Australia Pacific LNG Project

Volume 2: Gas Fields

Chapter 25: Cumulative Impact Assessment

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25. Cumulative Impacts

25.1 Introduction

This chapter summarises the potential cumulative impacts associated with the construction and operation of the Australia Pacific LNG Project (the Project) gas fields, combined with relevant other projects in the region. The requirements for cumulative impact assessment are outlined in Section 7 of the terms of reference for the Project's environmental impact statement (EIS), These requirements and the Australia Pacific LNG assessment methodology are described in Volume 1 Chapter 5.

25.1.1 Purpose

The objective of this cumulative impact assessment is to take into account not only the potential impacts of the Project's gas field components, but its effects when combined with the impacts of other proposed projects that may have a significant effect on important physical/biological, social, cultural, economic and/or built environmental values in the vicinity of the gas fields.

There are currently a number of existing, approved or proposed projects within the vicinity of the gas fields that could contribute to cumulative impacts. The decision about which projects to include in the cumulative impact assessment was based on criteria explained in Volume 1 Chapter 5. This chapter also includes summary details for the assessed projects, as well as an explanation of how they, and the project selection criteria, relate to the Australia Pacific LNG Project. The projects that met the selection criteria are listed in Table 25.1. For more information on these projects, including location figures refer to Volume 1 Chapter 5.

Table 25.1 Projects considered in cumulative impact assessment

- Australia Pacific LNG Project
- Arrow Energy Gas Field Development
- Australian Inland Rail Expressway - Toowoomba to Gladstone Railway (see Surat Basin Railway)
- Boyne Smelters Expansion Project
- Cameby Downs (Coal) Expansion Project
- Central Queensland Gas Pipeline
- Darling Downs Power Station
- Dawson Coal Mine Expansion Project
- East End No.5 Limestone Mine
- Fisherman's Landing Port Expansion
- Gladstone LNG Project
- Gladstone LNG Project – Fisherman's Landing
- Gladstone Pacific Nickel Refinery
- Gladstone Steel Making Facility
- Gladstone to Fitzroy Pipeline
- Linc Energy Underground Coal Gasification
- Moura Link (Government Project)
- Nathan Dam and Associated Pipelines (Government Project)
- Queensland Curtis LNG Project
- Queensland Gas Pipeline Expansion
- Shell Australia LNG Project
- Surat Basin Railway
- Surat to Gladstone Pipeline
- Walloon Coal Seam Gas Field
- Wallumbilla-Darling Downs Power Station Gas Pipeline
- Wandoan Coal Project
- Western Basin Dredging and Disposal Project
- Wiggins Island Coal Terminal
- Woori Coal Project
- Yarwun Alumina Refinery.

25.2 Assessment outcomes

25.2.1 Overview

Table 25.2 indicates the physical/biological, social, cultural, economic or built environmental values which have the potential to be significantly affected by cumulative impacts arising from the identified existing or proposed projects. The overall risk of adverse cumulative impacts for the construction and operational phases of each project are summarised in the table. They are grouped into three categories of project type:

- Mining, including coal seam gas (CSG)
- Manufacturing, including mineral processing
- Infrastructure, including gas pipelines.

Australia Pacific LNG has designed its mitigation strategies to address cumulative impacts as far as practicable, particularly those values that are expected to be at most risk of significant cumulative impacts. Analysis underpinning the summary tables is provided in Sections 25.2.2 through to 25.2.17.

In some cases, such as noise and vibration, air quality, heritage, and hazard and risk, the impacts arising from the various projects on environmental values are localised. Therefore, mitigation strategies are clearly identifiable and able to be successfully implemented based largely on standardised practices. The extent of overlapping impact areas is also generally limited in these cases. As a result, it is considered that there is only a low level of risk associated with these potential cumulative impact categories, and a 'low' summary rating has been identified for these impact categories.

In contrast, in a limited number of cases such as social, economic, greenhouse gas and associated water, one or more of the following factors has led to a higher rating in terms of impact significance and/or risk:

- A relatively high degree of complexity exists relating to characteristics of the values in question
- A relatively high degree of complexity exists relating to cumulative impact mechanisms
- Available mitigation approaches are not standardised and require the ongoing cooperation of multiple parties.

The remaining eight categories, (land, visual amenity, terrestrial ecology, aquatic ecology, surface water, groundwater, waste, and transport), have been given a 'moderate' rating. This is because they tend to involve more standardised impact mitigation strategies, relative to the high rating categories, but involve more extensive impact zones, relative to the low rating categories. That is, the pre-mitigation impacts may collectively be considered to represent regional-scale or basin-wide impacts rather than representing clear localised impacts.

Table 25.2 Cumulative environmental value impact - project category relationship summary

Existing, approved or proposed projects		Land	Landscape and visual amenity	Terrestrial ecology	Aquatic ecology	Surface water and watercourses	Groundwater	Associated water	Air quality	Greenhouse Gas Emissions	Noise and vibration	Waste	Traffic and transport	Heritage	Social	Economic	Hazard and risk
Gas fields																	
Mining projects (e.g. CSG projects, coal projects and underground coal gasification)	Construction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Operations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Manufacturing and mineral processing projects (e.g. Gladstone Pacific Nickel)	Construction									✓					✓	✓	
	Operations									✓					✓	✓	
Infrastructure and transport projects (e.g. Darling Downs Power Station, Surat Gas Pipeline)	Construction	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓
	Operations	✓	✓	✓	✓	✓	✓		✓	✓					✓	✓	
Overall assessment of impact significance/level of risk		**M**	**M**	**M**	**M**	**M**	**H**	**H**	**L**	**H**	**L**	**M**	**M**	**L**	**H**	**H**	**L**

L – low, M - moderate, H - high

25.2.2 Land

The projects involving the development of coal and CSG tenements held by other companies in the Surat Basin, and infrastructure projects such as the proposed Surat Basin Rail, will broadly have similar impacts to those identified for the Australia Pacific LNG Project in Volume 2 Chapter 6. That is, the development of the gas fields and the other relevant projects will all result in potential cumulative impacts in relation to land use changes, mainly in terms of agriculture and the depletion of resources (e.g. construction materials).

The loss of good quality agricultural land (GQAL) within the region is a potential significant cumulative impact associated with the various relevant projects. This is due to constructing and operating project-related work sites and structures. An impact will occur due to occupation of GQAL. This will be highest during construction, but minimised during operation through progressive rehabilitation.

The development of the gas fields encompasses approximately 570,000ha. This will result in some cropping, farming and grazing land being temporarily disturbed. It is estimated that some 40,717ha of land used for various farming purposes will be initially disturbed by construction activities for the Australia Pacific LNG Project alone. However, following construction, only 7,524ha is expected to remain unavailable for agricultural or pastoral use for the life of the Project.

