



ARROW BOWEN PIPELINE PROJECT

INITIAL ADVICE STATEMENT



Rev	Date	Description	Prepared	Checked	Approved
0	14.02.11	Issued to DERM	LR	GLM / IB	GLM / IB

Executive Summary

Arrow Bowen Pipeline Pty Ltd (Arrow), a wholly owned subsidiary of Arrow Energy Pty Ltd (Arrow Energy), proposes to construct a 600 km long point-to-point transmission pipeline to convey coal seam gas (CSG) from its fields in the Bowen Basin to a proposed Liquefied Natural Gas (LNG) Plant on Curtis Island in Gladstone for export as part of the further development of its CSG interests.

This Initial Advice Statement (IAS) has been prepared to provide preliminary information about the physical, ecological and socio-economic environment in relation to the proposed Arrow Bowen Pipeline (ABP). The document will enable stakeholders to determine the nature of, and their level of interest in, the proposed Arrow Bowen Pipeline Project (the Project).

The purpose of this IAS is to provide supporting material for an application to the Queensland Department of Environment and Resource Management (DERM) to prepare a voluntary Environmental Impact Statement (EIS) under Chapter 3, Part 2 of the *Environmental Protection Act 1994* (EP Act). This information will also be used to determine whether a referral will be made to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWP&C) pursuant to the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The ABP Project's schedule has been established, with the Final Investment Decision (FID) to be made early 2013.

Arrow is committed to sustainably implementing the ABP Project and will work closely with all stakeholders as part of its extensive corporate community consultation process. Arrow has a proven track record of successfully implementing gas and associated infrastructure projects in the region. This is due to a strong focus on achieving sound environmental outcomes and maintaining close communication with DERM and other regulatory bodies and agencies throughout all project stages.

Arrow is confident that the ABP Project can be implemented in a manner that minimises the risks of adverse environment and community impacts.

Project benefits at the regional, state and national level, include:

- Initial capital investment of approximately \$1 billion;
- Creation of a new long-term CSG processing and export industry in Queensland utilising Arrow's Bowen Basin reserves;
- Providing diversification to many local and national industries and economies through the introduction of new technology and business in the region;
- Contribution to the growing CSG – LNG processing and export industry in Queensland, particularly in the central Queensland region;
- Creation of up to 650 jobs at the peak of construction;
- Contribution to Queensland and Commonwealth revenue.

Early route selection and planning has considered a number of alternative options within environmental, social and constructability constraints to minimise, and largely avoid, sensitive areas thereby reducing the potential environmental impacts in the planning stages of the Project.

During early route selection, particular attention has been placed on the avoidance of 'Endangered' and 'Of Concern' Regional Ecosystems (REs). At least 93.7% of the area to be cleared is classified as 'Non Remnant' and 'Not of Concern'. The maximum disturbance area of 16.3 ha of 'Endangered' vegetation represents only 0.13% of the area of similar status vegetation occurring within a 5 km buffer of the preferred alignment.

No internationally or nationally important wetlands will be impacted by the pipeline. The majority of referable wetlands are avoided by the proposed route. The locations of watercourse crossings and proposed construction methods have been carefully selected to minimise impacts to both riparian vegetation and bank profiles.

Five flora species and seven fauna species protected under the EPBC Act and / or the *Nature Conservation Act 1992* (NCA) are considered likely to have preferred habitat along the pipeline route. Small areas of essential habitat for two protected species are mapped within the proposed route.

Field assessments will ground-truth areas of interest identified during desktop searches and help determine the distribution, likely impacts and potential additional avoidance options for threatened species, ecological communities, referable wetlands and essential habitat.

More detailed environmental assessment documentation will be progressively developed during the approval process to determine the significance of impacts and include the identification of necessary avoidance, mitigation and management strategies as part of the EIS process.

Considering the relatively few environmental and social sensitivities directly impacted by the project, and the proposed low impact construction approach, Arrow believes that, subject to the proposed detailed ecological survey, cultural heritage assessment, transport study and pipeline safety management study to be considered in the EIS, the environmental and cultural heritage impacts of the ABP Project can be effectively minimised and proactively managed.

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1 INTRODUCTION

1.1 PURPOSE

Arrow Bowen Pipeline Pty Ltd (Arrow), a wholly owned subsidiary of Arrow Energy Pty Ltd (Arrow Energy), is proposing to construct a 600 km long transmission pipeline from Arrow Energy's coal seam gas (CSG) fields in the Bowen Basin commencing at Red Hill (north of Moranbah) to Gladstone.

The purpose of this Initial Advice Statement (IAS) is to provide supporting material for an application to the Queensland Department of Environment and Resource Management (DERM) to prepare a voluntary Environmental Impact Statement (EIS) under Chapter 3, Part 2 of the *Environmental Protection Act 1994* (EP Act). The EIS Terms of Reference (ToR) will be developed for the Arrow Bowen Pipeline (ABP) Project based on this IAS which will also inform stakeholders about the proposed Project.

1.2 SCOPE

This document will:

- describe the proposal, including any options being considered and authorised activities to be carried out;
- identify the key statutory approvals that may be required for the Project to proceed;
- describe the Project site;
- provide a preliminary overview of the physical, ecological and socio-economic environment associated with the proposed pipeline alignment;
- discuss the environmental values that may be affected by the Project; and
- identify potential impacts of the Project that will require further investigation.

2 PROJECT BACKGROUND

2.1 OVERVIEW

It is proposed to construct a 600 km long transmission pipeline, the Arrow Bowen Pipeline (ABP), from Arrow Energy's CSG fields in the Bowen Basin approximately 90 km north of Moranbah in central Queensland to Arrow Energy's proposed Arrow LNG plant on Curtis Island off Gladstone on the central Queensland coast.

The proposed pipeline will be buried, comprised of welded steel and constructed in accordance with AS 2885, Pipelines – Gas and Liquid Petroleum and other applicable standards and regulations (including the Australian Pipeline Industry Association (APIA) Code of Environmental Practice - Onshore Pipelines (APIA 2009)).

The pipeline will have a minimum technical design life of 40 years, however with ongoing integrity management the operational life is expected to exceed this period.

The overall proposed Project schedule is provided in Table 1.

Table 1: Proposed ABP Project Schedule

Milestone	Target Date
Initial Ecological Assessment	Sep 2010 to April 2011
Engineering Feasibility and Modelling	Sep 2010 to July 2011
Major Approvals (EA) ¹ Decision	Jul 2012
Major Approvals (PPL) ² Decision	Oct 2012
Final Investment Decision (FID)	End 2012 / 2013
Commence Construction	Mid 2015
Commence Commissioning	Early 2017
Commercial Operation	2017

¹ Environmental Authority (EA) to be issued by Department of Environment and Resource Management (DERM)

² Petroleum Pipeline Licence (PPL) to be issued by the Department of Employment and Economic Development and Innovation (DEEDI)

2.2 PROPONENT

Project proponent: Arrow Bowen Pipeline Pty Ltd.

ACN: 141 181 295

Registered Address: Level 19, AM 60, 42-60 Albert Street, Brisbane QLD 4000

Arrow Bowen Pipeline Pty Ltd (Arrow) is a fully owned subsidiary of Arrow Energy Ltd (Arrow Energy), a leading Australian based integrated energy company involved in the exploration, appraisal and development of coal seam gas (CSG), a cleaner burning fuel commonly used for electricity generation.

Arrow Energy was established in 1997 and listed on the Australian Stock Exchange (ASX) in August 2000. In August 2010, Arrow was acquired by CS CSG (Australia) Pty Ltd which is jointly owned by Shell Energy Holdings Australia Limited, a subsidiary of Royal Dutch Shell plc (Shell) and PetroChina International Investment Company Ltd, a subsidiary of PetroChina

Company Limited (PetroChina). Both companies have an established history of working together on the development of energy projects and bring the technical capabilities, capital backing, major project experience and LNG marketing ability to accelerate the realisation of Arrow Energy's business goals (Arrow Energy 2010a).

Arrow Energy has equity interest in more than 65,000 km² of CSG exploration tenements close to Queensland's three key markets; Townsville, Gladstone and Brisbane (Arrow Energy 2010a).

Arrow Energy currently operates, or is a major participant in, a number of gas production facilities and supporting infrastructure as well as power stations. Arrow Energy's gas infrastructure assets include the Moranbah Gas Processing Facility. The company is in the preliminary stages of developing the Surat to Gladstone Pipeline which will facilitate the supply of gas from the company's Surat Basin projects to a planned LNG export facility in Gladstone. Figure 1 illustrates Arrow Energy's acreage position and CSG assets in Queensland (Arrow Energy 2010a).

The company's five producing projects currently account for around 20% of Queensland's overall gas consumption. Most of this gas is supplied to the Daandine (33 MW), Townsville (235 MW) and Braemar 2 (450 MW) power stations and the electricity sold into the national grid (Arrow Energy 2010a).

ARROW ENERGY ACREAGE POSITION

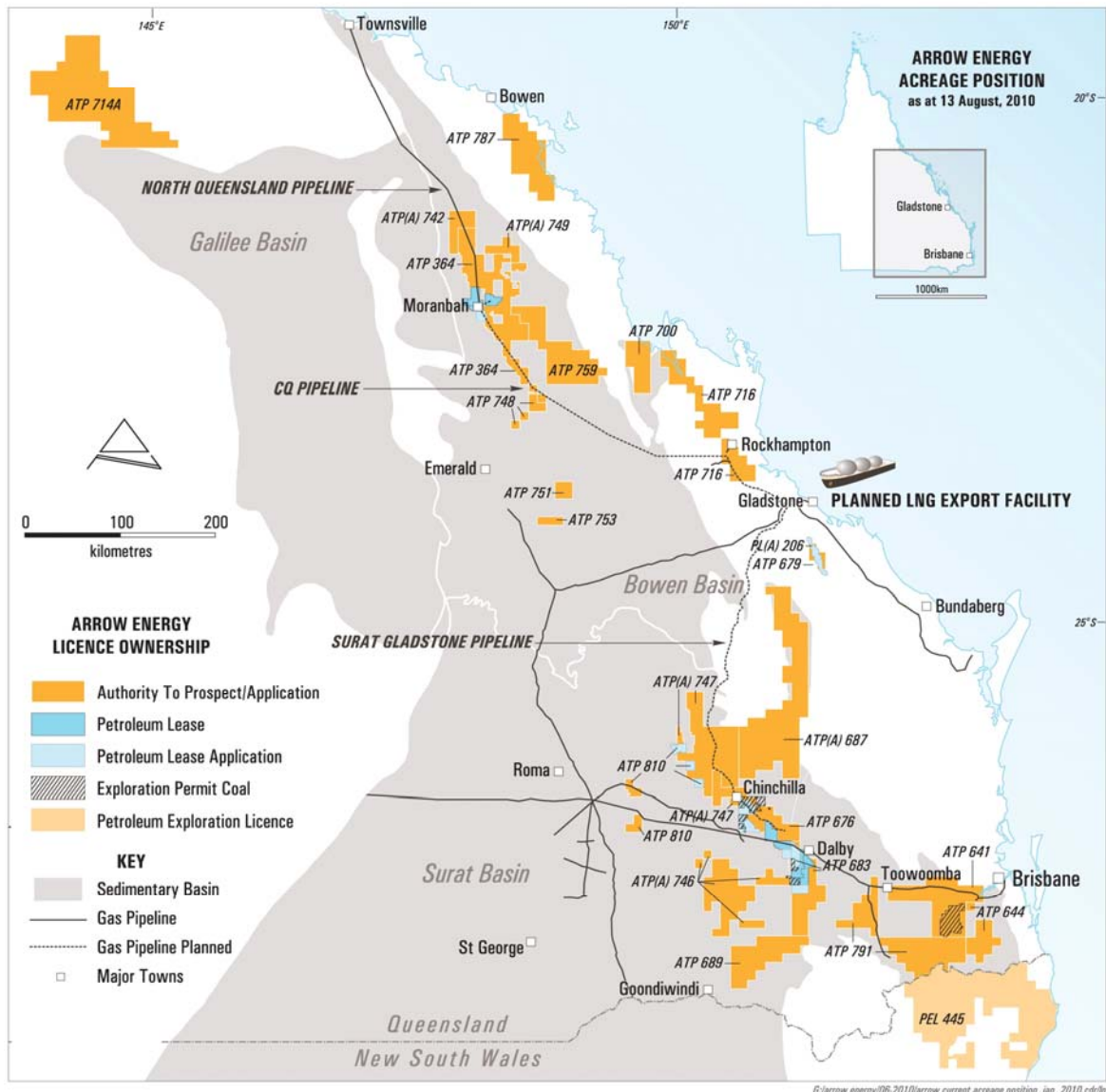


Figure 1: Arrow Energy's CSG resources in Queensland

2.3 STUDY AREA

2.3.1 LOCAL GOVERNMENT AUTHORITIES

The study area for the preferred pipeline route, illustrated on Figure 2 (also refer to Map 1, Appendix 1), traverses four local government authorities (LGAs), namely:

- Whitsunday Regional Council;
- Isaac Regional Council;
- Rockhampton Regional Council; and
- Gladstone Regional Council.

