in *Table 4.1.4.*

Table 4.1.4 Summary of Impacts for Land Use and Infrastructure

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term (limited to construction phase for existing land use)
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: minor in the short term to negligible in the long term based on existing land uses being able to resume on completion of construction.

1.4.5 Land Contamination

The Project environmental objective for land contamination is to protect land from contamination arising from Project activities and ensure that any existing contaminated land is not disturbed, or if disturbed is appropriately managed and/or rehabilitated.

A risk-based approach to land contamination has been adopted that considers the most likely contaminants and their locations. No contaminated areas have been identified to date. There is the potential for contamination along major

highways (e.g. hydrocarbon) and rail lines (e.g. asbestos dust from brake linings) but these would be avoided through the use of trenchless techniques in these locations. Based on these findings management plans will be developed.

A summary of the impacts associated with land contamination is provided in *Table 4.1.5*.

Table 4.1.5 Summary of Impacts for Land Contamination

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct impacts to soil through spills during construction
Impact duration	Short term
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: negligible.

1.4.6 Terrestrial Ecology

The Project environmental objective for terrestrial ecology is to undertake Project activities such that impacts on abundance and distribution of terrestrial flora, fauna and ecological communities are minimised.

The pipeline corridors fall within vegetated and cleared grazing land, cropping land, roadside and travelling stock reserves, council lands, state forests and resource reserves.

The proposed Pipeline corridors traverse predominantly cleared areas. Based on the Queensland Herbarium regional ecosystem (RE) mapping, the approximate length of remnant vegetation within each Pipeline corridor that could potentially be impacted by the Project is:

- 110 km of the 380 km Export Pipeline
- 25 km of the 150 km Lateral
- 80 km of the 190 km Collection Header.

The pipeline corridors transect small areas of communities and species habitat listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (*EPBC Act*) and *Vegetation Management Act 1999* (Qld) (*VMA*). Environmentally sensitive areas impacted by the pipelines include:

- state forests
- Threatened Species and Ecological Communities (*EPBC Act*)
- Endangered REs (*VMA*) (incorporated within Biodiversity Assessment and Mapping Methodology)

- Of Concern REs (*VMA*)
- woodlands fringing drainage lines (RE 11.3.25)
- wetlands (RE 11.3.27)
- Endangered, Vulnerable and Rare (EVR) and regionally significant species habitats
- large intact tracts of vegetation.

In the absence of appropriate mitigation measures there is potential for the Project to impact on these areas and their values.

However, clearing for pipeline construction represents a relatively small portion of the existing vegetation in the local area. As such, with the implementation of appropriate mitigation and rehabilitation measures, including a detailed ecological survey of the preferred alignment prior to its finalisation, there is little potential for the Project to have a significant impact on the ecological features and values of the pipeline corridors or adjoining areas.

A summary of the impacts associated with terrestrial ecology is provided in *Table 4.1.6*.

Table 4.1.6 Summary of Impacts for Terrestrial Ecology

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Long term due to time for full rehabilitation to be achieved
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: moderate in the short term to minor in the long term due to the initial loss of mature vegetation and small areas of Endangered REs which will be compensated for through offsets.

1.4.7 Aquatic (Freshwater) Ecology

The Project environmental objective for aquatic ecology is to undertake Project activities such that impacts on abundance and distribution of aquatic flora, fauna and ecological communities are minimised.

The Collection Header traverses the Condamine River downstream of which several nationally significant wetlands occur. The closest of these is the Ramsar-listed Narran Lake Nature Reserve which lies approximately 450 km to the south-west of the intended crossing of the Condamine River. The Export and Lateral Pipelines traverse a number of major watercourse catchments including the Auburn, Dawson, Nogoa and Calliope. A number of significant

wetlands occur in the vicinity of the marine crossing to Curtis Island. The Export Pipeline also transects a number of small areas mapped by Queensland Herbarium as wetlands.

Mitigation measures have been proposed by QGC to ensure that the diversification of the aquatic (freshwater) ecology is protected during the construction, operation and decommissioning of both the Export and Lateral Pipelines. These are discussed in *Chapter 8* of this volume.

A summary of the impacts associated with aquatic ecology is provided in *Table 4.1.7*.

Table 4.1.7 Summary of Impacts for Aquatic Ecology

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	Unlikely

Overall assessment of impact significance: minor provided that proposed management measures are implemented.

1.4.8 Marine Ecology

The Project environmental objective is to undertake Project activities such that impacts on abundance and distribution of marine flora, fauna and ecological communities are minimised.

The Export Pipeline route potentially crosses The Narrows between Phillipe's Landing and Curtis Island. The marine ecology features and values in these areas are detailed in *Volume 5, Chapter 8.* The potential impacts on marine ecology associated with the Export Pipeline crossing are described in *Volume 5, Chapter 8* along with the planned mitigation measures.