This level of change is not expected to materially alter the areas' land use balance, as it represents only a 1.3% shift in land use within the Project's tenements. Accurate estimates are not available for the other relevant projects in the area, so it has been assumed that the loss of GQAL associated with the Project represents an average loss across the several CSG, coal mining and linear infrastructure projects proposed for the area. In this case, the collective projects will change land use patterns.

Material requirements have not been accurately quantified for any of the relevant projects, but will be progressively determined during detailed design phases. However, during construction phases, there could be a substantial increase in demand for existing or new local extractive material sources such as quarries. This demand is expected to be manageable, as neighbouring regions (e.g. south east Queensland) have successfully addressed similar challenges during concurrent large-scale water and transport projects.

Potential impacts to land due to contamination will be associated mostly with the construction and operation of the various facilities associated with CSG projects. Such impacts are likely to come from spills, leaks and storage of waste products and waste materials, which have the potential to cause localised areas of contamination. Off-site migration of contamination via soil or groundwater is not likely because the design and construction of appropriate standard containment structures and management controls at gas processing or water treatment facilities and storage ponds have proven to be effective in the past.

25.2.3 Landscape character and visual amenity

Gas field infrastructure is industrial in nature and could therefore create a strong visual contrast to existing rural landscapes, depending on where it is located. This potential also applies to the several other gas and coal-related projects proposed for the vicinity of the gas fields. The visual impacts of the work sites and structures associated with these projects are generally reduced, due to the sparsely settled nature of the various project areas.

Residences and tourism sites are considered the most sensitive viewing locations, particularly in relation to larger-scale work sites or structures and/or multiple items in close proximity. Where these are proposed, structure or screening treatments are available. These are usually practicable and can

be implemented where necessary, in consultation with the affected people. In most cases, these impacts can be readily mitigated through site planning, landscape treatment (including vegetation screening) and site rehabilitation.

25.2.4 Terrestrial ecology

An assessment of terrestrial ecological cumulative impacts must take into account not only the potential impacts of the Project, but its effects in combination with the impacts of other proposed projects. There is the potential to affect regional terrestrial biodiversity values, in the absence of effective coordination and cooperation exists among project proponents and regulatory authorities.

The quantification of proposed impacts of projects other than the Australia Pacific LNG Project has been constrained by the lack of information available in relation to other gas field development projects. Existing reporting for these projects provides limited data on how much habitat will be lost, which habitat types will be affected, the severity of impacts, and mitigation and offset measures.

To compensate for a lack of information on which to base cumulative impact assessment, the other gas field tenements known to be subject to development applications have been mapped in conjunction with the Australia Pacific LNG tenements. Sites of other projects in the approval or early development stage have also been mapped, if they occur within the bioregional provinces affected by the Australia Pacific LNG Project.

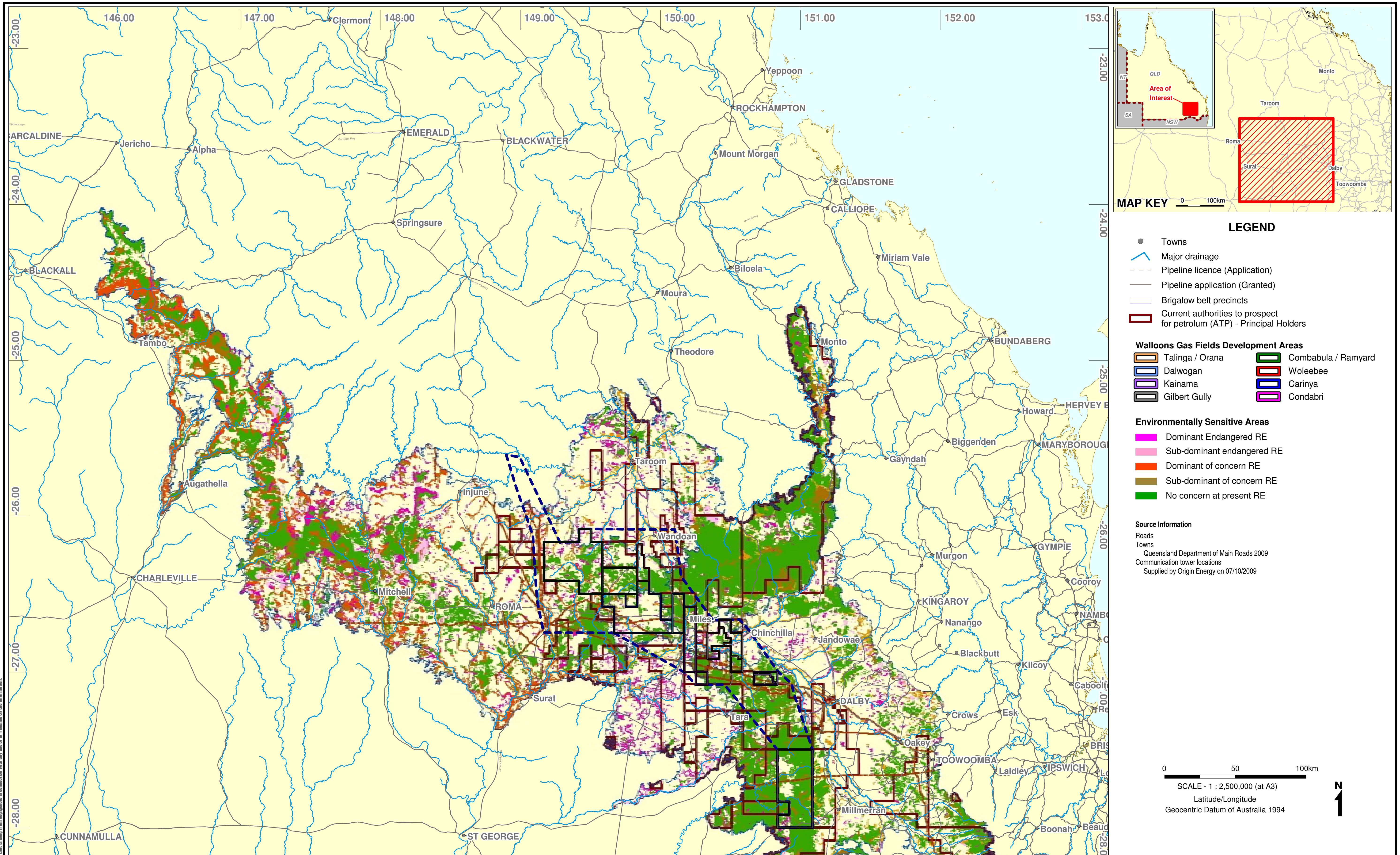
Figure 25.1 shows the areas of known proposed development projects over the biodiversity status remnant vegetation. A total of approximately 2,000,000ha of remnant vegetation falls within the boundaries of these project areas. Of this, 235,000ha falls within the Australia Pacific LNG tenures and Australia Pacific LNG proposes to clear 6000ha or less than 0.5% of that area.