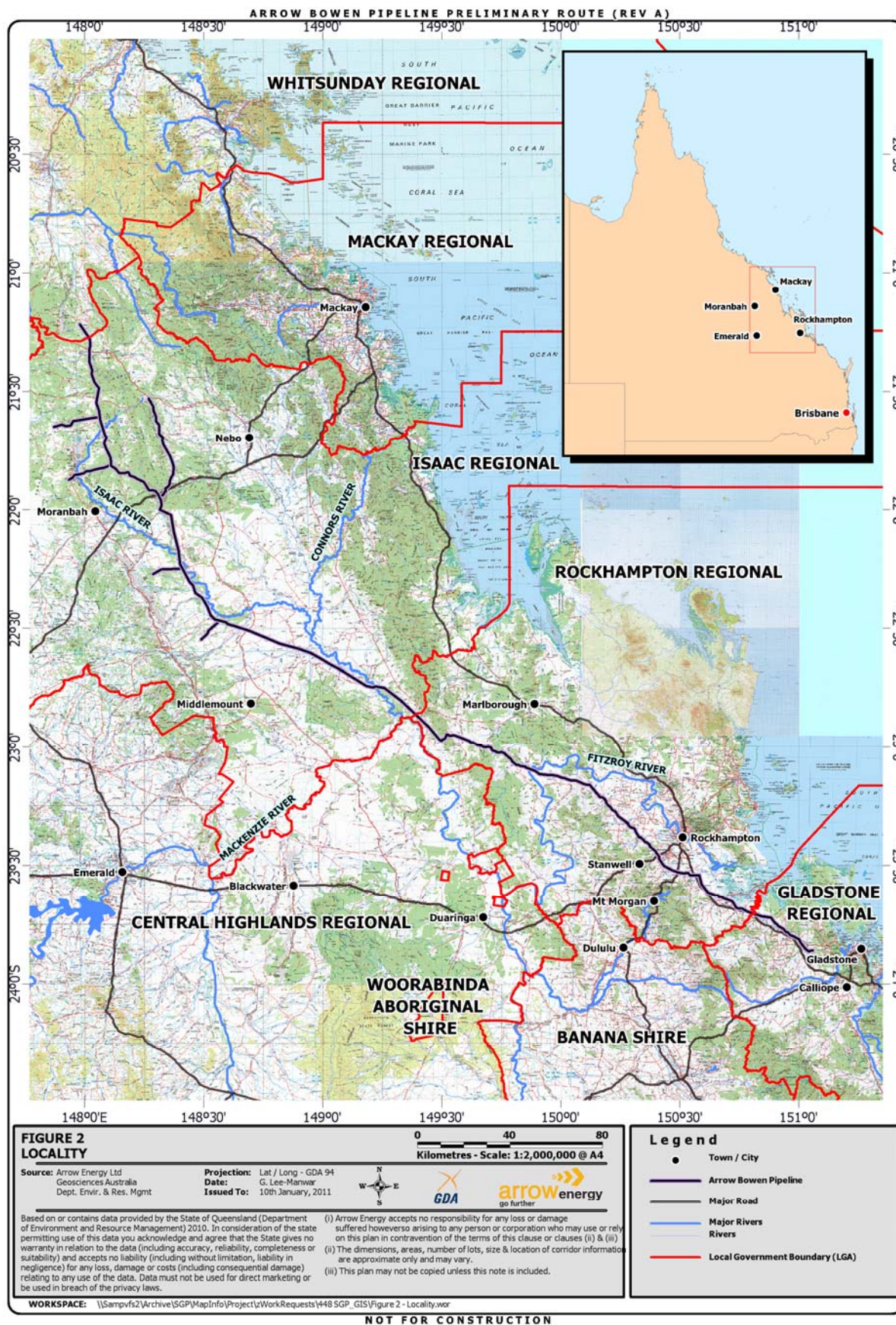


Figure 2: Study Area – General locality, key towns and LGA

2.4 PROJECT RATIONALE

2.4.1 NEED FOR THE PROJECT

There is an increasing local, national and global demand for cleaner, carbon-efficient energy. Arrow Energy is a leader in CSG development in Queensland, with the ABP Project forming part of Arrow Energy's vision to deliver gas to the domestic and export markets by:

- developing Queensland gas reserves and contributing to Queensland's domestic gas market by presenting a commercially sound and reliable investment in the economy;
- developing identified opportunities in the export LNG markets at a time when energy supply is in deficit and a continued growth in global demand anticipated;
- utilising a fuel source regarded internationally as a cleaner fuel source with lower greenhouse gas emissions compared to other fossil fuels; and
- strengthening both Queensland's and Arrow Energy's position as leaders in CSG development in Australia and globally.

The proposed ABP will connect Arrow Energy's vast coal seam gas (CSG) resources in the Bowen Basin with LNG facilities proposed for construction in Gladstone. The proposed Arrow LNG facility on Curtis Island, a joint venture between Shell and PetroChina, has a design capacity of 16 Mtpa.

Arrow is seeking a PPL to construct and operate the ABP from the Bowen Basin gas fields to Gladstone. A tunnel will be bored under the Coral Sea from a location south of Boat Creek between Fishermans Landing and the Wiggins Island Export Coal Terminal Site to Curtis Island in Port Curtis to accommodate the CSG transmission pipeline. This section of the transmission pipeline is not part of this IAS and will be considered in the EIS prepared separately for the proposed Arrow Energy LNG plant on Curtis Island.

2.4.2 PROJECT ALTERNATIVES CONSIDERED

There are a number of potential alternatives associated with the proposed ABP Project and selection options at a number of levels, including:

- Not developing the project;
- Pipeline route options; and
- Project design, construction techniques and environmental impact mitigation measures.

2.4.2.1 "No Project" Option

The alternative options to this Project are to proceed with the construction of the Central Queensland Pipeline (CQP) or do nothing. The proposed size of the CQP is, however, inadequate to transmit sufficient CSG to the proposed Arrow Energy LNG Plant on Curtis Island. It would in any event, be necessary to relocate part of the proposed CQP route to avoid impact on mining tenements and to re-design the pipeline to deliver the volumes of gas required for the Arrow LNG Plant.

The consequences of not proceeding with the ABP Project would be the non-realisation of the benefits outlined in Section 2.4.4 to the detriment of the local, regional, state and national economies. Increased competition in the gas supply market would not be achieved, potential

export markets would not be reached and the direct economic benefit from construction expenditure and the longer term benefits of the pipeline operation would be lost.

2.4.2.2 Route Options

Arrow Energy's objective for the ABP Project, is to cost effectively deliver CSG from its Bowen Basin resources to the proposed LNG plant at Curtis Island for global export.

To deliver on this objective, the proposed pipeline must be:

- Located in a pipeline corridor that allows cost-effective construction while minimising impacts to the environment, landholders, local communities and mining interests;
- Optimally configured to efficiently accommodate current capacity requirements while allowing for cost-effective expansion to meet future capacity requirements; and
- Designed and constructed in compliance with relevant standards while achieving capital and operating cost efficiencies through innovation in design and construction.

A number of alternate pipeline routes have been considered based, initially, on desktop assessment of topographical and ecological mapping. As illustrated in Figure 3 (also Appendix 1, Map 2), each route commences in the Bowen Basin, approximately 90 km north of Moranbah and consists of an additional header from the vicinity of Lake Elphinstone and a number of lateral line options (Red Hill Lateral; Goonyella Lateral (potentially linking ABP to the North Queensland Gas Pipeline); Saraji Lateral; Dysart Lateral (terminating at the currently proposed location of CQP)).

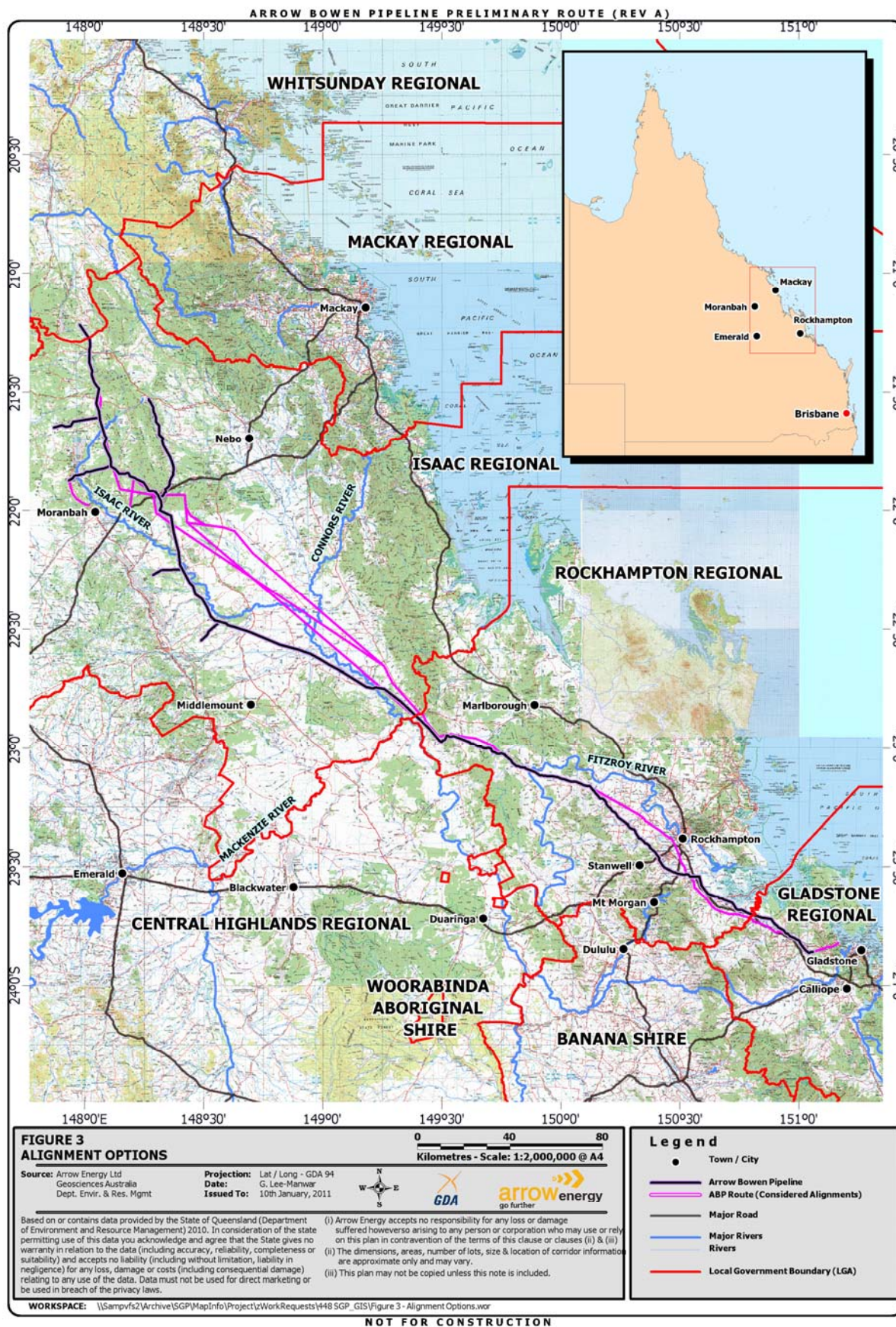


Figure 3: Alternate Route Options Considered

Initial work identified the feasibility of using a similar route following the former, and now relinquished, Papua New Guinea (PNG) Pipeline route from the Broadsound Range to Rockhampton. From Rockhampton to Gladstone, investigation initially centred on using the Stanwell - Gladstone Infrastructure Corridor (SGIC) as a probable option. The currently preferred route (Rev A), however, lies west of the northern end of the SGIC and parallels the Gladstone Nickel Project's Marlborough to Gladstone slurry line between Midgee and Ridgeland to avoid the floodplains in this section of the SGIC.

The pipeline route selection and evaluation methodology considered the following:

- Identification and assessment of the above baseline routes;
- Identification and assessment of potentially affected parties (stakeholders) i.e. land owners / holders, mining and exploration lessees, known and potential heritage and native title sites;
- Identification and assessment of environmental constraints;
- Identification and assessment of European and Cultural Heritage constraints;
- Identification and assessment of land use, tenure and access constraints;
- Identification and assessment of Native Title impacts;
- Identification of major crossings such as roads, railways, watercourses and other buried services;
- Identification and assessment of technical considerations for design, construction and operation;
- Assessment of identified constraints for impact on approvals schedule for each corridor;
- Assessment of Project impact on any identified constraints and route adjustment if warranted; and
- Assessment and comparison of options identified and prioritisation of a preferred route corridor.

The criteria utilised in selecting the preferred pipeline route were:

- Land:
 - Minimise community disturbance;
 - Minimise conflict with mining and petroleum tenements;
 - Minimise interruption to land use;
 - Minimise disturbance to third party infrastructure;
 - Utilise existing usable easements / reserves where practical; and
 - Rationalise the number of tenure negotiations.
- Environment:
 - Avoid protected areas and areas of high ecological value;
 - Minimise disturbance to remnant vegetation;
 - Minimise disturbance to sensitive or unstable landforms;
 - Minimise disturbance to RAMSAR wetlands and State Forests;

- Utilise previously disturbed areas or corridors where practical; and
- Minimise regulatory approval timeframes.
- Cultural Heritage and Native Title:
 - Undertake negotiations with registered claimants;
 - Avoid areas of Cultural Heritage significance;
 - Minimise disturbance to Cultural Heritage values; and
 - Minimise disturbance to land subject to Native Title.
- Technical:
 - Minimise pipeline length;
 - Minimise specialised construction activities;
 - Minimise extent of specialised materials / protective measures;
 - Maximise ease of access for construction and operations;
 - Minimise operational / maintenance costs; and
 - Maximise safety to residents and the general public.

The above constraints were scrutinised using GIS with avoidance, rather than management or mitigation, being the general principle. Data captured during a helicopter reconnaissance flight (22 to 26 November 2010) and an initial desk top assessment of flora and fauna has been used to inform the route selection.

The key geographical constraint on pipeline route options for the Arrow Bowen Pipeline is traversing the ranges running parallel to and inland of the Queensland coast. The two options considered were the valley between the Native Cat and Razorback ranges at Stanwell (the route adopted for the CQP) and Apis and Pluto creeks between the Broadsound and Boomer ranges. The Central Queensland Pipeline route adjacent to Stanwell is constrained by power station infrastructure and small landholdings to the east of the power station. This route is not the most direct route. In contrast, routes via Pluto Creek are shorter and less congested and are favoured over the CQP route. Refer to Appendix 1, Map 3 for travelogue constraints.

Adopting Pluto Creek as the preferred crossing of the Broadsound and Boomer ranges results in pipeline route selection being divided into two sections, the section south of the Broadsound Range and the section north of that range. In both instances straight lines were drawn between this point and the start and end points of the proposed pipeline to inform the identification of pipeline route options having regard to the route selection criteria.

Northern Section (Newlands to Broadsound Range)

Existing coal mining operations and proposed expansions, as indicated by mineral development licences, are key factors in route selection in the northern section. The proximity of coal exploration areas to existing and proposed coal mining operations was also taken into account in identifying route options. The depth of coal seams was also used to minimise potential conflicts with future developments and avoid potential impacts to the pipeline from subsidence resulting from underground mining operations. Pipeline route options through areas where coal seams are more than 700 m deep are favoured over areas with shallower coal seams, as surface and underground mining operations are likely to result in competing land uses.