A summary of the impacts associated with marine ecology is provided in *Table 4.1.8*.

Table 4.1.8 Summary of Impacts for Marine Ecology

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct and secondary
Impact duration	Permanent loss of habitat as a result of infrastructure that is constructed in the marine environment Short term changes to water quality and impacts on

Impact assessment criteria	Assessment outcome
	marine receptors in the event of a spill Long term impacts associated with vessel movements, lighting and discharges to the marine environment during the life of the Project
Impact extent	Local
Impact likelihood	High for loss of habitat resulting from infrastructure construction, land reclamation and dredging Unlikely for spills High for impacts associated with vessel movements, lighting and discharges to the marine environment during the life of the Project

Overall assessment of impact significance: minor provided that proposed management measures are implemented which will maintain structure and function of marine ecosystems, and protect biodiversity and the integrity of populations of listed species within the study area. No significant impacts to *EPBC Act*-listed threatened or migratory marine species are predicted due to the small number of individuals likely to use the area.

1.4.9 Surface Water Resources

The Project environmental objective for surface water resources is to protect as much as practicable surface waters from contamination, diversion of natural flows, and sedimentation so as to preserve the ecological health, public amenity and safety of surface waters.

Surface water characteristics of the pipeline routes have been assessed. The key catchments potentially impacted by the pipelines are the Condamine-Balonne, Burnett-Calliope and Dawson–Fitzroy catchments. All watercourse crossing points have been characterised and the potential for the Project to impact on local watercourses and wetlands is described. Appropriate management strategies have been proposed.

A summary of the impacts associated with surface water resources is provided in *Table 4.1.9*.

Table 4.1.9 Summary of Impacts for Surface Water Resources

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term during construction
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: minor provided that mitigation measures are implemented for the management of soils and the storage and handling of fuel, chemicals and ASS.

1.4.10 Groundwater Resources

The Project environmental objective for groundwater resources is to protect, as much as practicable, groundwater from contamination so as to preserve ecological health, public amenity and safety.

Groundwater data from the Queensland Department of Environment and Resource Management (DERM) boreholes lying within the 40km wide study area have been reviewed and groundwater has been assessed. It is considered that pipeline construction works are unlikely to intercept groundwater although some groundwater may be intercepted at watercourses.

The pipeline routes overlay the Great Artesian Basin (GAB) but due to the shallow depth of construction (i.e. a maximum of approximately 2.5 metres of excavation) they are not expected to impact on GAB resources.

Appropriate management strategies to ensure that other groundwater users are not disadvantaged have been proposed. These are described in *Chapter 10* of this volume.

A summary of the impacts associated with groundwater resources is provided in *Table 4.1.10.*

Table 4.1.10 Summary of Impacts for Groundwater Resources

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term (limited to construction)
Impact extent	Local
Impact likelihood	Unlikely

Overall assessment of impact significance: negligible due to the shallow depth of construction in relation to groundwater resources and provided that mitigation measures are implemented for the storage and handling of fuel, chemicals and ASS.

1.4.11 Air

The Project environmental objective for air quality is to preserve ambient air quality to the extent that ecological health, public amenity or safety is maintained.

The main long-term source of air emissions will be screw compressors at the

mid-line compressor station once installed (not anticipated initially). Emissions would include oxides of nitrogen, carbon monoxide and hydrocarbons. A conservative approach has been adopted in modelling impacts on air quality, as the exact location of the in-line compressor station is not known. Modelling results indicate that there will be no exceedences of air quality objectives for the Pipeline Component.

In the short term the key air emission will be dust associated with construction activities. This will be managed through measures described in the Environmental Management Plan (EMP) in *Volume 10*.

A summary of the impacts associated with air is provided in *Table 4.1.11*.

Table 4.1.11 Summary of Impacts for Air

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: negligible as air emissions from the pipelines are not expected to exceed air quality objectives. Mitigation measures will be developed if further testing and modelling proves otherwise.

1.4.12 Noise and Vibration

The Project environmental objective for noise and vibration is to ensure that impacts arising from noise and vibration on ecological health, public amenity or safety are minimised.

The main source of noise emissions from the Pipeline Component will be earth-moving activities during construction. Generic noise modelling has been carried out to determine the area likely to be affected. Noise management measures have been proposed to minimise construction noise impacts.

A summary of the impacts associated with noise and vibration is provided in *Table 4.1.12.*

Table 4.1.12 Summary of Impacts for Noise and Vibration

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term (predominantly limited to the construction phase)
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: minor due to the predominantly rural location of the pipelines and the temporary and short-term nature of the construction activities.