There are several regional ecosystems in the bioregion which are present within the relevant provinces. In time, these may increase in remnant status under the *Vegetation Management Act 1999*, moving from 'least concern' to 'of concern'[1] as the total bioregional extent nears <30% of the pre-clearing extent. There are also two regional ecosystems in the bioregion, and present within the relevant provinces, that may in time increase in remnant status under the Act from 'of concern' to 'endangered'[2] as the total bioregional extent gets close to <10% of the pre-clearing extent.

Clearing for the Australia Pacific LNG Project will not reduce the extent of these regional ecosystems within the Brigalow belt bioregion such that their remnant status will be altered. In fact, clearing represents a very small extent (no greater than 0.5%) of the pre-clearing extent of any regional ecosystems within the relevant provinces. Similar analysis is not available for the other relevant projects. To avoid significant cumulative impacts to terrestrial ecology values, other project proponents would need to adopt a similar approach to Australia Pacific LNG's to minimise clearing of important ecosystems and habitats, and to deliver offsets where necessary to ensure conservation of ecosystems and habitat.

Figure 25.2 shows the estimated project impact areas in relation to the bioregional corridors identified by the Biodiversity Planning Assessment process. Maintenance and enhancement of these corridors have been identified as key recommended mitigation actions for the Australia Pacific LNG Project. An agreed approach for the consistent treatment of these corridors in all developments will maximise the benefits through maintaining and improving landscape connectivity.

[1] Regional ecosystems 11.3.19 – 39.97%, 11.3.26 – 37.57%, 11.5.5 – 35.21% and 11.7.1 – 39.94%
[2] Regional ecosystems 11.3.17 – 13.74% and 11.9.10 – 16.82%


MAP KEY
0 100km
QLD
NT
SA
NSW
Area of Interest
Monto
Taroom
Roma
Surat
Dalby
Toowoomba
LEGEND
Towns
Major drainage
Pipeline licence (Application)
Pipeline application (Granted)
Brigalow belt precincts
Current authorities to prospect for petrolum (ATP) - Principal Holders
Walloons Gas Fields Development Areas
Talinga / Orana
Dalwogan
Kainama
Gilbert Gully
Combabula / Ramyard
Woleebee
Carinya
Condabri
Environmentally Sensitive Areas
Dominant Endangered RE
Sub-dominant endangered RE
Dominant of concern RE
Sub-dominant of concern RE
No concern at present RE
Source Information
Roads
Towns
Queensland Department of Main Roads 2009
Communication tower locations
Supplied by Origin Energy on 07/10/2009
0 50 100km
SCALE - 1 : 2,500,000 (at A3)
Latitude/Longitude
Geocentric Datum of Australia 1994
N
146.00
147.00
148.00
149.00
150.00
151.00
152.00
-23.00
-24.00
-25.00
-26.00
-27.00
-28.00
-29.00
Clermont
Yeppoon
ROCKHAMPTON
EMERALD
BLACKWATER
Mount Morgan
GLADSTONE
CALLIOPE
ARCALDINE
Jericho
Alpha
Springsure
BLACKALL
Biloela
Miriam Vale
Moura
Theodore
Monto
BUNDABERG
Tambo
Howard
Biggenden
Gayndah
Taroom
Augathella
Injune
Wandoan
GYMPIE
Murgon
Cooroy
CHARLEVILLE
Mitchell
ROMA
KINGAROY
Nanango
Miles
Chinchilla
Jandowae
Blackbutt
Kilcoy
Surat
DALBY
Crows
Esk
Tara
Oakey
TOOWOOMBA
Laidley
IPSWICH
Millmerran
Boonah
CUNNAMULLA
ST GEORGE
WARWICK
Inglewood
GOONDIWINDI
Dirranbandi
STANTHORPE
Texas
Wallangarra
Mungindi

AUSTRALIA PACIFIC LNG PROJECT

Volume 2 Chapter 25
Figure 25.1 - Cumulative gas fields tenements Regional ecosystems - remnant vegetation

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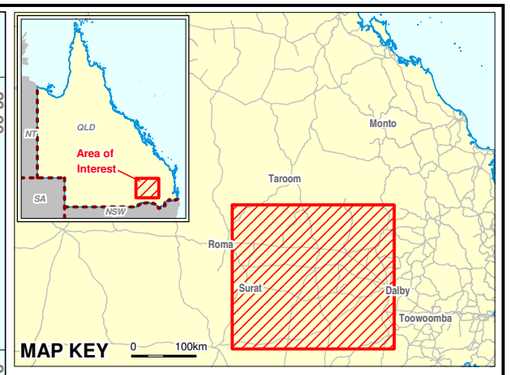
146.00 147.00 148.00 149.00 150.00 151.00 152.00

-23.00 -24.00 -25.00 -26.00 -27.00 -28.00 -29.00

Aramac, Clermont, Yeppoon, BARCALDINE, Jericho, Alpha, EMERALD, BLACKWATER, ROCKHAMPTON, Mount Morgan, GLADSTONE, CALLIOPE, Springsure, Miriam Vale, BLACKALL, Biloela, Moura, Tambo, Theodore, Monto, BUNDABERG, Howard, MARYB, Biggenden, Gayndah, Taroom, Augathella, Injune, Wandoan, CHARLEVILLE, Mitchell, ROMA, Miles, Chinchilla, Jandowae, KINGAROY, Murgon, GYMPIE, Nanango, Blackbutt, Kilcoy, Surat, DALBY, Tara, Crows, Esk, Oakey, TOOWOOMBA, Laidley, IPSWI, Millmerran, Boonah, CUNNAMULLA, ST GEORGE, WARWICK, Inglewood, GOONDIWINDI, Dirranbandi, STANTHORPE, Texas, Wallangarra



LEGEND

- Towns
- Major drainage
- Pipeline licence (Application)
- Pipeline application (Granted)
- Brigalow belt precincts
- Current authorities to prospect for petrolum (ATP) - Principal Holders

Walloons Gas Fields Development Areas

- Talinga / Orana
- Dalwogan
- Kainama
- Gilbert Gully
- Combabula / Ramyard
- Woleebee
- Carinya
- Condabri

Environmentally Sensitive Areas

- Regional
- State

Source Information

Data provided by BAAM 08/12/2009

0 50 100km

SCALE - 1 : 2,500,000 (at A3)

Latitude/Longitude

Geocentric Datum of Australia 1994

N

AUSTRALIA PACIFIC LNG PROJECT

Volume 2 Chapter 25
Figure 25.2 - Cumulative gas fields tenements bioregional corridors

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The total amount of clearing by all proponents for gas field development is relatively small compared with the overall tenement sizes. However, the need to establish gas wells in a grid format, connected by access tracks and pipelines, has the capacity to fragment remnant vegetation. Regardless of the conservation status of that vegetation, the activities must be carefully managed to avoid severing landscape linkages for flora and fauna.

Fragmentation also has the capacity to degrade the quality of significant areas of adjacent habitat over time. Vigilance in weed and pest animal species control for the duration of these projects is vital for the protection of the significant number of 'endangered, vulnerable, or rare' or near threatened species present within both remnant and non-remnant vegetation in the region.