North of the Peak Downs Highway, the Carborough, Kerlong and Burton ranges preclude east-west connection to the North Queensland Pipeline from tenements to the east of those ranges. Consequently, it was resolved that a header pipeline was required to service the tenements located in the vicinity of Lake Elphinstone. The header pipeline will connect to the main pipeline that will traverse the tenements to the west of those ranges. Connections to the North Queensland Pipeline are possible from the main pipeline.

The existing Newlands, Eastern Creek, Goonyella and North Goonyella collieries extend north of Moranbah in a north-south line. These mines are expanding to the north and east. Consequently, pipeline route options in this area are limited to the area adjacent to the Burton Range. Options for connection to the North Queensland Pipeline are also limited by the existing and proposed developments. Two options for connection to the North Queensland Pipeline were identified, one to the north of the North Goonyella colliery in the vicinity of Red Hill Bluff (Red Hill Lateral), and the other adjacent to mine infrastructure located south of the Goonyella open cut coal mine (Goonyella Lateral).

The South Walker Creek Colliery and coal mining leases and mineral development licences east of the Carborough Range constrain pipeline route options for the header pipeline (Elphinstone Header), resulting in options that traverse the severely eroded terrain at the base of the range being the only feasible routes.

The Goonyella and Norwich Park branch railways constrain pipeline route options in the vicinity of Coppabella where the proposed Elphinstone Header connects to the main pipeline (Arrow Bowen Pipeline). South of the Peak Downs Highway, Moorvale Colliery, mining leases and mineral development licences constrain pipeline route options to adjacent to the Annandale Road, as far south as Daunia Station which is located approximately 15 km south of the highway.

South of Daunia Station, the most direct route to Pluto Creek at the southern end of the Broadsound Range is along Devlin Creek which runs south–south westerly to its confluence with the Isaac River near its confluence with Connors River. To avoid unnecessary watercourse crossings, routes to the east and west of Devlin Creek were investigated. These routes involved long lateral pipelines to connect to potential coal seam gas fields in the vicinity of Peak Downs Colliery north of Dysart, and Norwich Park Colliery to the south. To reduce the length of the lateral pipelines, pipeline route options to the south and west of the Isaac River were investigated and found to offer feasible routes.

Southern Section (Broadsound Range to Gladstone)

The pipeline corridor investigated for the PNG Queensland Gas Pipeline Project offers the most feasible pipeline route options from the Broadsound Range to south of the Fitzroy River where it intersects the proposed Gladstone Nickel Pipeline. From this point there are two feasible pipeline route corridors, one following the proposed PNG Queensland Gas Pipeline corridor to the Stanwell Gladstone Infrastructure Corridor adjacent to Rockhampton Airport, and the other following the general alignment of the Gladstone Nickel Pipeline to south of Midgee. Both pipeline corridors along with a potential link between the routes in the vicinity of Limestone Creek, which is located east of Alton Downs, were investigated.

South of Midgee, the investigation of pipeline route options was confined to determining the feasibility of constructing the ABP in the Stanwell Gladstone Infrastructure Corridor (SGIC) and in, or adjacent to, the proposed Northern Infrastructure Corridor (NIC).

The alternate routes have been discounted, and the preferred route selected, based on maximising avoidance of 'endangered' and 'of concern' regional ecosystems. Vegetation clearing, in general, is minimised by utilising pre-existing clearings where practicable. The preferred route provides the basis for the discussion in this IAS and is described in greater detail in Section 4. This will be further refined based on detailed specialist field assessments including ecological, cultural, engineering and construction surveys during the EIS process.

2.4.2.3 Design and Construction Options

The basic design concepts for a high pressure natural gas pipeline are reasonably fixed and few alternatives that would lead to a different level of environmental impact exist.

A number of alternatives that may affect the environmental outcome exist during the construction phase. For example, although generally undesirable from a construction viewpoint, the option of narrowing the construction Right of Way (ROW) can be feasible for very short sections and can allow impacts to significant features (such as large trees or areas of essential habitat or endangered ecosystems) to be minimised or avoided. General management and mitigation measures for potential impacts of the Project are presented in Section 0 of this IAS.

2.4.3 PROJECT FINANCING

Arrow Energy has sufficient financial resources to carry out all works associated with the proposed Project, including survey and assessment activities associated, employing both its permanent staff and consultants, where necessary, to ensure the ready availability of the necessary equipment, skills and expertise.

For the 2009 financial year, Arrow Energy achieved total revenue of \$670 million. Earnings Before Interest, Tax, Depreciation and Amortisation (EBITDA) rose 753% to \$580 million, compared to the previous year. The company's strong performance was underpinned by its transaction with Shell which saw the company pay \$565 million for a 30% share of Arrow's interests in all of its Australian upstream tenements and a 10% interest in the Singaporean-based subsidiary, Arrow International Pte Ltd. Excluding non-operating items, total revenue from operations was \$112 million, an increase of 31% from the previous year. This result was achieved despite a 30% reduction in gas sales revenues from January 2009 onwards following the Shell transaction.

Gross gas production was up 13.4% over the prior year to 32.4 PJ and Arrow Energy is continuing to push into electricity generation, thereby strongly enhancing its performance. The 450 MW Braemar 2 Power Station, in which Arrow Energy has a 74.9% share, was delivered ahead of schedule and under budget during the year. Revenue from electricity sales increased from \$31 million to nearly \$45 million over the year (Arrow, 2010b). Subsequent to the takeover of Arrow by CSCSG, Arrow now has the financial backing of both Shell and PetroChina.

2.4.4 PROJECT SOCIO-ECONOMIC IMPACTS

The Queensland Government has publically outlined its commitment to supporting the emerging CSG to LNG industry, which has the potential to generate thousands of jobs and billions of dollars in investment for Queensland, in the 2010-11 State Budget Highlights (DEEDI 2010).

The proposed ABP Project is expected to have overall positive socio-economic impacts on a regional, state and national scale including the following benefits:

- Creation of a new long-term CSG processing and export industry in Queensland utilising Arrow Energy's Bowen Basin reserves;
- Direct (immediate and future) employment opportunities through job creation, and indirectly through goods and services provision. Construction and operational activities are expected to extend through the life of the development;
- Growth of economies in local cities (Rockhampton and Gladstone) and townships (including Moranbah, Alton Downs, Midgee and Bajool) are anticipated through the provision of goods and services. Arrow will continue to use suppliers and contractors from local and surrounding areas where possible to maximise local benefits;
- Arrow intends a multi-billion dollar initial investment in the project development area including the Bowen gas fields and Curtis Island LNG facility;
- The CSG industry provides diversification to many local and national industries and economies through the introduction of new technology and business in the region; and
- Substantial cash flows are expected to accrue to the Australian Government through increased Goods and Services Tax (GST), company tax and personal income tax and to the Queensland Government through royalties and payroll tax.

Arrow will investigate the economic impacts of the Project on a regional, state and national scale during the EIS process. Among other matters, the EIS will also consider the impact of CSG development on agriculture and industry in the region.

The capital expenditure (estimated to be approximately \$1 billion) includes all necessary planning and approvals associated with the construction of the gas transmission pipeline. More detailed financial analysis, including cost optimisation and budgeting, will be undertaken during Front End Engineering Design (FEED).

2.4.5 CUMULATIVE IMPACTS

It is currently considered possible that the southern end of the ABP may be located in the SGIC (as described in Section 2.5.4.2) which will accommodate up to seven pipelines. The Gladstone Pacific Nickel slurry pipeline and the Fitzroy to Gladstone water pipeline have yet to be constructed but are proposed to be located in this State Development Area (SDA). There may be limitations associated with the placement of each.

ABP will intersect with the four proposed CSG pipelines from the Surat Basin to Gladstone, namely Arrow Surat Pipeline (ASP) (previously known as Surat Gladstone Pipeline), Queensland Curtis LNG Pipeline (QGC / BG), GLNG Pipeline (Santos / PETRONAS / TOTAL) and Australia Pacific LNG Pipeline (Origin Energy / Conoco Phillips) at the Bruce Highway.

A number of major projects currently proposed in eastern Queensland and Gladstone include:

- Arrow Bowen Pipeline (Arrow Bowen Pipeline Pty Ltd);
- Arrow Surat Pipeline (Surat Gladstone Pipeline Pty Ltd) formerly Surat Gladstone Pipeline (SGP);

- Arrow LNG plant (Arrow CSG (Australia) Pty Ltd) formerly Shell CSG (Australia) Pty Ltd;
- Australia Pacific LNG and pipeline (Origin Energy / Conoco Phillips);
- Balacclava Island Coal Export Terminal (Xstrata Coal);
- Central Queensland Gas Pipeline (Arrow Energy/AGL – on hold);
- GLNG and pipeline (Santos/ PETRONAS / TOTAL);
- Gladstone Pacific Nickel (GPNL);
- Gladstone Steel Making Facility (Boulder Steel);
- Gladstone to Fitzroy Pipeline (GAWB);
- Queensland Curtis LNG and pipeline (BG Group / QGC);
- Sun LNG (Sunshine Gas / Sojitz Corp - on hold);
- Surat Basin Railway (Surat Basin Railway Joint Venture comprises the Australian Transport and Energy Corridor Pty Ltd (ATEC), Xstrata Coal and QR);
- Wandoan Coal Mine (Xstrata Coal);
- Western Basin Dredging and Disposal (Gladstone Port Corporation (GPC)); and
- Wiggins Island Coal Terminal (QR Network and the Gladstone Port Authority).

Cumulative impacts of multiple projects in the vicinity of Gladstone will significantly impact the social infrastructure needs of the local community but are anticipated to have an overall positive effect on the regional, state and national economies.

Key cumulative social and economic impacts, both positive and negative, will affect landholders, the broader community, suppliers and service providers. Impacts will be associated with social changes, increased road traffic, altered land use, land disturbance, ground water and surface water quality, noise (environmental nuisance), reduced air quality, and visual amenity.

ABP is not anticipated to significantly contribute to these impacts as the disturbance associated with a buried pipeline is primarily associated with the construction phase.

With construction and operational workforces and other development in the Gladstone area, a significant increase in population is inevitable, particularly during the construction phases of each project. This has the potential to impact community lifestyles particularly if the ABP construction schedule overlaps with those of other projects in this vicinity.

The current construction schedule for ABP is anticipated to commence after the other pipelines currently proposed to convey CSG to Curtis Island are substantially completed, thereby avoiding significant cumulative impacts.

The ABP construction crew will consist of the same team proposed to construct the Arrow Surat Pipeline and will be housed in existing mining camps (if available) or mobile construction camps established on previously disturbed land where possible for most of the route which is sparsely populated.

Line pipe will be delivered to the ABP alignment using existing public roads where feasible, although there may be a need to upgrade additional access routes. This will be established

during the EIS process as a result of consultation with local government and the Department of Transport and Main Roads.

Arrow will engage all stakeholders in direct dialogue to ensure that a mutually agreeable and sustainable outcome is achieved where possible.

2.5 REGULATORY PROCESS AND APPROVAL STRATEGY

The pipeline will be designed, constructed, operated and decommissioned (if and when applicable) in accordance with Australian Standard AS 2885 – Gas and Liquid Petroleum.

The ABP will be subject to a point-to-point petroleum pipeline licence (PPL) pursuant to the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act) as the applicable petroleum authority granted by the Department of Employment, Economic Development and Innovation (DEEDI). An associated Environmental Authority (EA) pursuant to the EP Act will be required from DERM for a Chapter 5A Activity.

Specific activities (including Environmentally Relevant Activities (ERAs)) associated with the construction of the pipeline may also trigger additional approval requirements. A summary of the applicability of key environmental regulations is provided in Appendix 2, Table A-1.

2.5.1 COMMONWEALTH

2.5.1.1 Environmental Protection and Biodiversity Conservation Act 1999

The EPBC Act applies to those actions which are likely to have a significant impact on matters of National Environmental Significance (NES). The eight matters of NES protected under the EPBC Act are:

- world heritage properties;
- national heritage places;
- wetlands of international importance (listed under the RAMSAR Convention);
- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park; and
- nuclear actions (including uranium mines).

Arrow will refer the ABP Project to DSEWP&C for determination as to whether it constitutes a 'controlled action' under the EPBC Act. This decision will be made with consideration of the Project's potential to significantly impact matters of NES. A 'controlled action' requires formal assessment and approval. One such pathway is for Arrow to prepare an Environmental Impact Statement for assessment under a bilateral agreement between the Federal and State Governments. This agreement allows the Commonwealth Minister to rely on specified environmental impact assessment processes of the State of Queensland in assessing actions under the EPBC Act.

2.5.1.2 Native Title Act 1993

The purpose of the Native Title Act 1993 (NT Act) is to provide for the recognition and protection of native rights for Australia's indigenous people, as well as providing a legislative approach for dealing with matters of native title.

Under the NT Act, indigenous rights may exist in areas such as vacant or unallocated crown land, some reserve lands, some types of pastoral lease and waters that are not privately owned. In accordance with the NT Act, a native title process will be undertaken with native title claimants and regulatory agencies over lands for which native title has not been extinguished.

2.5.2 QUEENSLAND STATE GOVERNMENT

2.5.2.1 Petroleum and Gas (Production and Safety) Act 2004

Arrow has an approved EA (PEN201616610) and a Petroleum Survey Licence (PSL 64) from DERM and DEEDI respectively pursuant to Chapter 4, Part 1, of the P&G Act. PSL 64 provides land access, enabling field assessments to be undertaken for ecological and cultural heritage surveys and engineering and construction inspections, particularly to refine route selection.

A Petroleum Pipeline Licence (PPL) authorising the construction and operation of the point-to-point transmission pipeline (including all connected facilities e.g. valve, scraper and meter stations, plant and equipment) will be required from DEEDI. The PPL also authorises activities considered to be incidental to the pipeline (i.e. they are considered reasonably necessary for the construction and operation of the pipeline and are located within the area of the PPL).