1.4.13 Transport

The Project environmental objective for transport is to ensure that use of roads, rail and other transport infrastructure does not impact on ecological health, public amenity or safety of those who use or are in proximity to transport infrastructure.

A model has been developed to quantitatively predict, to the greatest extent possible, the likely transport impacts from Pipeline Component activities. The overall transport strategy has not been developed at this stage of the Project. This means that final transport methods and routes are not known. The model has assumed that all transport will be by road and highlights those roads which have the potential to be adversely impacted by the Project. A methodology for determining the overall impact and management strategies has been proposed.

A summary of the impacts associated with transport is provided in *Table 4.1.13*.

Table 4.1.13 Summary of Impacts for Transport

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	Likely

Overall assessment of impact significance: moderate depending on the strategies to be implemented and the final transport corridors to be used. 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 from transport on roads will be minor to negligible.

1.4.14 Visual Amenity

The Project environmental objective for visual amenity is to preserve the visual amenity of the landscape as far as practicable.

A visual amenity review has been carried out to determine the level of impact that the Pipeline Component may have within the region. As pipeline infrastructure is generally of low height and scattered widely across a vegetated landscape, visual amenity is not expected to be significantly impacted. Mitigation measures will be developed where required.

A summary of the impacts associated with visual amenity is provided in *Table 4.1.14.*

Table 4.1.14 Summary of Impacts for Visual Amenity

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Long term
Impact extent	Local
Impact likelihood	Unlikely

Overall assessment of impact significance: negligible due to the limited above ground structures which have a low profile providing a limited field of view.

1.4.15 Waste Management

The Project environmental objectives for waste management are to:

- minimise waste generation and maximise reuse and recycling of waste products
- transport, store, handle, and dispose of waste in a manner that does not cause contamination of soil, air or water.

Solid and liquid waste streams and volumes have been identified, including general domestic waste, commercial and industrial waste and some minor amounts of hazardous waste. Waste management strategies, taking into account location of the pipelines and the necessity of providing a range of waste services, have been proposed to mitigate potential impacts.

A summary of the impacts associated with waste management is provided in *Table 4.1.15*.

Table 4.1.15 Summary of Impacts for Waste Management

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	High

Overall assessment of impact significance: minor.

1.4.16 Hazard and Risk Assessment

The Project environmental objective for hazard and risk assessment is to protect the ecological health, public amenity and safety of those on site or in proximity to the site from hazardous events.

A quantitative risk assessment was undertaken for the unplanned release of gas from the Collection Header Pipeline and Export Pipeline and associated infrastructure. All other hazards were identified and assessed using a qualitative risk assessment process.

For hazards assessed qualitatively, controls have been proposed to minimise the likelihood of the hazard occurring and then, should an impact occur, minimising that impact. Hazards with the greatest residual risk related to transport incidents. Further control measures have been proposed to minimise these risks.

A number of scenarios were considered for the unplanned release of gas, relating to the type of equipment and the size of the hole from which gas may be released. There are potentially five consequences for each scenario: toxic effects; potential vapour-cloud flash fire; blast overpressure; thermal radiation from ignition of gas; and downwind toxic effects of a fire.

Thermal radiation from an ignition of gas released from a pipeline was the only hazard that presents a fatality risk other than “negligible” or an injury risk greater than “minor”. Modelling of this scenario used the most conservative assumptions about consequence (150 mm hole) and likelihood.

The most conservative fatality risk criterion of 0.5×10^{-6} per annum was not exceeded for distances greater than 126 m. This is likely to be less distance than the minimum separation distances under Australian Standard AS2885. Moderate injury (irreversible impairment or disability) risk criteria (50×10^{-6} per annum and 10×10^{-6} per annum.) are highly unlikely to be exceeded at distances greater than 150 m.

Establishing and maintaining adequate safety zones for all pipeline infrastructure will ensure that the risk to human health is reduced to as low as

reasonably practicable (ALARP).

It is probable that both fatality and injury risk will, in order of magnitude, be less than predicted by the model. Pipelines for the Project will be constructed to Australian Standards, which data shows, result in a lower likelihood of gas release than that used in the model.

The Environmental Management Plan (EMP) will further mitigate potential hazards and manage any impacts, should they occur.

The overall Project risk in relation to the environmental factor is minor to negligible due to the mitigation strategies and the hazard and risk identification program to be implemented throughout the Project's lifecycle.

A summary of the impacts associated with hazard and risk is provided in *Table 4.1.16*.

Table 4.1.16 Summary of Impacts for Hazard and Risk

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Short term
Impact extent	Local
Impact likelihood	Likely

The overall Project assessment level of significance: negligible.

1.4.17 Conclusion

The following chapters of *Volume 4* discuss how environmental values for each environmental factor were assessed and describe proven mitigation strategies for the environment, health and social management of the Pipeline Component.