With diligent and cooperative management of terrestrial ecological impacts in all developments (actively involving regional community organisations) and a broad-scale and integrated planning approach to rehabilitation and offset locations, the combined development projects currently proposed for the relevant provinces are expected to minimise the impact on habitats for a number of conservation significant flora and fauna species. Those species most at risk are those which are endemic to the region and rely specifically on connected, large tracts of intact, remnant vegetation.

Concentration of rehabilitation efforts within the bioregional corridors recommended for the Australia Pacific LNG Project will have positive local ecological benefits. However, coordination of habitat rehabilitation efforts for all of the proposed gas field projects is outside of the authority of any of the individual proponents and will require government input.

25.2.5 Aquatic ecology

The aquatic ecology values, potential impact mechanisms and related impact mitigation strategies relating to the Project's gas fields' area are detailed in Volume 2 Chapter 9. These are generally applicable to all potential projects identified for the area.

Much of the Condamine, Balonne, Dawson and Border rivers contain poor or very poor quality aquatic habitat due to past habitat disturbance. However, there are some sites in these river systems containing habitat values due to good channel and habitat diversity, minimal surrounding land use impact, and good riparian connectivity and shading. The Australia Pacific LNG assessment in Volume 2 Chapter 9 demonstrates that following implementation of the identified mitigation strategies, the residual risk levels for aquatic ecology values is assessed as low.

No other project proponent proposing to develop a mining or other project within the gas fields' project area has publicly confirmed that discharges to watercourses are planned.

There are potential cumulative impacts to water quality resulting in adverse effects on aquatic flora and fauna due to increased total suspended solids and turbidity as a result of riparian vegetation removal and construction of pipelines and roads across watercourses from other project developments within the gas fields' water catchments. Implementation of erosion control and sediment controls to address regulatory requirements, along with construction activities being undertaken in consideration of wet weather should minimise the risk of cumulative environmental impacts to aquatic ecology values.

25.2.6 Surface water

Water courses within the principle catchment areas of the gas fields are mostly ephemeral and have been significantly modified following settlement of the region.

The analysis within Volume 2 Chapter 11 identifies the potential impacts to these water courses, including on stream flow and downstream users resulting from discharges of treated associated water. These risks and possible impacts include:

- Damage to the environment from changes to natural flow regimes, which can cause erosion of watercourses and increased turbidity, and changes to aquatic ecology
- Damage to the environment from discharge that is beyond the hydraulic capacity of waterways, which can cause hydraulic and geomorphic changes to waterways
- Impact to downstream water users (including the environment) from adding flows to the system, which can increase water availability to downstream users and possibly improve the hydrological condition of Narran Lakes.

Preliminary hydrological modelling detailed in Volume 2 Chapter 11 identifies preliminary discharge guidelines to be applied to ensure acceptable environmental and water security outcomes.

No other project proponent proposing to develop a mining or other project within the gas fields' development area has publicly confirmed that discharges to watercourses are planned. If other discharge proposals emerge in the future, the preliminary discharge guidelines would be similarly applicable.

Australia Pacific LNG has designed the gas fields such that key infrastructure, such as gas processing and water treatment facilities will be located above the 1 in 500-year average recurrent interval flood events. It has not proposed to place any infrastructure within flood prone areas that could increase the intensity of flood impacts on downstream property.

If other proponents for major projects across the gas fields' region adopt a similar approach to site planning and flood management, it is unlikely that significant cumulative impacts associated with flooding will occur.

25.2.7 Groundwater

The proposed development of the various CSG projects has the potential to affect the groundwater environment within and beyond the proposed gas fields' area. The groundwater modelling detailed in Volume 2 Chapter 10 was based on projected groundwater impacts for all major CSG projects in the Surat Basin.

In general, the magnitude of the projected groundwater level drawdown in the overlying and underlying aquifers was related to the thickness of the intervening lower permeability layers and the projected drawdown in the coal seams. The extent and magnitude of drawdown in aquifers of the Surat Basin, underlying and overlying the Walloon Coal Measures, is projected to expand in the cumulative case (relative to the project case) due to groundwater production by all CSG operators.

The drawdown effect is projected to be highest in the Springbok Sandstone, which is closest to the CSG interval. The Hutton Sandstone, which is beneath the Walloon Coal Measures and separated from it by a low permeability unit, is expected to experience comparatively less drawdown. Small amounts of drawdown are expected to occur in the deeper Precipice Sandstone, and shallower Gubberamunda Sandstone/BMO Group and near-surface Cainozoic Units.

Potential impacts associated with the projected groundwater level drawdown include:

- A low potential for adverse groundwater quality changes and groundwater-induced salinity
- A high risk of reduction of groundwater production rates in landholder bores

- A low risk of the reduction of baseflow to surface water systems and/or increases in stream losses
- A low risk of reduction to spring flows and negative effects of reduced water availability to groundwater-dependent ecosystems
- A medium risk of gas migration away from the gas fields and through inappropriately constructed wellbores
- A low risk of differential land subsidence
- A low risk of CSG production wells and existing well bores providing an artificial connection between aquifers, thereby locally exacerbating drawdown effects in overlying aquifers.

In relation to landholder bores, Australia Pacific LNG is committed to monitoring and mitigating these impacts according to the 'make good' requirement of the Queensland *Petroleum and Gas (Production and Safety) Act 2004*. It is considered that such measures would significantly reduce the residual risk.

A key element of managing potential impact for the Project will be the development of an adaptive groundwater monitoring program predicated on risk identification and management. Development of the regional monitoring network will be assisted by the projections of the numerical groundwater flow model.

It appears that all project proponents are making commitments similar to those adopted by Australia Pacific LNG. This involves committing to collaborating with the Queensland Government in support of its Blueprint for Queensland's LNG Industry (2009), and other CSG operators in the south central Queensland region, to develop an agreed approach to regional groundwater monitoring and cumulative effects groundwater modelling.

The implementation and use of this approach to enable effective impact and risk mitigation will require high levels of collaboration with other project proponents and regulatory authorities over time.

25.2.8 Associated water

Associated water is water that is co-produced from CSG wells as a result of de-pressuring the coal seams to liberate the adsorbed gas. The Queensland Government requires each proposed CSG project to submit an associated water management plan specific to that project. An adaptive associated water management plan for the Australia Pacific LNG Project is presented in Volume 2 Chapter 12.

The plan notes that, although several pilot studies for associated water management have been trialled, an understanding of the quantity and quality of associated water production from the Walloons gas fields is being progressively developed as further exploration and evaluation studies are completed. This highlights a need to adapt to changing conditions when developing water treatment facilities and brine management systems for the various CSG projects in the Surat Basin.

Australia Pacific LNG will optimise commercial and beneficial water use through a flexible approach including:

- Water which can be readily supplied long-term will be contracted to commercial customers
- Pursuit of opportunities for water to be managed in conjunction with other producers including water aggregation
- Investigation of beneficial uses and alternative water management technologies including aquifer injection.