Approval under the P&G Act exempts some pipeline activities conducted within the PPL area from approval under other acts, e.g. vegetation clearing under the *Vegetation Management Act 1999* (VMA).

2.5.2.2 Environmental Protection Act 1994 and Regulation 2008

Construction of a new pipeline more than 150 km long under a petroleum authority is classified as a Level 1 Chapter 5A Activity in Schedule 5 of the *Environmental Protection Regulation 2008*. An EA is required from DERM to undertake a Level 1 Chapter 5A Activity and other Environmentally Relevant Activities (ERAs) pursuant to the EP Act.

Arrow intends to apply to DERM to prepare a voluntary EIS for the ABP Project in accordance with the Chapter 3, Part 2 of the EP Act. It is anticipated that this IAS contains adequate information for DERM to approve this voluntary application.

The EP Act statutory process for voluntary submission of an EIS involves:

- Application by Arrow to the chief executive to prepare an EIS for the project (s.70);
- Chief executive determines whether an EIS is appropriate for the project (s.72);
- Chief executive prepares a draft Terms of Reference (ToR) notice for comment (s.42);
- Application by Arrow to the chief executive to prepare an EIS for a project (s.70);
- Public Notification of draft ToR for comment (s.43);
- Chief executive to issue Final ToR for the project (s.46);

- Preparation of a voluntary EIS by Arrow in accordance with the ToR;
- Submission of the voluntary EIS to the chief executive (s.47);
- Chief executive decides whether the EIS addresses the Final ToR and may proceed to public notification (s.49);
- Public notification of the EIS for comment (s.51);
- Public submissions on the EIS made to the chief executive (s.54);
- Arrow is provided copies of submissions and prepares a response (s.56); and
- Chief executive prepares an Assessment Report making a recommendation whether to approve, approve with conditions, or not approve the project (s.57).

This IAS has been prepared to assist the chief executive determine whether an EIS is appropriate for the project (s.72).

Target dates for the EIS program are provided in Table 2.

Table 2: Proposed target dates for EIS process

Milestone	Target Date
IAS	Feb 2011
EPBC Act Referral	July 2011
DSEWP&C Decision	Aug 2011
Final ToR	May 2011
EIS Submission	Sep 2011
Public Notification and Submission Phase	Nov 2011 – Jan 2012
EIS Supplementary Report	Mar 2012
Assessment Report issued by Chief executive of DERM	May 2012

Significant expansion of resource exploration and development activity in key parts of the state has resulted in the agricultural sector becoming increasingly concerned about the adverse impacts of current and potential growth on agricultural enterprises at the property scale. The development of a legislative framework to clarify the rights and responsibilities of tenure holders and rural landholders is necessary to facilitate continued growth in exploration activity across key parts of the state whilst ensuring access to private land is appropriately regulated and occurs in a transparent and equitable manner.

The co-existence and long term sustainability of both the agricultural and resource industries is vital to the Queensland economy. The amendments relating to land access and owners and occupiers (land access amendments) in the *Geothermal Energy Act 2010* implemented one of the Queensland Government's strategies to minimise land use conflict between the resource and agricultural sectors and are incorporated in the current revision of the P&G Act.

The purpose of the land access amendments is to ensure that resource sector growth is managed and that more equitable outcomes are achieved in terms of access to private land.

The agricultural and resource sectors have worked collaboratively with Government to develop a Land Access Policy Framework, comprising the land access amendments and supporting land access documentation. It is applicable to petroleum authorities granted under the P&G Act.

The land access amendments establish:

- a legislative requirement for compliance with a single statutory Land Access Code for tenure/authority holders in all resource sectors;
- notice of entry requirements for preliminary activities;
- a requirement for the making of a conduct and compensation agreement prior to entry to land for advanced activities;
- a graduated negotiation and dispute resolution process to remedy disputes about agreements; and
- improved compliance and enforcement processes for administering the Land Access Code.

The land access documentation that supports the legislative framework includes:

- a single statutory Land Access Code;
- standard conduct and compensation agreement; and
- additional guidelines, information and extension resources to assist with implementation (Qld Gov 2010).

2.5.2.3 Aboriginal Cultural Heritage Act 2003

Under the *Aboriginal Cultural Heritage Act 2003* (ACH Act), there is legislative recognition that:

- Aboriginal people are the primary guardians, keepers and knowledge holders of their cultural heritage;
- Existing rights of ownership of cultural heritage by Aboriginal people and native title are not affected;
- There is Aboriginal ownership of:
 - Aboriginal human remains wherever held
 - secret and sacred material currently held in state collections (such as the Queensland Museum)
 - Aboriginal cultural heritage material removed from land;
- Residual ownership (custodianship) of any other Aboriginal cultural heritage material resides in the state (e.g. to ensure protection of heritage on freehold land).

Duty of care provisions are outlined in the ACH Act. The mechanisms for meeting duty of care obligations are specified in s.23. Cultural heritage management plans (CHMPs) are required for certain high-level impact activities (e.g. where an environmental impact statement is required under legislation). Alternatively, the duty of care for cultural heritage can be addressed in a native title agreement (e.g. Indigenous Land Use Agreement (ILUA) or by use of the Native Title Protection Conditions) prior to project approval being granted.

In the legislation, an Aboriginal Party is defined as a Registered Native Title Holder or Claimant, including cases where a native title claim is removed from the register or where native title is extinguished (unless someone else subsequently becomes registered as a Native Title Party).

In the absence of a Native Title Party, the Aboriginal Party is the Aboriginal person with particular knowledge about traditions, observances, customs or beliefs and who is recognised in accordance with Aboriginal tradition as having responsibility for the area or object.

Alternatively, if the Aboriginal parties agree, they can seek state recognition of an Aboriginal Cultural Heritage Body whose function is to identify the Aboriginal party for particular areas.

2.5.3 LOCAL GOVERNMENT

Project components are located across a number of local government areas. The proposed pipeline route traverses the four local government authorities of Whitsunday Regional Council, Isaac Regional Council, Rockhampton Regional Council and Gladstone Regional Council.

The pipeline and associated incidental activities authorised under the P&G Act are exempt from assessment against local planning schemes under the *Sustainable Planning Act 2009* if they are conducted within the pipeline licence area.

Local planning scheme requirements (i.e. land use changes) will be considered in the preparation of the EIS.

2.5.4 STATE DEVELOPMENT AREAS

State Development Areas (SDAs) are created under s.77 of the *State Development and Public Works Organisation Act 1971*. The Coordinator-General (CG) is responsible for the planning and ongoing management of SDAs throughout Queensland.

Under s.79 of the Act, all SDAs require a development scheme which overrides local council and state planning instruments relating to the use of the land. The development scheme is a land use control instrument, administered by the CG, to guide future development in SDAs.

The role of the CG is to assess and determine all material change of use (MCU) applications for land uses within SDAs.

The development scheme for each SDA sets out the assessment procedure and process required for making an application to the CG for a MCU of premises.

Each of the SDA development schemes currently in effect require that an application include the application fee determined by the CG (DIP 2010a).

2.5.4.1 Gladstone State Development Area

The Gladstone State Development Area (GSDA) was created on land north-west of Gladstone considered broadly suitable for large-scale industrial development on the basis that it conformed to acceptable engineering, environment and social criteria. The area has been amended a number of times and now comprises approximately 28,000 hectares, including the Curtis Island Industry Precinct to facilitate the establishment of LNG plants (DIP, 2010d).

The gas gathering station proposed as the terminal point of the ABP is likely to be located in the Aldoga Precinct.

2.5.4.2 Stanwell - Gladstone Infrastructure Corridor (SGIC)

The SGIC was created by the CG in response to a recognised need for a designated infrastructure corridor of land between Stanwell Energy Park and the GSDA to house multiple underground pipelines. Refer to Figure 4 for an overview map of the SGIC declaration area.

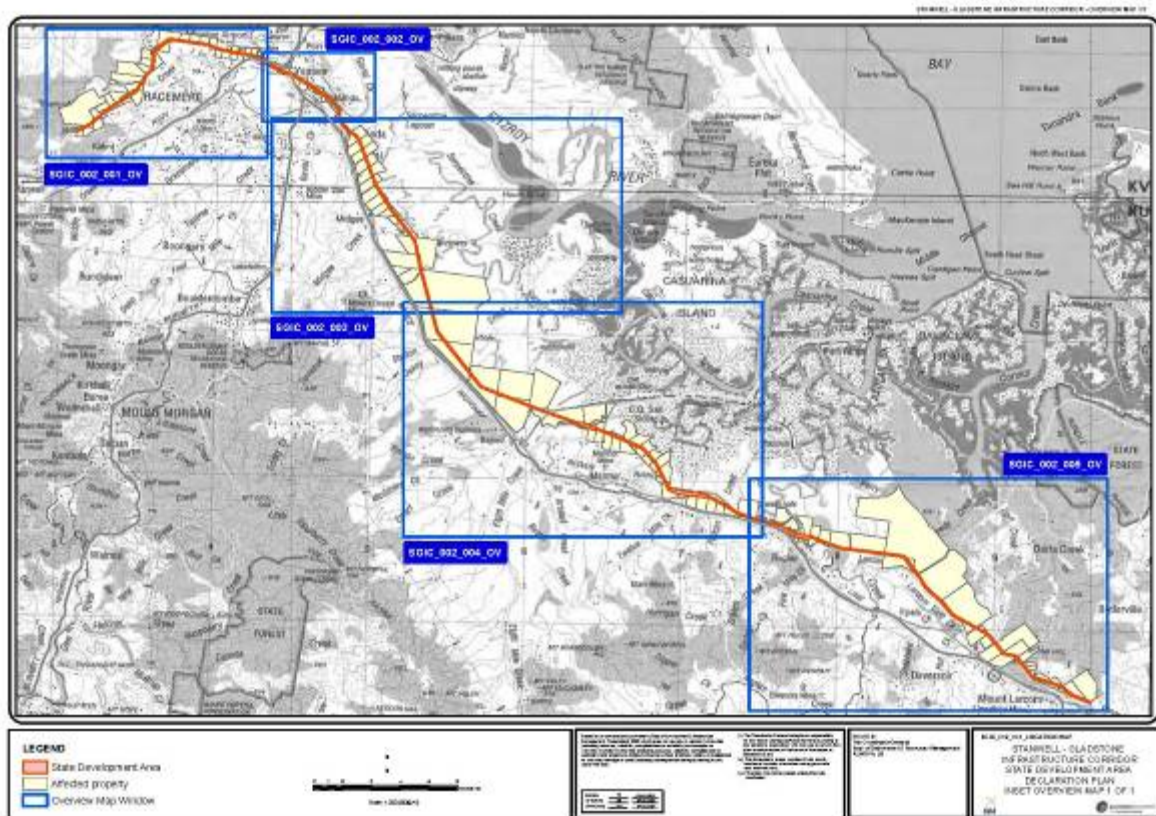


Figure 4: Overview map of the SGIC Declaration Area

The corridor can accommodate up to seven underground pipelines in a single area for uses including raw, treated and sea water, gas, mineral slurries and telecommunication cables. This will help in:

- delivering essential services throughout the region;
- efficiently transporting industrial materials throughout the area;
- discouraging future private or public infrastructure providers from investigating project-specific pipeline routes outside the designated corridor; and
- limiting the disruption of such investigation and construction on individual landowners, surrounding communities and the environment that would otherwise occur if access to multiple pipeline routes was sought on a project-by-project basis.

As the first potential user of the corridor, the Gladstone Area Water Board plans to lay an underground water pipeline to transport water to and from the Fitzroy and Gladstone regions.

The SGIC is approximately 90 km long and is generally 100 m wide. In specific areas where environmental, geographic and construction issues exist, the corridor may be widened for pipe separation and construction purposes (DIP 2010b).

The southern end of the ABP may be located in the SGIC.

2.5.5 SUBSEQUENT APPROVALS

The ABP Project may require additional approvals under other State and Local Government legislation and planning schemes, including:

- *Dangerous Goods Safety Management Act 2001*;
- *Fisheries Act 1994*;
- *Greenhouse Gas Storage Act 2009*;
- *Land Act 1994*;
- *Land Protection (Pest and Stock Route Management) Act 2002*;
- *Local Government Act 2009*;
- *Nature Conservation Act 1992* ;
- *Queensland Heritage Act 1992*;
- *Sustainable Planning Act 2009*;
- *Transport Infrastructure Act 1994*;
- *Vegetation Management Act 1999*; and
- *Water Act 2000*.

Refer to Appendix 2, Table A-1 for a more comprehensive list of legislation and potential triggering activities.

3 DESCRIPTION OF ACTIVITIES

3.1 DESIGN AND ENGINEERING

The proposed pipeline will be typical of a modern, large diameter gas transmission pipeline that will be designed, constructed and operated in accordance with the Australian Standard series AS 2885, Pipelines – Gas and Liquid Petroleum, particularly:

- AS 2885.1 Part 1 – Design and Construction;
- AS 2885.2 Part 2 – Welding;
- AS 2885.3 Part 3 – Operations and Maintenance; and
- AS 2885.5 Part 5 – Field Pressure Testing.

Final design parameters are yet to be determined, but will most likely feature:

- A buried, high pressure, steel, natural gas pipeline, with a nominal diameter of 42”;
- A connection to a gas gathering station at, or near to, the Bruce Highway; and
- Above ground facilities at intervals along the pipeline including mainline valves, scraper stations, cathodic protection systems and marker signs.

All materials and workmanship shall be in accordance with the applicable codes and standards referenced in AS 2885.1. In addition, the design shall comply with the specific requirements of the P&G Act, the PPL and the associated EA.

The following risk studies will also be conducted by ABP as part of the design process:

- A Pipeline Safety Management Study series in accordance with AS 2885.1. This includes developing a line pipe fracture control plan; and
- A Hazard and Operability (HAZOP) Study for any above ground facilities.

3.2 CONSTRUCTION

Construction will require a right-of-way (ROW) with a width of 40 m for clear and grade, trenching and spoil placement, stringing, pipeline welding and laying as illustrated in Figure 5 and Plate 1. A narrower construction width may be considered for sensitive watercourse crossings and sensitive ecosystems where rare / endangered or ‘Of Concern’ vegetation is encountered. As part of construction, the pipeline trench will be backfilled and restored, typically within three months of clear and grade.

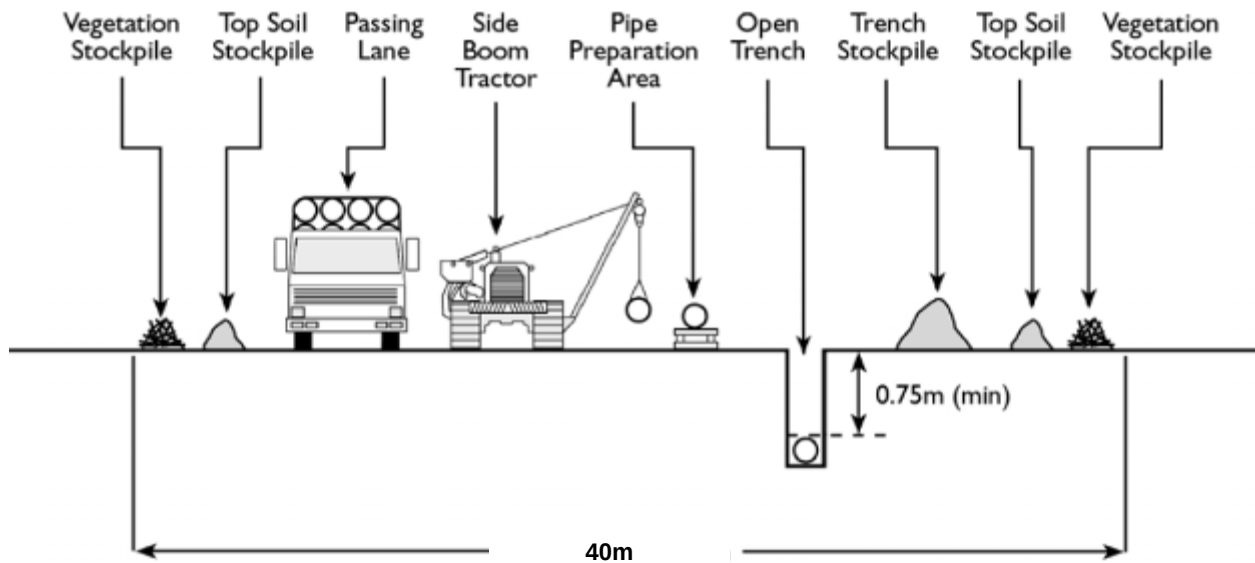


Figure 5: Indicative Corridor Layout for Pipeline Construction

Source: APIA 2009, adapted

On completion of construction, a 30 m easement width will be established over the pipeline. This may be reduced at sensitive watercourse crossings and sensitive ecosystems as described above. Above-ground structures will include main line valves, scraper and meter stations. Typically, these facilities may be located within the 30 m wide easement and will be fenced. Pipeline markers will be provided at fences, roads crossings and other locations as required by AS 2885.

As noted in Section 6.2.2.1, normal agricultural activities occur over buried pipelines following construction and thus the presence of a buried pipeline would not create any long term adverse impact upon good quality agricultural land (GQAL) and strategic cropping land. Construction of ABP will not result in the permanent alienation of GQAL or strategic cropping land. Compensation is offered to the landowner for any temporary disruption to agricultural production during construction and rehabilitation of the pipeline.

Construction activities will be managed in accordance with a Construction Environmental Management Plan (CEMP) to be developed based on specific aspects determined during environmental impact assessment and will be presented in the EIS.



Plate 1: Typical ROW

3.2.1 DETAILED SURVEY

The pipe centreline will be surveyed and pegged after detailed geotechnical, engineering, ecological and cultural heritage surveys are completed. Markers will be placed along the entire route to identify the pipeline centreline, ROW and any additional work spaces. Vegetation boundaries will be well defined. Trees to be retained, areas of reduced ROW and any transected Regional Ecosystems (RE) will be flagged. Areas outside the ROW used for extra workspace, truck turnarounds or lay-down areas will be subject to appropriate heritage and environmental assessment and landholder approval.

3.2.2 FENCING

Fences will be strained and cut and temporary gates installed where fences are required to be breached prior to clearing of the surveyed ROW for construction access.

3.2.3 CLEAR AND GRADE

Clear and grade (as illustrated in Plate 2 and Plate 3) will be carried out to provide a safe construction ROW for vehicular movement, trenching and other construction activities. A width of 40 m will generally be required to enable construction to be safely and efficiently carried out. The ROW may be reduced in width for limited distances through sensitive areas. This is only viable for any significant distance if an existing clearing / track parallels the ROW and can be used as part of the construction ROW.

The ROW will be cleared of vegetation (although root stock will be left in the ground where practicable to stabilise the area and reduce erosion potential). In scrubby areas, some vegetation will be stockpiled for respreading as part of the restoration process. Breaks will be left in stockpiled vegetation to allow continued access to stock, fence lines, tracks and drainage lines. Large mature trees will be preserved where practicable. Topsoil will be removed (typically to a depth of 100 to 150 mm) and stockpiled separately for reuse during rehabilitation. The ROW will be levelled to the required gradient using graders, backhoes and bulldozers.



Plate 2: Typical grading of the ROW



Plate 3: Typical clearing of the ROW and avoidance of sensitive vegetation

3.2.4 STRINGING

Stringing (illustrated in Plate 4) is the term used to describe the laying out of the pipe in preparation for welding. Pipe will generally be transported to site on trucks in 12 m lengths. The pipe will be laid out adjacent to the trench and held off the ground on skids and sandbags that protect the pipe coating from damage.

Where required, pipe lengths are bent to match changes in either elevation or direction of the route using a hydraulic bending machine.



Plate 4: Pipeline stringing

3.2.5 WELDING

Once the pipe is strung, a line-up crew will position the pipe using side boom tractors and internal line-up clamps.

Specialised construction crews undertake the welding phase of the Project (illustrated in Plate 5) in accordance with AS 2885.2. Pipes are typically welded into strings of up to 800 m in length, allowing for stock and landholder access breaks where necessary.



Plate 5: Pipeline welding

3.2.6 NON-DESTRUCTIVE TESTING

Each weld is subjected to a 100% Non-Destructive Testing inspection (X-ray analysis or ultrasonic testing) in accordance with AS 2885.2 to check for compliance to specification, thus ensuring the integrity of each weld. This is illustrated in Plate 6.



Source: www.ge-mcs.com

Plate 6: Non-destructive testing being conducted

3.2.7 JOINT COATING

Following welding, the weld joints will be cleaned by abrasive grit blasting and an external coating (compatible with the factory applied external coating) will be applied to prevent corrosion as illustrated in Plate 7. In any areas of certified organic farming, a closed blasting rig will be used.



Plate 7: Coating and wrapping of the weld joint

3.2.8 TRENCHING

A wheel trencher, rocksaw or excavator or a combination of the above will be used to excavate the trench as illustrated in Plate 8. The distance covered per day will be dependent on terrain and weather conditions, but typically on projects of this nature, a production rate of two to three kilometres per day can be anticipated.

The depth of the trench is determined by a risk assessment conducted in accordance with AS 2885.1, with the minimum depth of cover being 750 mm and 1,200 mm for creek and infrastructure crossings. Trench depth (typically 2,000 mm) depends on the current or anticipated use of the land. Trench spoil is stockpiled separately to topsoil on the non-working side of the ROW. Other than changes in depth for the above reasons, the pipeline is generally laid to follow the contours of the land.

Breaks in the trench will be left to facilitate stock and wildlife crossing, agricultural vehicle movements and at drainage lines. In addition, methods will be adopted to minimise fauna entrapment and mortality (e.g. trench breakers, ramped ends of trench, safe havens). These methods will ensure that fauna egress points in the trench will be no more than 1,000 m apart. In addition, there will be breaks in the trench for tracks, watercourses, drains, roads and buried services crossed by the pipeline.



Plate 8: Trenching machine in operation

3.2.9 LOWERING-IN AND BACKFILLING

Where required, the trench is prepared by placing padding (fine sub-soil) in the bottom to protect the pipe coating from damage. Padding machines are generally used to generate

this padding by sifting the excavated trench spoil to remove coarse materials to produce a fine substrate, as illustrated in Plate 9. Topsoil will not be used as padding.

In some instances (e.g. very rocky areas) imported sand may be used, although this is not currently planned. The use of a crusher to produce padding material is proposed to be utilised in rocky areas. Soil extraction sites, if required, will be located close to the pipeline and subject to appropriate permits and landholder approval. Excavation sites will not be located in ESAs and vegetation clearing will be avoided to the greatest extent possible. Following excavation, the affected areas will be re-profiled and any cleared vegetation re-spread to encourage natural regeneration.



Plate 9: Padding machine in operation

The pipe coating will be inspected and tested for defects and then lifted off the skids and lowered into the trench using side-boom tractors, as illustrated in Plate 10 to Plate 12.

Where required, impermeable trench blocks (known as trench or sack breakers) will be installed prior to backfilling of the trench to control water movement along the backfilled trench. Trench breakers are commonly installed in a number of environmental conditions, such as adjacent to watercourses, on steep slopes or where drainage patterns change.

Excavated material will be bladed into the trench by a bulldozer or grader. The material will be placed in layers and wheel-rolled to provide compaction and prevent subsequent settlement.



Plate 10: Pipe after welding and coating, before lowering-in



Plate 11: Pipe lowered into trench



Plate 12: Pipe lowered into trench and spoil backfilled

3.2.10 HYDROSTATIC PRESSURE TESTING

Hydrostatic testing is the pressure testing of a section of the pipeline with water to establish the strength and leak tightness of the test section and to confirm the strength of the pipeline for the purposes of confirming the maximum allowable operating pressure (MAOP).

All pipe sections will be subject to a hydrostatic pressure test (as shown in Plate 13 and Plate 14).

Hydrostatic testing procedures, including water sourcing and disposal, will be determined during the detailed design and construction phase. The following information should be viewed as provisional only and will be confirmed during the procedure development and approval phase.

At least one month prior to the intended commencement of hydrostatic pressure testing activities, a hydrostatic test water management plan will be submitted to DERM for review. The plan will be project-specific and will include, but not necessarily be limited to, details of the following:

- Volume and source of hydrostatic test water;
- Additives to be used (if any);
- Any proposed holding dams;
- Proposed method and location of reuse and / or disposal; and

- Proposed management measures to avoid or minimise environmental impacts associated with hydrostatic testing, including sourcing, storage, treatment, reuse and / or disposal of test water.

Hydrostatic test activities will not take place unless this plan has been approved by DERM.



Plate 13: Hydrostatic Testing in progress



Plate 14: Hydrostatic Testing in progress

3.2.10.1 Test Water

Water is normally obtained from existing sources in the area, such as property dams and local watercourses. Where required, approvals will be obtained from DERM and / or the owner of the water. Source and disposal options will be explored to maximise efficiency of testing, timing of construction and commissioning, as well as environmental good practice. Beneficial reuse of CSG associated water may also be considered at this time.

Hydrostatic testing water will not be extracted from significant aquatic habitat areas. Water sourced from natural waterways will be screened with a small mesh to protect aquatic life and then with a finer mesh to limit particle size intake into the test section.

Flow rates and water levels will be maintained in natural watercourses from which hydrostatic test water is extracted.

Where hydrostatic test water is sourced from natural watercourses, it will, where necessary, be re-used to minimise future extraction and disposal volumes. Permits will be obtained where necessary for the sourcing of hydrostatic test water.

Alternatively, in areas where CSG is being produced, current trials of reverse osmosis plants indicate that sufficient volumes of good quality (potable) water can be produced in the timeframes necessary.

Prior to filling the test section with water, the section will be flushed with a slug of water to ensure that no construction detritus remains that may inhibit either the cleaning and drying or commissioning processes. This slug of water will be captured on release from the test section and not permitted to discharge directly to the ground.

Additives, such as biocides and oxygen scavengers, may be added to hydrostatic test water, if required, to remove biological organisms and reduce corrosion potential during testing. If test water may be in use within and / or between pipe sections for more than 30 days, it is likely that the fill water will need to be treated with a combination of oxygen scavenger and biocide to ensure that corrosion attributable to bacterial, oxygen or microbial action does not occur.

Where biocides or oxygen scavengers are required, dosing concentrations will be in accordance with the manufacturer's recommendations and international best practice. Where reagents are required, they will be selected to ensure they degrade rapidly under aeration, or similar natural treatment.

Before water is transferred from one test section to another, further analysis will be carried out to determine whether additional applications of biocide or oxygen scavenger are required to maintain the required concentrations.

3.2.10.2 Water Discharge

Prior to the discharge of hydrostatic test water, an evaluation will be undertaken to confirm that there is no risk of contamination to watercourses, water bodies and groundwater. Where the water source and water quality is known, and no chemicals have been added, water quality testing may not be required. If chemicals have been added, or if there are concerns about water quality, it will be necessary to test the water prior to discharge to land.

Hydrostatic test waters will not be directly discharged to natural waterways.

Soil contamination and erosion can be an issue if the hydrostatic test water is discharged onto land at pressure. Prior to discharge, hydrostatic test waters will be filtered through a geotextile fabric or held in a temporary sediment retention basin in order to remove the majority of solid materials prior to discharge.

The hydrostatic test water released between pipe sections will be discharged in such a way as to prevent flooding or erosion (e.g. against a splash plate or other dispersive device to aerate, slow and dissipate the flow).

Hydrostatic test water discharge or recycling for secondary uses, such as pasture irrigation, will only be undertaken where water quality is within relevant water quality guidelines.

3.2.10.3 Test Section Criteria

The test section length will be determined after consideration of:

- The permissible elevation difference;
- The estimated extent of yielding at the intended strength pressure;
- The test section volume; and

- Logistic constraints.

As stated previously, hydrostatic testing serves two purposes:

- To demonstrate that the pipeline has the strength required of it; and
- To demonstrate its leak-tightness.

The basic procedure is essentially the same for both tests and involves the pipeline section being closed off and pumped full of testing fluid (normally water) to a certain pressure and the fluid being held at that pressure for a specified time.

Leak tests are carried out by observing the presence or absence of leaks, either visually or by pressure change. The main objective is the identification of leaks with certainty, compared with the uncertainty of the measurement methods and instrumentation.