The complexity and need for adaptive management and ongoing collaboration among different project proponents and regulatory authorities means that, while proposed mitigation strategies are expected to effectively manage impacts, the details are still evolving. On-going discussions are occurring between industry and government about potential future management of the water.

As part of associated water treatment, a brine stream will be produced. It is proposed that the brine will be initially stored in appropriate ponds. The ponds will be designed, operated and decommissioned to meet hazardous dams' standards, to ensure potential impacts on the surrounding environment are avoided. Currently, encapsulation is the industry management standard for evaporated brine (salts). This appropriately caps the cell to avoid environmental impacts. Australia Pacific LNG and other CSG proponents are currently investigating the technical feasibility of opportunities for the injection of brine into suitable reservoirs and/or crystallisation of brine for commercial use.

The cumulative volume of brine accumulated at surface by all CSG producers represents a significant cumulative risk to environmental values in the region, which will require careful and coordinated management to reduce this risk to an acceptable level.

25.2.9 Air quality

As detailed in Volume 2 Chapter 13, the primary source of air emissions within the gas fields' area will involve gas-fired engines used to drive equipment such as well-head pumps and gas processing facilities, as well as for power generation. Construction and transport activities will also result in air emissions, such as from internal combustion engines, dust generated from earth moving activities, and vehicle movements on unpaved roads and construction sites.

The key air pollutant identified in the Australia Pacific LNG air quality assessment was nitrogen dioxide. Modelling was undertaken to determine the cumulative ground level concentration for nitrogen dioxide over the central gas fields' area southwest of Chinchilla. This area was selected as it has the greatest concentration of existing and proposed CSG development in the Walloons gas fields and hence where the cumulative impact is most likely to occur. Cumulative impacts include the Australia Pacific LNG Project, and existing and other proposed CSG facilities and power stations in the south central Queensland region

The modelling enabled the potential total pollutant load in the region to be compared with ambient air quality objectives. The modelling results are presented in the technical report on air quality in Volume 5 Attachment 28.

The maximum ground-level concentration of emissions, predicted at any sensitive receptor location in this area, was below the relevant Environmental Protection (Air) Policy 2008 air quality objectives for both short-term and annual average requirements. This assumes that oxides of nitrogen emissions from the current rich-burn gas-fired engines at the Talinga gas processing facility are reduced, through non-selective catalytic convertors or similar reduction technology. Figure 25.3 shows the predicted cumulative maximum one-hour average ground level concentrations for nitrogen dioxide for the Australia Pacific LNG Project, and other existing or proposed CSG developments in the central gas fields' area (also known as the Undulla Nose area).

In relation to the potential for cumulative impacts from dust associated principally with construction activities, Australia Pacific LNG proposes a range of dust mitigation and management measures. These include minimising the area and duration of land disturbance, dust suppression, traffic controls and speedy rehabilitation of disturbed areas.

As a consequence, potential dust impacts are expected to be generally minor in magnitude, localised in extent and short in duration. They are considered to have a very low potential to contribute significantly to cumulative impacts with other proposed projects in the region.

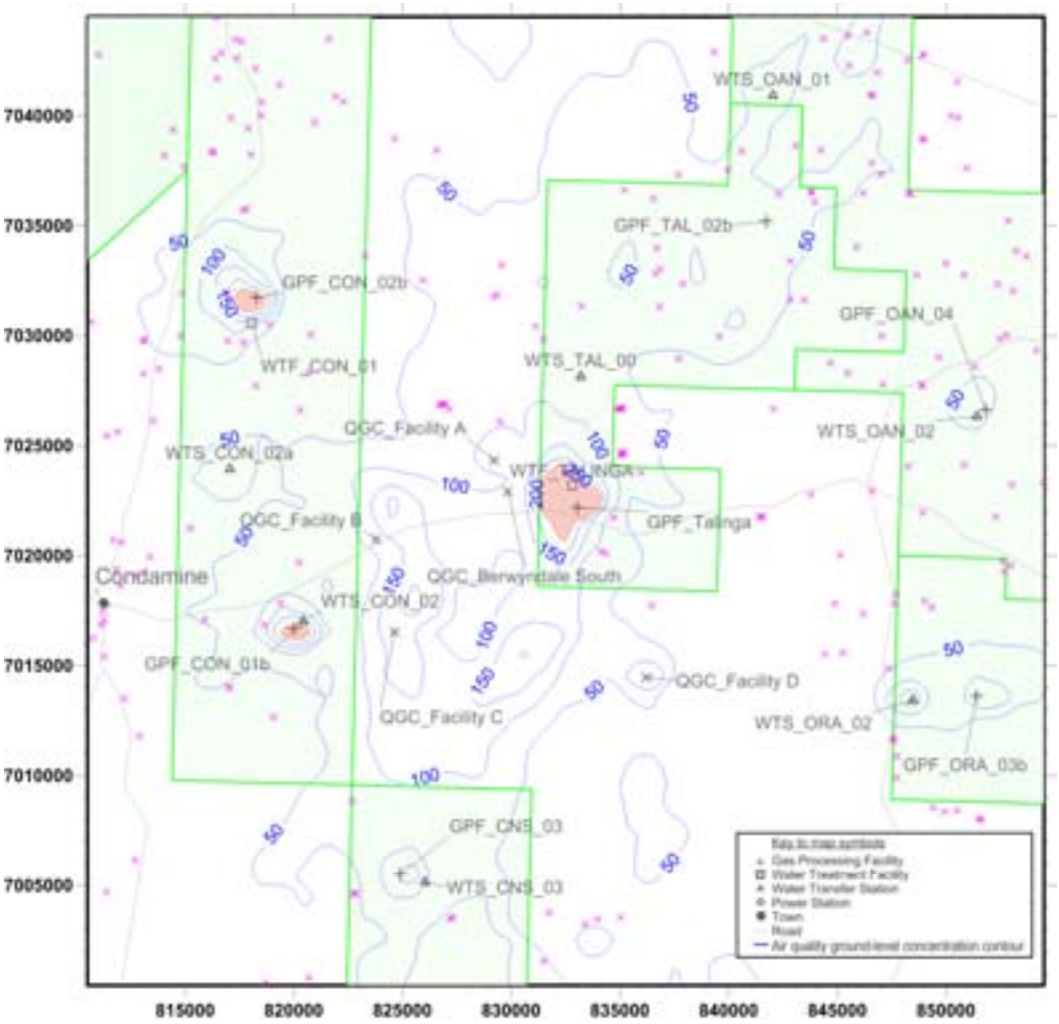

Figure 25.3 Predicted cumulative maximum 1-hour average NO_2 ground level concentrations

Notes:

Normal operating scenario – predicted maximum 1-hour average ground-level concentrations of nitrogen dioxide (NO_2)for the Australia Pacific LNG gas fields with background including third party gas producers (central gas fields' case study model)

Locations of identified sensitive receptors are also shown with pink crosses.