Procedures for identifying and evaluating very small leakages are provided in AS 2885.5.

3.2.10.4 Dewatering and Drying

After satisfactory hydrostatic testing of a section, it will be dewatered and dried. Swabbing / cleaning pigs (illustrated in Plate 15) will be passed through the test section using oil-free compressed air until the acceptance criteria for dryness and cleanliness are met. These criteria will have been established and will be included in the procedures to be developed and approved prior to the commencement of hydrostatic testing.



Plate 15: Pipeline cleaning pigs

When clean and dry, the test section will be tied-in to any preceding sections and left sealed and full of dry air in readiness for commissioning.

3.2.11 CLEAN UP, RESTORATION AND REHABILITATION

Clean up, restoration and rehabilitation measures will be applied to all areas disturbed during construction, including the ROW, access tracks and camp sites, as soon as practical after pipe laying and backfill. Generally, clean up (as illustrated in Plate 16) and rehabilitation will involve removal of foreign material (construction material and waste), surface contouring, respraying topsoil, respraying vegetation and reseeding / revegetation (typically with native grass or improved pasture species).



Plate 16: Clean-up of ROW

Generally the landscape will be rehabilitated to pre-existing contours with natural drainage lines restored and protected (if required). In certain cases, rehabilitation is tailored to site-specific conditions in consultation with the landholder. To promote vegetation regrowth and protect against the loss of topsoil, the ROW surface will normally be lightly scarified prior to respreading of topsoil.

Rehabilitation, as illustrated in Plate 17 to Plate 20, will be undertaken in accordance with industry practice and will ensure that:

- Topsoil cover is re-established and all land and waterways disturbed by Project activities are returned to a stable condition as soon as possible after construction;
- Land is returned as close as possible to its previous productivity;
- Stable landforms are re-established to original topographic contours;
- Natural drainage patterns are reinstated;
- Erosion control measures (e.g. contour banks, filter strips) are installed in erosion prone areas;
- The pre-construction environment is reinstated and disturbed habitats recreated;
- Fences and gares are restored; and
- Pipeline marker signs are installed.



Plate 17: Rehabilitation of ROW across a road



Plate 18: Rehabilitated ROW in rural area



Plate 19: Rehabilitated ROW in rural area



Plate 20: Rehabilitated ROW in rural / wooded area

3.2.12 ROAD AND INFRASTRUCTURE CROSSINGS

The Bruce, Peak Downs, Burnett and Capricorn Highways are among the more significant of the infrastructure crossings along the pipeline route.

While the balances are primarily roads, tracks or stockroutes, seven railway lines are crossed by the main pipeline, the Goonyella Lateral and Elphinstone Header.

The following formed roads and railway lines will be crossed by the proposed pipeline route:

-
- | | |
|-----------------------------|---|
| ▪ Bruce Highway | ▪ Somerset Road |
| ▪ Peak Downs Highway | ▪ Boongary Road |
| ▪ Capricorn Highway | ▪ Mogilno Road |
| ▪ Burnett Highway | ▪ Mclean Road |
| ▪ Newlands Access Road | ▪ Comino Road |
| ▪ Suttor Developmental Road | ▪ Bajool Port Alma Road |
| ▪ Daunia Road | ▪ Twelve Mile Road |
| ▪ Annandale Road | ▪ Reedy Creek Road |
| ▪ Carfax Road | ▪ Darts Creek Road |
| ▪ Fitzroy Development Road | ▪ Popenia Road |
| ▪ May Downs Road | ▪ Gostevsky Road |
| ▪ Manly Access Road | ▪ The Narrows Road |
| ▪ Tartrus Road | ▪ Gladstone Mount Larcom Road |
| ▪ Apis Creek Road | ▪ Red Hill Road |
| ▪ Morbank Road | ▪ Golden Mile Road |
| ▪ Glenroy Marlborough Road | ▪ Goonyella Road |
| ▪ Fairview Road | ▪ Ellrot Road |
| ▪ Glenroy Road | ▪ Moses Road |
| ▪ Craignaught Road | ▪ Goonyella Branch Railway |
| ▪ Mornish Road | ▪ Norwich Park Branch Railway |
| ▪ Faraday Road | ▪ Central Line (Railway) |
| ▪ Dalma Ridgeland Road | ▪ North Coast Line (Railway) |
| ▪ Stanwell Waroula Road | ▪ C.Q. Salt (Railway) |
| ▪ Harding Road | ▪ East End Mine Branch Line (Railway) |
| ▪ Tucker Road | ▪ Moranbah North Balloon Loop (Railway) |
| ▪ Cunningham Road | |
| ▪ Hopper Road | |
| ▪ Kabra Scrubby Creek Road | |

3.2.12.1 Minor Road, Track and Stock Route Crossings

These crossings will be completed using open cut methods generally perpendicular to the road / stock route. Construction will be timed to minimise disruption to users. Side diversion tracks will be constructed or road plates used to minimise impacts to traffic flow. Traffic and safety management procedures will be implemented during this work to ensure that users are warned of the activity. There will be no permanent disruption to the stock route network.

3.2.12.2 Sealed Roads

Crossings of these roads will be carried out by thrust boring beneath the road. While this will slow traffic to ensure the safety of construction personnel, it will eliminate the need to close the road and traffic will be allowed to flow at all times. Traffic and safety management procedures will be implemented during this work to ensure that users are warned of the activity.

Thrust Bore

Thrust bores are used for shorter sections, typically under roads or embankments, as illustrated in Plate 21 and Plate 22. Thrust bores are generally horizontal, or have a single slope, as unlike HDDs, the drill head is not steerable.

It is a low impact technique that involves drilling short distances from below ground within an enlarged trench within the construction ROW. The feasibility of a bore is limited by site conditions, including geology (preferably homogeneous ground conditions), landform and soil type, as well as depth and width of the crossing. Thrust bores are typically completed within one to five days.



Plate 21: Thrust bore drill hole



Plate 22: Thrust boring

3.2.12.3 Railway Crossings

Rail crossings will generally be undertaken using the thrust boring technique or alternatively, a horizontal directional drill (HDD) depending on geotechnical investigations. There will be no requirement to limit the speed of trains during the construction work. Traffic and safety management procedures will be implemented during the construction work to ensure continued safety of all involved.

3.2.13 WATERCOURSE CROSSINGS

Watercourse crossings will be required for pipe laying and the movement of construction equipment. The proposed pipeline transects a number of watercourse locations that are mapped by DERM at a scale of 1:100,000. These include the Isaac and Fitzroy Rivers, while the rest are creeks and gullies, including the following with a stream order greater or equal to 5 as determined by the Strahler stream classification system:

- | | | |
|-------------------|-------------------|------------------|
| ▪ Suttor Creek | ▪ Bellarine Creek | ▪ Neerkol Creek |
| ▪ Boomerang Creek | ▪ Clarke Creek | ▪ Six Mile Creek |
| ▪ Stephens Creek | ▪ Apis Creek | ▪ Raglan Creek |
| ▪ Rolf Creek | ▪ Limestone Creek | |

To minimise the period of construction and subsequent environmental disturbance, watercourse crossings will be completed within the shortest period practicable. It is anticipated that construction will occur during winter months when there is little rainfall and watercourses are at their lowest flow level.

Common pipeline construction methods available for the crossing of watercourses include:

- Open cut trenching (including flow diversion if applicable); and
- HDD.

These techniques are further discussed in Table 3 below.

Table 3: Crossing method selection

Sensitivity	Sensitivity Criteria	Technique
Low	Ephemeral stream (or no flow at time of construction); No threatened species habitat; In-stream habitat highly modified / disturbed; and Poor riparian vegetation, high percentage of introduced and / or weed species.	Open trench
Moderate	Flow at time of construction; Some good quality in-stream habitat; Moderate riparian vegetation, with some native species present; and Downstream water users that can tolerate temporary increased sediment load.	Open trench with flow diversion
High	High flow at time of construction; Threatened species habitat present; Known presence of threatened species; Near natural / excellent in-stream habitat; Good intact native riparian vegetation; and Highly sensitive downstream water users.	HDD or flow diversion with site specific mitigation measures

Most of the watercourses along the proposed route are ephemeral and are considered to have low to moderate sensitivity. However, there are 21 crossings of watercourses with a stream order of 5 or above, including one crossing of the Fitzroy River and five crossings of the Isaac River. Essential habitat for Black Ironbox, which is listed as Vulnerable under State and Commonwealth legislation, is present on the crossing of Limestone Creek and may also occur on other large creeks in the Fitzroy catchment. Crossings will be further assessed based on ecological surveys, geotechnical reports and other constructability constraints.

3.2.13.1 Dry Rivers, Minor Creeks and Streams

Generally, crossings will be constructed while the watercourse is dry using the open cut trenching method. If running water is present, it will be taken across the trench using flume pipes or, alternatively, the watercourse will be dammed and the water flow pumped around the crossing site.

Standard Open Cut / Flow Diversion

The majority of watercourse crossings are expected to be constructed using standard open cut (trenching) construction, as illustrated in Plate 23 to Plate 25. This technique is most suited to dry or low flow conditions. It involves establishing a stable working platform either side of the watercourse and creating a trench using excavators. Tie-in points will be located on high ground well away from any water flow.



Plate 23: Open cut construction of watercourse crossing



Plate 24: Open cut construction of watercourse crossing



Plate 25: Open cut construction of watercourse crossing

Watercourse bed and bank material and trench spoil will be stockpiled separately. Trench spoil removed from the watercourse will be placed above the bank. Trench and backfill activities will be undertaken so as to ensure that bed and bank material is stockpiled separately and returned to the trench in the order and depth equivalent to original conditions.

The pipe will be concrete coated for water crossings and areas of significant inundation (as identified by risk assessment in compliance with AS 2885.1) to reduce buoyancy.

Welded pipe will be laid in the trench and spoil material returned to the trench. Rock protection will be installed over the trench in the stream bed where required, to prevent potential scouring during flood conditions.

Flow diversion is a modification of the standard open cut method where higher water volumes and flows (typically 1,000 L/s) are present. Techniques include:

- Concentrating the flow through a flume pipe to prevent siltation problems that may be created during trenching, lowering in and backfilling (not suitable for watercourses with broad channels, low gradients and permeable substrates); and
- Pumping water around the work area by constructing barrier dykes / head walls above and below the trenched area keeping the work area relatively dry (suitable for low gradient streams with a discharge < 1,000 L/s).

The construction period will be minimised to complete the crossings in the shortest period practicable, with small crossings typically completed within one day.

Banks will be reinstated as near as practicable to their original profile. Where required, geofabric (for example, jute matting), which remains permeable to water and enhances plant growth, will be used to hold soil in place during re-establishment. Vegetation is then reinstated, usually involving initial seeding with sterile grasses (for example, millet or rye corn) to facilitate revegetation and stabilisation of watercourse banks. Subsequent revegetation of the crossing will aim to re-establish native plant species through natural regeneration and / or seeding. Rehabilitation of the ROW across a watercourse is illustrated in Plate 26 and Plate 27.

Following construction, reinstatement will be monitored and access will be restricted to facilitate rehabilitation.



Plate 26: Rehabilitation of ROW across a watercourse



Plate 27: Rehabilitation of ROW across a watercourse

3.2.13.2 Permanent Flowing Waterways

Permanent flowing watercourse crossings may be constructed using the HDD technique in which a hole is drilled under the watercourse bed and the pipeline section is pulled through the hole.

If access is required across the river, the water is directed through flume pipes and a causeway constructed over the river to allow the passage of construction traffic.

This technique may be considered for crossing the Isaac and Fitzroy Rivers should these locations be across permanently flowing waters.

Horizontal Directional Drilling

HDD, illustrated in Plate 28, is generally used to cross major watercourses, roads or railways.



Plate 28: Horizontal directional drilling under a watercourse

It is necessary to conduct a detailed geotechnical investigation to determine site suitability as HDD is governed by site conditions, such as soil stability, slope, access, available workspace and nature of subsurface ground conditions. The size of the HDD rig and associated footprint depends on the size of the pipe, subsurface geology and the length of the drill.

Installation of the pipeline by HDD involves drilling a hole beneath the surface through which the pipe is pulled. A purpose-designed drill rig, operated by a specialist contractor, is used. Drilling mud (typically bentonite) is used to hydraulically drive the drilling head, as a coolant, to wash the drill cuttings to the start of the drilled hole and to seal and line the drilled hole to facilitate insertion of the pipe. The returned bentonite is screened and recycled.

Once the pipe string is installed and tied into the main section of the pipeline, the entry and exit holes are remediated and excess material disposed of in the trench or at an approved disposal site.

3.2.14 SIGNAGE

Pipeline information markers are erected in line of sight along the pipeline as per AS 2885.1. Signs are placed at regular intervals. They are placed closer together at bends, on either side of road crossings, at fences and at watercourse crossings.



Plate 29: Pipeline information marker

3.2.15 COMMISSIONING

When the pipeline has been fully tested, it is ready for commissioning.

If construction starts from the Gladstone end, gas cannot be introduced until the full length of the pipeline has been completed. However if construction was to commence from the Bowen Basin end, commissioning could proceed sequentially on completion of nominated sections.

The completed test sections are left clean and dry ready for commissioning.

Commissioning will be in accordance with a procedure to be prepared during the detailed design and construction phase. The following information is provisional only and will be confirmed during the procedure development and approval phase.

Commissioning activities referenced within the scope of the procedure will include the following major items:

- Evidence of pre-commissioning of the pipeline, including cathodic protection, instrumentation and supervisory control, and data acquisition systems;
- Commissioning of the pipeline, involving:
 - Initial CSG purge;
 - Low pressure CSG fill to 3,000 kPa;
 - Final high pressure fill to limit of gas availability;
 - Commissioning checks and performance tests; and
 - Punch listing of defective items.

The initial CSG purge¹ will be preceded by the introduction of a slug of an inert gas, typically nitrogen, and a number of foam pigs to separate the air present in the pipeline after construction and the CSG, thereby minimising the likelihood of a potential explosion due to any air / gas mixture.

During purging, air is discharged from the downstream end of the section being commissioned (typically at a line valve) followed by the nitrogen slug and then CSG. As there

¹ Purging describes the process in which air is removed from the pipeline prior to the introduction of CSG to ensure safe entry of the CSG

is some mixing of the slugs, the CSG initially contains some nitrogen. Venting continues until pure CSG is detected at the outlet (valve), after which the section is locked in and the pressure increased until the low level cap is reached.

Volumes of gas discharged at this time are very small as most of the discharge is at pressures only slightly above atmospheric pressure and the mixing only occurs over short lengths.

The low pressure fill enables leak testing at low pressures to be undertaken prior to the pipeline reaching full line pressure.

Once the pipeline has been leak tested at the low pressure level, there are no further gas discharges during commissioning.

The commissioning process will have the following limited environmental impacts:

- The limited release of natural gas and nitrogen to the environment;
- The major component of natural gas, methane, is a greenhouse gas with an effective multiplier of 20 times that of carbon dioxide. The material safety data sheet (MSDS) for nitrogen states that it does not contribute to ozone depletion or global warming;
- Intermittent noise from nitrogen / gas venting; and
- Minor dust release from venting.

At the completion of commissioning, the ABP will have been purged and filled with gas to a pressure determined by the Operational Commissioning Manager, and be ready for operation.

3.3 OPERATION

The operation of the pipeline will be in accordance with approval documentation, the Operational Environmental Management Plan (OEMP) that will be developed, AS 2885 and the APIA Code (APIA 2009).

The pipeline will be a high-integrity pressure vessel constructed from high strength steel that has been integrity tested by 100% examination of welds and a high-pressure hydrostatic test at pressures in excess of the MAOP. Specifications for the pipeline and associated infrastructure are provided in Section 3.1. Operational activities will ensure that this integrity is maintained over the life of the pipeline.

An operational pipeline easement of 30 m will be maintained.

Following reinstatement and revegetation of the ROW, very little above ground infrastructure will be visible. Above-ground infrastructure will be limited to marker posts to identify the location of the pipeline, cathodic protection test points and line valve, meter and scraper stations.

A typical enclosure around a valve is illustrated in Plate 30.



Plate 30: Typical enclosure around a valve on a rural property

3.3.1 OPERATIONAL ACTIVITIES

A summary of operational activities is provided in Table 4 below.

Table 4: Summary of pipeline operational activities

Activity / Issue	Description / Management
Easement Maintenance	
Weed control	Localised weed spraying (in consultation with landholders) is undertaken along the easement as required (primarily in the first 12 months following commissioning) and forms a key part of ongoing maintenance of the pipeline easement.
Line-of-sight clearance	Clearance of the easement to maintain line-of-sight will be required as shrubs and trees regenerate within three metres of the pipeline centreline. Regeneration of shrubs and trees elsewhere on the easement will be encouraged to preserve continued pipeline integrity.
Aerial inspection of easement	Inspections may be undertaken using rotary or fixed-wing aircraft, particularly in areas where only limited public road access is available. Frequency will vary depending upon the particular issue being inspected, but is typically monthly or quarterly.
Patrolling / inspections easement access	This will be undertaken, in conjunction with aerial inspections, by travelling along the easement in vehicles on an as-needed basis. This will involve access to private property and use of private access tracks.
Pipeline Operations	
Cathodic protection surveys	Surveys involve travelling the easement and stopping to measure cathodic protection point output. Typically conducted annually. Depending upon the results detected, this may also involve coating repairs – refer to 'Excavations' below.
Testing and inspection of valves	Valves will be operated to ensure their availability in the event of an emergency. Extremely small volumes of gas may be released during this activity. Typical frequency is annually.
Erosion repair	Following major rainfall events, the pipeline route will be subject to aerial inspection (particularly during the first 24 months after commissioning) to determine if any areas have suffered from erosion or subsidence. Any areas detected will be repaired immediately to match existing ground contours.

Activity / Issue	Description / Management
Emissions	Throughout the lifetime of the pipeline, small amounts of gas may be released to the atmosphere under controlled conditions during pipeline and facility maintenance.
Pipeline incident	The main threats to pipeline safety from operation and maintenance are fire, explosion or radiation exposure as a result of pipeline rupture. Pipeline risk assessments have identified that these threats are associated with factors such as third party or external interference to the pipeline, and pipeline (external) corrosion. All identified threats presenting an unacceptable level of risk will be mitigated through adoption of AS 2885. The pipeline will also be constructed and operated according to the Pipeline Protection Safety Measures and in accordance with an approved Emergency Response Plan.
Pipeline Maintenance	
Coating integrity surveys	Immediately after commissioning, and generally in conjunction with the annual cathodic protection surveys referred to above, a coating conductance test (Direct Current Voltage Gradient (DCVG) survey) will be carried out to determine if there are any defects in the external pipe coating that might compromise the continued long-term integrity of the pipeline. Where these readings indicate that such defects cannot be controlled by the cathodic protection system, the section will be excavated and the pipeline coating repaired.
Pigging	Pigging is periodically undertaken to assess the continued integrity of the pipeline. An 'intelligent pig' (Plate 31) is placed into the pipeline at a launcher station and is propelled through the pipeline by the gas flow before removal at the pipeline receiver station. This pig detects any damage to the pipeline or its coating and is used to direct repairs if significant damage is detected. Minor venting of gas to the atmosphere results during pig removal.
Excavations, including coating refurbishment, installation of anode beds, emergency response exercises and new tie-ins	Excavations of the pipeline follow the same processes as those identified in Section 3.2, namely clear and grade, trenching, backfill and restoration and rehabilitation but are on a much smaller scale. Once vegetation and topsoil have been cleared and stockpiled, the excavation is performed and spoil stockpiled. The pipeline maintenance is then undertaken – this may include welding, painting, blast cleaning. Once complete, the trench is then backfilled, the ground surface re-contoured and topsoil respread. Some reseeding may also be undertaken if needed. These activities are expected to be very rare during the operational lifetime of the pipeline.
Replacement of pipeline section	The pipeline is isolated and a controlled release of gas may be required from the affected section. The affected area is then excavated, the old pipe removed and a new section installed – this includes welding, blasting and coating. This is expected to be a particularly rare event during the operational lifetime of the pipeline.
Welding	Welding is usually only required during pipeline repairs (refer above) or when modifications to existing infrastructure may be required. Pipeline welding requires excavation of the pipeline –

Activity / Issue	Description / Management
	refer above.
Coating	Heat-shrink sleeves or tape are expected to be applied to effect coating repairs occasioned during any of the above repair work.
Pressure testing	When a section of pipe is replaced, a section of pre-tested pipe, from stock held for this purpose, is used. Where a facility is installed that has to tie-in to the pipeline, additional sections will generally be pre-tested prior to installation.
Facility Operation and Maintenance	
Gas delivery station	A gas delivery station consists of a pipeline isolation valve and scraper receiver. These operate continuously.
Pressure reduction station	A pressure reduction station consists of a pipeline isolation valve and pressure control valving to regulate (reduce) pipeline pressure. These operate continuously.
Gas metering station	A gas metering station consists of a pipeline operating valve and gas metering equipment. They are installed at (gas) custody transfer locations and operate continuously.
Scraper Station	A facility for the launching and receiving of pipeline pigs
Weed control	Localised weed spraying is undertaken in and around above ground facilities typically 1 – 2 times/year.
Production of hazardous wastes	Waste hydrocarbons are generated from maintenance / pigging operations. Liquids and heavy metals (e.g. mercury) are not expected in the product, but if present they will be trapped by the coalescing filters that form part of the Custody Transfer Metering Station prior to entering the pipeline. Contaminated waste and used oils will be removed from site for disposal by a licensed contractor.
Waste disposal	General waste generated during operations is collected on site and removed to licensed facilities for disposal.
Station blow downs	All venting during emergency situations is controlled by Emergency Response Procedures.



Plate 31: Intelligent pig

3.3.2 OPERATION AND MAINTENANCE PROGRAM

A routine operation and maintenance program that will include leak detection surveys, ground and aerial patrols, pigging and cleaning of the pipeline, corrosion monitoring and remediation and easement maintenance, will be implemented. Aerial and / or ground inspections will monitor vegetation (including presence of weed species), erosion and subsidence and rehabilitation success of the ROW.

All gas flows will be metered with high accuracy metering. This information will be checked against the volume of gas within the pipeline and any significant imbalance will be investigated as indicative of a potential leak after metering errors have been ruled out.

Pipeline pressure will be continuously monitored for a significant rate of change that could indicate a major leak. Pipeline inlet valves will close automatically on detection of an excessive rate of change in pressure and intermediate valves located along the pipeline will allow individual sections to be isolated.

Prevention of damage due to third party activity will be achieved through appropriate depth of cover, signposting of the pipeline, one-call 'Dial Before You Dig' programs, extensive and continuous landholder and other stakeholder liaison, regular inspection of the pipeline easement to spot any construction or earthmoving activities in the area, and third party education on the potential dangers of carrying out excavation activities in proximity to the pipeline. Operational buried pipelines generally have very little environmental or landholder impact.

In some areas, such as crossings, additional protection may be provided to reduce the risk of third party interference (e.g. marker tape buried above the pipeline, physical barriers or thicker wall pipe). The below-ground pipe will have a minimum wall thickness of 14 mm for X70 strength pipe or similar, which provides a high resistance to penetration from third party activities.

Heavy wall pipe, security fencing, gates and locks will be provided around all major above-ground facilities (e.g. valves) to inhibit accidental damage or unauthorised tampering.

External pipeline corrosion will be prevented by an external protective coating and cathodic protection system. The cathodic protection system will be checked regularly to ensure that the protection voltages are within limits to protect the pipeline from corrosion at any points of coating damage. The cathodic protection system and external coating system work independently to protect the pipeline from corrosion. The internal surface of the pipeline is protected from corrosion as the transported gas is a non-corrosive dry gas, consisting mostly of methane with minor amounts of nitrogen and carbon dioxide.

Given that the pipeline will be underground, land users will be able to resume previous land use activities on top of the pipeline. The only limitations generally will be with regard to excavation and building activities on the 30m wide easement.

Deep-rooted vegetation will not be encouraged directly above the pipeline centreline due to the potential to damage the corrosion protection coating system and the need for continued access along the pipeline, but grass and cropping is encouraged to re-establish a stable surface across the easement.

A company contact number (1800 number) will be displayed on markers and advertised locally so that third parties can contact the pipeline operators for advice or emergency response.

Access to the easement will be necessary to follow up issues identified from inspections. Low level inspection for erosion, subsidence and weeds is likely to be necessary, particularly during the first 12 months following commissioning.

Light vehicle access will be required along the easement to allow inspection and maintenance. However, existing access tracks will be utilised wherever possible.

More significant maintenance activities, such as dig-ups to address coating defects, are likely to be infrequent. However, all maintenance activities that are required will be conducted in accordance with the CEMP and the OEMP. Dig-ups involve the excavation of material from around the pipeline (typically referred to as a bell-hole) to allow sufficient room for operations technicians to safely undertake any remedial works that may be necessary.

The excavation of material will be undertaken in accordance with management conditions outlined for construction, including separate stockpiling of topsoil from trench spoil and restoring the site as soon as practical following completion of maintenance work.

Prior to commencing work, or where several sites are involved, operations personnel will consult with landholders and regulatory authorities as appropriate.

3.4 DECOMMISSIONING

When, and if, the pipeline is no longer required, it will be decommissioned in accordance with the regulatory requirements and accepted environmental best practices at that time. Currently, decommissioning procedures require the removal of all above ground infrastructure (including all scraper station plant and all pipeline valves and metering stations) and the restoration of associated disturbed areas.

At the time of decommissioning, a decision will be made regarding the opportunities for future use of the pipeline. The following two options will be considered:

- Moth-balling – this would involve depressurising the pipeline, capping and filling with an inert gas (such as nitrogen) or water with corrosion inhibiting chemicals. The cathodic protection would be maintained to prevent the pipe corroding.
- Abandonment – this could involve purging the pipe of natural gas, disconnecting it from the manifolds and removing all above ground facilities. The pipe would then be filled with water and left to corrode in-situ. Removing the pipe from the ground is unlikely to be an environmentally or commercially viable option. A detailed rehabilitation program would be developed and implemented in consultation with landholders and the regulatory agencies at the time of abandonment.

3.5 WORKFORCE AND ACCOMMODATION

The Project is anticipated to directly employ up to 650 people during the construction phase and up to 10 people once fully operational, thereby benefiting local communities. Construction personnel are likely to be accommodated in 5 temporary camps located outside the ROW and adjacent to the pipeline route within the PPL area. Clearing, earthworks and additional access will be minimised and previous campsite locations (if available) or existing

cleared areas will be used if possible to reduce the need for additional clearing. Transport from the temporary camp sites to the construction site will be arranged for workers.

Construction camps will require power generation, sewage treatment and potable water and are likely to include offices, construction depots, lay down areas and workshops. Further details regarding construction camps will be outlined in the EIS.

4 ROUTE DESCRIPTION

Details of the preferred route and key ecological aspects are described in this section. Key travelogue constraints are provided on Figure 6. Additional details are included in the 1:500 000 topographical maps provided in Appendix 1, Map 3.

The proposed route commences approximately 2 km west of Eastern Creek Colliery which is located east of Newlands Colliery. It traverses open woodland with bluegrass grasslands, as it runs south to the Burton Range, passing Glenden (10 km to the east) and Lenton Downs (5 km to the west). The water supply pipeline from Eungella Dam to Goonyella is crossed northeast of Lenton Downs.

Located at the northern end of the Burton Range, the Red Hill Lateral connects the proposed ABP to the North Queensland Pipeline in the vicinity of Denham Park which is located approximately 5 km north of North Goonyella Colliery. The lateral traverses predominantly cleared land adjacent to a property boundary, diverting around Denham Park airstrip and brigalow communities in that vicinity.

The proposed pipeline route continues some 25 km further south along the base of the Burton Range to the proposed Goonyella Lateral, after which it runs southeast to Annandale Station on the Peak Downs Highway. The Goonyella Lateral connects the proposed ABP to the North Queensland Pipeline at Moranbah North. The Goonyella Lateral traverses an escarpment and woodland communities, avoiding patches of brigalow, as it negotiates power lines, railways, river diversions, haul roads and hardstanding areas servicing the Goonyella Colliery.