Areas exceeding objective are shaded red.

Data source: CALPUFF; Units: µg/m³

Environmental Protection (Air) Policy 2008 - Air quality objective: Health and wellbeing: 250 µg/m³

Prepared by: Katestone Environmental, December 2009

25.2.10 Greenhouse gas emissions

Assessment of the cumulative impacts of the major 30 projects in the region on state and national greenhouse gas (GHG) emissions inventories was assessed in comparison to the year 2007. The impact on Australia's projected GHG emissions for 2030 was also considered.

Due to the non-site specific nature of GHG emissions, the analysis considered the emissions from all projects, irrespective whether they are located within the vicinity of the gas fields, gas pipeline, or LNG facility.

Figure 25.3 shows the scope 1 (and where relevant, scope 2)[3] GHG emissions of the Australia Pacific LNG Project and other major projects in the region, specifically those projects currently undergoing expansion and new projects (including CSG developments) not yet operating.

GHG data were sourced from environmental impact statements for the other major projects where they were publicly available. For example, data for the Gladstone Steel Plant, the East End Mine Expansion, the Wiggins Island Coal Terminal and the Yarwun Alumina Refinery were either not available or not reliable for use in this analysis.

Data on the estimated GHG emissions for the proposed Shell LNG project were not publically available at this time. Scope 1 GHG emissions data for the Shell LNG project were therefore estimated based on the average GHG emissions intensity for the Australia Pacific LNG, Gladstone LNG (GLNG), Queensland Curtis LNG (QCLNG) and Gladstone LNG – Fisherman's Landing projects. The average was estimated to be 0.3 million tonnes of carbon dioxide equivalent per year (Mt CO_2-e/yr). The estimated LNG production capacity of the Shell LNG facility is 16Mtpa LNG; therefore, the estimated GHG emissions are 4.8Mt CO_2-e/yr. The gas field GHG emissions were estimated for the Shell LNG and Gladstone LNG (Fisherman's Landing) projects on the basis that the ratio of gas fields to LNG facility GHG emissions is about 1:1 on average.

Some GHG emissions estimates are for peak annual GHG emissions (e.g. Australia Pacific LNG, Gladstone LNG and QCLNG), while GLNG GHG emissions data is an annual average and the Shell LNG data is coarse estimates. Complexities due to differing CSG production ramp-up periods for each project were not considered in this analysis.

It should be emphasised that the data presented in Table 25.3 for Shell LNG and Gladstone LNG projects are estimates. A comparison of the GHG intensity data for the proposed Australia Pacific LNG, Gladstone LNG, GLNG and QCLNG LNG facilities is presented in more detail in Volume 4 Chapter 14 and Volume 5 Attachment 31.

The total GHG emissions for these major projects in the Gladstone region are approximately 39Mt CO_2-e/yr. These projects would represent 6.5% of Australian GHG emissions in 2007 (597Mt CO_2-e). In terms of Queensland GHG emissions in 2007 (182Mt CO_2-e), these projects represent 21.4% of state GHG emissions.

A second scenario considers if all projects were operational in 2030. From the Garnaut Report (Garnaut 2008), Australia's GHG emissions under a business as usual scenario without a carbon pollution reduction scheme could reach approximately 800Mt CO_2-e. If it is assumed that all facilities would continue their GHG emissions at their current or presently projected levels then total GHG emissions from the major projects in the Gladstone region represent 4.9% of Australia's net GHG emissions. Of this 4.9%, 3.2% is related to LNG projects. Based on the analysis conducted in Volume 5 Attachment 31, the combined LNG projects could avoid global emissions of 190Mt CO_2-e/yr based on 42Mtpa of export LNG substituting for coal-fired electricity generation. This equates to a reduction of 24% of Australia's emissions in 2030.

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[3] Scope 1 GHG emissions are produced directly from combustion and fugitive sources that are within the project's boundary. Scope 2 GHG emissions arise from the generation of purchased electricity, heat and steam. This energy is generated outside of the project boundary and is transmitted to the project site.

Table 25.3 Summary of GHG emissions for major projects in the south central Queensland region

Project	Emissions data million tonnes CO_2-e/yr	Comments
Australia Pacific LNG	3.3	Estimated annual scope 1 GHG emissions for the Project's gas fields and the gas pipeline during peak LNG production.
	2.4	Estimated annual scope 1 GHG emissions from other gas fields during peak LNG production.
	5.5	Estimated annual scope 1 GHG emissions for the Project's LNG facility with four-LNG production train (train) operations producing 18 Mtpa of LNG
Boyne Smelters Reduction Line Expansion	3.1	Total scope 1 and 2 emissions for the expansion of plant's three reduction lines (refer Boyne Smelters 2002).
GLNG Facility	3.7	10Mtpa case using the upper limit GHG emissions; covers operations and land-clearing GHG emissions (refer Santos Ltd. and PETRONAS 2009).
	3.5	Total scope 1 emissions (10Mtpa); average annual emissions – assumes ConocoPhillips' Optimized Cascade® Process technology.
Gladstone LNG (Fisherman's Landing)	0.6	Estimated scope 1 GHG emissions for gas field and pipeline operations carried out by Arrow Energy/AGL (refer Gladstone LNG 2008).
	0.6	Estimated maximum annual scope 1 and 2 GHG emissions for two-train operations (3Mtpa).
Gladstone Pacific Nickel	0.2	Stage 1 emissions: scope 1 and 2 emissions per annum (refer URS Australia 2009, Appendix M).
	0.6	Stage 2 emissions: scope 1 and 2 emissions per annum.
Moura Link Railway	0.5	Scope 1 and 2 emissions per annum (refer Queensland Rail 2008, Section 10).
Queensland Curtis LNG	2.5	Maximum annual scope 1 GHG emissions for gas field and pipeline emissions scaled by 1.5 for three-train operations (refer QGC Limited 2009)

Project	Emissions data million tonnes CO_2-e/yr	Comments
	3.0	Maximum annual scope 1 GHG emissions for 11Mtpa operations (includes commissioning phase).
Shell LNG (with Arrow Energy)	4.8	Estimated scope 1 GHG emissions. Only initial advice statement available at this time (Shell CSG (Australia) Pty Ltd 2009)
	4.8	Estimated scope 1 GHG emissions for a 16Mtpa LNG facility with four-train operation
GPC Western Basin Dredging	0.3	Data provided in EIS, assumed to be scope 1 emissions (refer Gladstone Ports Corporation 2009a, Appendix T).
GPC Fisherman's Landing Northern Expansion	0.03	Data provided in EIS, assumed to be scope 1 emissions (refer Gladstone Ports Corporation 2009b, Appendix F).
Yarwun Alumina Refinery	0.002	Stage 2 of the expansion will increase output to 3.4Mtpa. Reported GHG emissions data may not be reliable and are therefore not used in this analysis

25.2.11 Noise and vibration

The key noise creating aspects of the various identified projects in the gas fields' area are expected to be constructing wells and operating gas processing facilities. Additional noise and vibration associated with construction activities, particularly rock breaking, trenching for pipelines and blasting, if required, have the potential to cause relatively short-term noise disturbance at some dwellings. Similarly, traffic noise associated with transport of equipment or personnel, particularly on quieter rural roads out of hours, could cause local noise disturbance.

Given that multiple gas tenement holders have numerous tenements scattered throughout the Surat and Bowen Basins, it is possible that different CSG project proponents could develop infrastructure in adjacent gas fields. However, the modelling detailed in Volume 2 Chapter 15 demonstrates that noise impacts from gas field development activities are localised and do not generally extend outside tenement boundaries. As a result, it is highly unlikely that there will be any particular locations at risk of experiencing significant cumulative noise impacts.

25.2.12 Waste

It is assumed that all relevant project proponents will adhere to common practices for waste minimisation. Australia Pacific LNG commits to:

- Implement the waste hierarchy – avoid, reduce, re-use, recycle, dispose
- Dispose of any generated waste in a safe and efficient manner, limiting risk to employees and the public, and in compliance with the relevant legislation.

While limited data is currently available, the extent of cumulative waste may have the potential to place pressure on the capacity of landfills in the area.

This issue will require various project proponents to effectively consult with local councils, to determine current landfill capacities and accepted waste types. Should insufficient capacity be identified, the proponents will need to individually or collectively provide information to councils to enable planning for the expansion and upgrade of their landfills.

25.2.13 Traffic and transport

The traffic and transport analysis outlined in Volume 2 Chapter 17 highlights that the key cumulative traffic and transport impacts associated with the Project and other proposed regionally significant projects will come from substantial increases in road traffic over time. It is likely that other proposed projects in the gas fields' region would use the same general road network for transport of equipment, materials and personnel as that proposed by Australia Pacific LNG.

As part of this technical analysis, when determining the impact of the project, four components of the road infrastructure network were analysed as follows:

- Road link capacity
- Intersection capacity
- Pavement capacity
- Bridge capacity.

Road link, intersection and pavement capacity were assessed using a spreadsheet-based sketch traffic model. This combined background traffic and growth rates with project generated traffic. The impact of the Project on bridges was assessed qualitatively, as only limited bridge condition data was made available for this assessment.

These projected traffic increases will require the following works to upgrade the road network in the relevant parts of the south central Queensland region:

- Upgrades to federal, state and local government road links within the region
- Pavement rehabilitation works brought forward on federal, state and local government road segments, due to heavy vehicle traffic generated by the proposed projects.

The technical analysis summarised in Volume 2 Chapter 17 indicates that with the proposed mitigation measures the cumulative impacts on traffic and road networks of all CSG projects and other regionally significant projects will be significantly lower. However, the risk of serious traffic accidents remains high due to the relatively 'uncontrolled' nature of this risk. To reduce the risk of accidents to employees and other transport network users from project operations, Australia Pacific LNG will develop and implement detailed traffic management plans and transport and logistics management plans for constructing and operating the Project. These plans will incorporate safety measures to be implemented across all relevant modes of transport. Australia Pacific LNG will also work with the relevant regulatory authorities and, where appropriate, other project proponents to address road safety issues.

25.2.14 Heritage

Potential impacts to Indigenous and non-indigenous (shared) cultural heritage in the vicinity of the gas fields typically relate to construction activities.

Australia Pacific LNG is developing cultural heritage management plans with the relevant Indigenous parties within the Walloons gas fields to minimise potential impacts to cultural heritage values.

Should the other projects in the region develop cultural heritage management plans to meet regulatory requirements and manage Indigenous heritage, the likelihood of cumulative impacts to registered Indigenous heritage sites is considered to be low.

Management approaches usually involve:

- Identifying listed Indigenous cultural heritage locations early in project planning
- Carrying out a site selection process to avoid identified locations
- Agreeing on mitigation and management measures with the Indigenous parties where impacts cannot be avoided.

There is potential for increased risks to non-indigenous (shared) heritage sites from the cumulative effects of multiple projects in the region, particularly during construction phases of the various proposed projects.

Australia Pacific LNG proposes to manage shared heritage through avoiding identified non-Indigenous heritage sites, managing development impacts in the vicinity of these sites, developing procedures to deal with sites detected during construction, carrying out detailed recording (archives) of threatened sites, and recovering information on early non-Indigenous land use.

If other project proponents manage shared heritage in a similar manner to Australia Pacific LNG, the cumulative risks are considered to be low.

25.2.15 Social impacts

The development of multiple projects within the gas fields' study area will impact on the local social environment and values. These impacts are broadly consistent with those associated with the Australia Pacific LNG Project in isolation. However, the probability and consequences of cumulative impacts are greater if they are not appropriately mitigated.

In the context of social impacts, quantitative and qualitative tools (e.g. modelling and stakeholder consultation) were used to evaluate the collective information from the projects to assess the cumulative impacts to the gas fields' study area. As with the Project level assessment, cumulative social impacts have been classified according to a number of categories identified through existing knowledge of the study area and contemporary social impacts assessment practices, and then refined during the Australia Pacific LNG impact assessment workshops.

Impact categories which are anticipated to be particularly affected through the construction and operation of numerous projects in the gas fields' study area include population, income and affordability, local facilities and services, skills shortages, demand on house prices and community values and lifestyles.

Population increases resulting directly and indirectly from the construction and operation of the various projects in the gas fields' study area have the potential to impact significantly on the social values and environment of the local communities. If all projects proposed in the gas fields' study area were to go ahead, it is anticipated that they could directly employ up to 6,300 construction workers by 2012, averaging 3,600 workers during the 2009 to 2016 period. With respect to the operational workforce it is anticipated up to 1,000 workers could be required by 2013 with further increases of up to 2,100 by 2017 and beyond.

In addition to these workforce-related population increases, there will be further increases associated with the partners and families of some workers choosing to move to gas fields' communities as well as indirect population increases associated with the growth of businesses, infrastructure and services in response to increased demand from development in the region.

Increasing population (both permanent and temporary), transport movements and businesses have the potential to increase the demand for services and infrastructure; including roads, housing, and education and health facilities.

Although the cumulative population increase due to the operational phases of projects is considerably less than for construction, it is expected that the potential impact to facilities, services and demand for housing will be significant. This is due to a greater proportion of the workforce (and their families) residing within communities rather than temporary accommodation facilities. The greater the influx of population into gas fields' communities, the more likely there will be an increased impact to community values and lifestyles as the region would be experiencing an increased rate of change and increased pressure on facilities and services. Furthermore, community values and lifestyle may be impacted through reduced opportunities for volunteering and involvement in local community activities and events as a result of shiftwork.

Cumulative effects will further exacerbate the potential Australia Pacific LNG Project impacts associated with increases in weekly income due to the influx of construction workers, short-to-medium term increases in the cost of goods and services and decreased housing affordability. Local businesses may be impacted positively through increased revenue and opportunities to expand and/or diversify. Potential impacts include an estimated cumulative increase in real post-tax wages of 0.6%, accompanied by a regional increase in goods and services in the short-to-medium term, as the supply side in local areas adjusts to the increase in demand.

The cumulative impact of multiple projects, during both the construction and operational phases, is anticipated to place severe strains on labour force availability and skills shortages if not appropriately managed. Cumulative effects will further exacerbate the potential impacts to local and regional businesses including competition for labour, goods and services and commercial real estate, somewhat offsetting some of the gains that are likely to flow through from increased demographic and economic growth.

An increase in the population due to cumulative construction workforce requirements, particularly an influx of young, male-dominated workers may have an impact on community concerns regarding safety and health. Cumulative impacts due to construction and operation of the gas fields' infrastructure will cause a significant increase to road, air and shipping movements as a direct result of the transport of personnel, materials and equipment and potentially impact on community health and safety.

In order to address the cumulative impacts associated with the anticipated population increase and related social impacts, Australia Pacific LNG will work with other industries, government and service providers to plan and share information relating to potential impacts and mitigation measures. This will facilitate longer term planning and seek to mitigate the potential impacts detailed above.

25.2.16 Economic impacts

Australia Pacific LNG engaged KPMG Econtech to undertake economic modelling to identify the cumulative economic impact of the projects. The cumulative impact modelling captures the impact on the national, state and regional economies, if the identified 30 major projects (including the Australia Pacific LNG Project) proceed to full operation.

Detailed information about the modelling is provided in Volume 5 Attachment 44.

The model was used to assess the economy-wide cumulative impact of the 30 identified projects. Due to the specific geographical nature of the projects, these impacts were then also examined at a state and regional level. To evaluate the maximum impact associated with the projects, it has been assumed that all projects will proceed.

For practicable purposes, the economic impacts have been modelled for the whole Australia Pacific LNG Project, from the gas fields through to the LNG facility. This has been largely been done so the impacts can be examined and mitigated in a holistic manner.

The cumulative impact scenario has assumed that each project impacts the economy independently, with no sharing of resources. The following results represent the deviation from the baseline scenario, where no projects proceed. This captures the effects on the economy of all 30 proposed projects listed in Table 25.1.

Once all of the proposed projects are fully operational, the national economy will benefit from:

- Higher real Gross Domestic Product on average by A$6.1 billion annually
- Increased real national income, driving both higher consumption and investment
- Higher standard of living of around A$1.1 billion annually, on average.

Due to the anticipated increase to the Australian real national income, the price of non-tradeables relative to tradeables, the real exchange rate is expected to be higher. Modelling illustrates that in the cumulative impact scenario, the Australian dollar would appreciate by 2.1%.

The change in the real value of the Australian dollar would impact on both export and import levels in Australia. Specifically, with an appreciation of the exchange rate, Australia's international competitiveness on global markets would be marginally lower, leading to lower demand for Australian exports. However, this will not be the case for LNG exports which will continue to increase. Trade exposed industries, such as manufacturing and agriculture, are expected to experience lower production levels following appreciation of the Australian dollar. Although an appreciating Australian dollar poses a number of challenges to export dominated industries, there are also a number of positive benefits including a reduction in the cost of imported goods and services thus reducing living costs for households.

At the state level, once the projects are fully operational:

- The projects are estimated to lead to higher employment in Queensland by an average of 55,000 direct and indirect jobs
- Queensland's Gross State Product is expected to be A$6.9 billion (3.6 %) higher on average each year.

As with the impact of the Australia Pacific LNG Project in isolation, the contribution to the Queensland economy is greater than for the Australian economy because of the location of the 30 projects in Queensland. This will mean that a higher proportion of inputs (labour, goods and services) would be sourced from within Queensland than elsewhere in Australia.

At full operation, the 30 projects are estimated to have the following impacts on the regional economy within which the gas fields are situated:

- In the Darling Downs-South West region, the projects are estimated to lead to higher employment by an average of 39,300 jobs
- The Darling Downs-South West's Gross Regional is expected to be A$5.2 billion (41.4%) higher on average each year with the projects at full operation.

The primary cumulative economic impacts of the projects will be positive, leading to increased incomes, expenditure and employment. The Western Downs and Maranoa Regional Council areas will be key beneficiaries of the impacts on the Darling Downs-South West region. These impacts will create substantial employment opportunities in communities such as Miles, Chinchilla, Dalby and Roma, specifically in the mining, electricity, gas, water and construction industries.

As well as directly stimulating output, if all 30 proposed projects included in the cumulative impact scenario proceed, there will be a range of indirect flow on benefits. This will occur through an increase in demand from the projects' supply chains, and increased demand by project workers. This, in turn, would boost revenue in the Mackay-Fitzroy-Central West and the Darling Downs-South West economies. This higher revenue will then flow through to extra spending in the regions' consumer-oriented industries, such as retail trade, health and community services, and cultural and recreational services.

25.2.17 Hazard and risk

The design and implementation of comprehensive and effective risk management practices will use the concepts based on Australian standards (AS/NZS ISO 31000:2009). These are standard operating procedures for constructing and operating major mining and infrastructure projects. Similarly, Australia Pacific LNG will design, construct and operated all gas pipelines in the gas fields in accordance with AS 2885: Pipelines - Gas and liquid petroleum.

Based on past practices and currently available environmental impact statements, it is reasonable to assume that the potential hazard and risks associated with abnormal events and accidents are limited to the extent of the petroleum tenements (refer to Volume 2 Chapter 22), with the exception of traffic and transport risks. The mitigation measures associated with traffic and transport are addressed in Section 25.2.13.

25.3 Conclusions

Cumulative impacts on physical/biological, social, cultural, economic and built environmental values have been assessed for the collective 30 projects currently proposed for the broader central Queensland and Western Downs regions. These have been applied, where relevant, across 16 categories of values – land, landscape and visual amenity, terrestrial ecology, aquatic ecology, surface water and watercourses, ground water, associated water, air quality, GHG emissions, noise and vibration, waste, traffic and transport, cultural heritage, social impacts, economic impacts, and hazard and risk.

It should be noted that in most instances quantitative published data was not available to enable quantitative assessment of cumulative impacts.

In 10 categories, it is considered that there is only a low to moderate level of risk associated with potential cumulative impacts. In a limited number of cases – groundwater, associated water, social, economic and greenhouse gas emissions – one or more of the following factors has led to a higher rating in terms of impact significance and/or risk:

- A relatively high degree of complexity exists relating to characteristics of the values in question
- A relatively high degree of complexity exists relating to cumulative impact mechanisms
- Available mitigation approaches are not standardised and require the ongoing cooperation of multiple parties.

In these cases, it is considered that the risks can be managed effectively if the various proponents and relevant regulatory authorities cooperate to implement impact mitigation strategies such as those committed to by Australia Pacific LNG.

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