South of the Goonyella Lateral, the proposed pipeline route utilises a hiatus between two mining tenements. A quarry and mesa located in the hiatus constrain route options at this point. Two options have been identified for further investigation: a route to the south of the quarry and mesa which is adjacent to the existing coal mining operation, and a route generally along the cleared area that extends across the top and flanks of the mesa.

East of the mesa, the proposed pipeline route generally follows the high voltage power line in predominantly cleared, gently undulating terrain to North Creek which it then follows to the Goonyella Branch Line. Homesteads, outbuildings and infrastructure associated with Annandale Station preclude pipeline routes to the south in this area. As a consequence, the proposed pipeline route follows the Goonyella Branch Line approximately 3 km east before turning south to its junction with the Elphinstone Header. Separation distances to the railway are increased by the presence of a water supply pipeline adjacent to the railway reserve, and have been maximised to the extent possible, which is limited by the constraints imposed by remnant vegetation along the tributaries of North Creek.

The proposed Elphinstone Header commences approximately 2 km east of Lake Elphinstone and approximately 1 km south of the Suttor Developmental Road at the watershed of Walker Creek. Historic vegetation clearing and grazing pressures have resulted in severe erosion in the gullies draining the eastern flanks of the Carborough Range. The proposed pipeline route for the proposed header pipeline utilises existing access tracks, elevated ground and existing fence lines to traverse open woodland of the Walker Creek valley, avoiding brigalow communities, dams and the worst of the erosion. The approach to Coppabella is constrained by the aforementioned railway and water supply pipeline, the highway, rural residential properties, rocky outcrops and borrow pits. A feasible route that addresses these constraints

and enables perpendicular crossings of the railway, highway and water supply pipeline was identified and adopted as the proposed route.

The granite outcrop west of Daunia Station prompted the investigation of alternative routes in this area which is constrained by coal mining tenements to the east and west of the homestead. Three possible routes were identified and investigated. The route to the west which traverses the flanks of the granite outcrop was rejected for constructability reasons. Of the two routes to the east of Daunia Station, the most easterly route is the preferred route as it is the most direct route and minimises potential impacts on water (unconfirmed) pipeline infrastructure associated with Annandale Station. The proposed pipeline route traverses predominantly cleared land and brigalow communities adjacent to the Norwich Park Branch Line. The latter is unavoidable due to the arrangement of infrastructure in that area.

South of Daunia Station, the proposed pipeline route traverses the Isaac and Mackenzie River valleys and floodplains which have been extensively cleared of brigalow. The proposed pipeline route has been selected to avoid impacts on remnant brigalow communities and maturing brigalow regrowth. Of concern and endangered regional ecosystems (predominantly brigalow and eucalyptus spp.) are encountered at watercourse crossings which have been selected to reduce potential impacts on the banks and riparian vegetation. Clearing of brigalow has exposed gilgai soils (melon holes) which are extensive throughout this section of the pipeline route, and along and to the north of the Goonyella and Red Hill laterals. Appropriate construction methods will need to be developed to install and maintain the pipeline in these soils.

A lateral pipeline (Saraji Lateral) connects the proposed ABP to a possible future gas processing facility adjacent to the Peak Downs Colliery. The Saraji Lateral traverses predominantly cleared land before crossing Ripstone Creek to run southwest in woodland communities to its nominal end point on the proposed CQP adjacent to the colliery. The crossing of Ripstone Creek has been chosen to avoid the brigalow communities located along and adjacent to the watercourse.

Immediately southeast of Leichhardt Downs, a lateral pipeline (Dysart Lateral) connects the proposed ABP to a possible future gas processing facility adjacent to the Norwich Park collieries, which are located southeast of Dysart. The Dysart Lateral traverses cleared land utilised for grazing and cropping to its notional end point on the proposed CQP. Small stands of maturing brigalow regrowth are largely avoided by the proposed route for the lateral.

The proposed pipeline route traverses the toe of the Broadsound and Boomer ranges as it runs east then west of Pluto Creek to cross its watershed and descend to Apis Creek valley before crossing the Duaringa Apis Creek Road. The proposed pipeline route then follows the PNG Queensland Gas Pipeline corridor from Apis Creek southeasterly to the Bouldersombe-Nebo 275kV transmission line.

The Stanwell Gladstone Infrastructure Corridor and PNG Queensland Gas Pipeline corridor traverse the extensive lagoon systems of the Fitzroy River floodplain in the vicinity of Rockhampton. Numerous watercourse crossings are required to negotiate these waterbodies, some of which are permanent waterholes. Heavy rains and flooding immediately prior to the helicopter inspection showed extensive inundation of land traversed by these pipeline corridors. In contrast, the Gladstone Nickel Pipeline route was observed to be largely unaffected by flooding. Both route options encounter rural residential subdivisions in the vicinity of Ridgeland, southwest of Alton Downs and at Kabra, west of Gracemere

Woodland communities comprising eucalypt species and brigalow are encountered in this section which has been predominantly cleared and is principally used for grazing purposes. Where possible, the proposed route follows existing roads and access tracks and utilises cleared land. The undulating to steep terrain, in parts, limits pipeline route options resulting in potential impacts on remnant vegetation.

Several pinch points are encountered along this route. Tactical realignment and construction methods are available to address these situations which occur at a watercourse crossing, at dwellings located in close proximity to the proposed pipeline route, adjacent to existing gas and water supply pipelines and in the vicinity of the junction of several high voltage transmission lines.

South of Midgee the proposed pipeline route runs in and adjacent to the western side of the Stanwell Gladstone Infrastructure Corridor to Mount Larcom. South of Mount Larcom the proposed pipeline route generally follows the CQP route to its junction with the proposed Arrow Surat Pipeline. The CQP route is located adjacent to and west of the proposed Northern Infrastructure Corridor. The Stanwell Gladstone Infrastructure Corridor is located in predominantly cleared land to the east of the Bruce Highway. It crosses numerous watercourses, some subject to tidal flows. Extensive lagoon systems are traversed in the vicinity of Bajool.

In summary, the proposed pipeline route minimises impacts on endangered and of concern ecosystems. It seeks to minimise conflicts with, and potential impacts on, existing and proposed coal mining operations. It avoids areas subject to inundation, except in parts of the Stanwell Gladstone Infrastructure Corridor. It minimises impacts on dwellings and small landholdings by avoiding Gracemere, the intensely settled area between Gracemere and Rockhampton and the more intensely settled rural residential subdivisions at Alton Downs. It avoids registered historic sites. The potential for Indigenous cultural heritage to occur along watercourses, terraces and escarpments was a key consideration in selecting watercourse crossings and traverses of escarpments. The results of an environmental impact assessment and negotiations with landholders, coal mining companies, the Indigenous community and governments will result in further refinement of the proposed pipeline route to address identified issues and concerns.

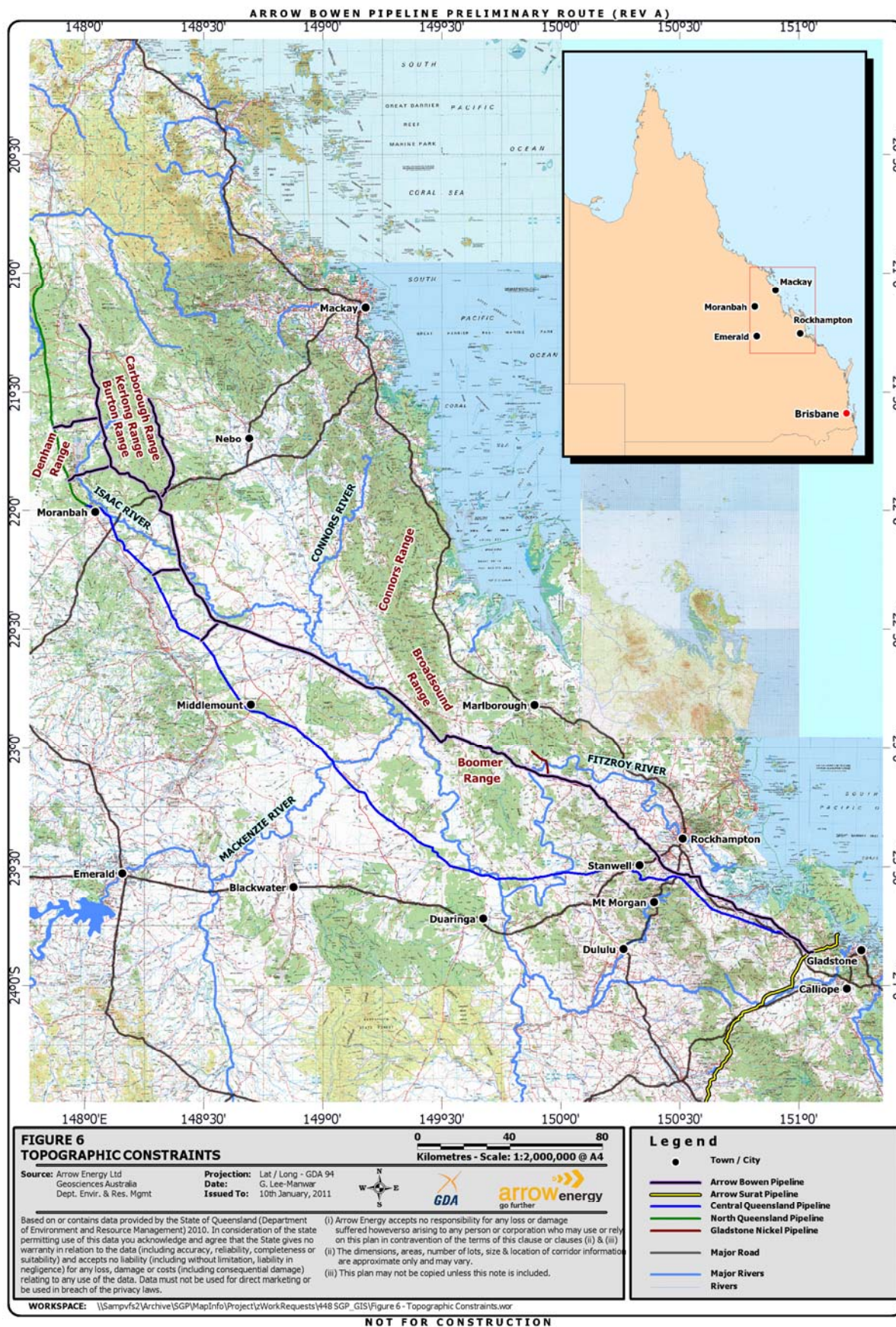


Figure 6: Route Description

5 RISK-BASED FRAMEWORK APPROACH

The proposed voluntary EIS will inform a risk-based environmental management framework. The principal objective of this approach is to protect the environmental values of the Project area and to identify appropriate environmental management measures for Project activities having regard to the constraints imposed by the environmental values whilst maintaining a high level of safety.

The framework approach ensures planning and development of the proposed pipeline will occur in a safe and orderly manner by stipulating environmental management controls reflective of the level of environmental sensitivity.

Environmental values of the Project development area will be identified in relation to their significance, exposure to threatening processes and their capacity to recover or adapt to change imposed by the project activities.

Environmental values and their local, regional, state and national significance will be determined through the EIS process. The impacts, benefits and risks will be assessed in an iterative process. Mitigation measures will be established to ensure the project is environmentally, socially and culturally acceptable whilst still remaining cost effective. A set of environmental management controls will be developed for each level of constraint to support implementation.

The framework approach will define the spatial extent of environmental values (e.g. the presence of significant flora and fauna species, threatened ecological communities, wildlife corridors, cultural heritage, good quality agricultural land, etc.) enabling informed route selection. It will result in an ecological constraints map that will identify the environmental values, including the level of environmental constraint they impose across the entire Project area. For non-spatial environmental values (e.g. air, noise, etc.), the framework approach will provide thresholds and triggers that guide design and equipment selection.

Collectively, the spatial and non-spatial controls will inform decision-making during route selection, design, construction and operation. Arrow will identify the proposed controls in the EIS and implement these through standard operating procedures (SOP) as part of the EMP presented in the EIS.

Arrow Energy's Environmental Management System is presented in Section 7.

6 EXISTING ENVIRONMENT AND POTENTIAL IMPACTS

This section provides an overview of the nature and extent of the potential environmental and socio-economic impacts that may be associated with the construction and operation of the proposed ABP Project. A detailed assessment will be provided in the EIS.

6.1 CLIMATE

6.1.1 EXISTING ENVIRONMENT

The regional area is predominantly sub-tropical with temperatures varying from warm to hot in summer, to mild to cool in winter with large diurnal variations. A number of weather stations are located in the general project area. Statistical data from Station 034038 at Moranbah Water Treatment Plant, Station 039083 at Rockhampton Aero and Station 039123 at Gladstone Radar have been selected as being representative of the Project area (BOM 2010).

The average minimum and maximum summer temperatures recorded at Moranbah Water Treatment Plant are 21.9°C to 34.1°C with winter temperatures ranging from 9.9°C to 23.8°C. Summer temperatures recorded at Rockhampton Aero are generally lower, although the minimum summer temperature is slightly higher than that recorded for the more northerly weather station. The recorded temperatures range from 22.1°C to 32.1°C in summer and from 9.5°C to 23.1°C in winter. The highest mean temperature at Gladstone in summer is 31.2°C with the lowest average being 22.5°C. The winter temperatures range between 13.4°C and 22.8°C.

Rainfall generally increases from north to south across the project area with a median annual rainfall of 569.8 mm at Moranbah and 841.2 mm at Gladstone. January and February are the wettest months with a mean monthly rainfall at Moranbah of 100 mm. September is the driest month at this location with the mean rainfall dropping to less than 10 mm. The wettest month in Rockhampton and Gladstone is February with a mean rainfall of 144.6 mm and 148.3 mm respectively. September is also the driest month in these locations with a mean rainfall of 24.5 mm and 28.2 mm at Rockhampton and Gladstone respectively. The mean number of days per annum on which more than 1 mm of rain is recorded is 41.9 mm and 62.3 mm for Moranbah and Rockhampton respectively. This is slightly higher at 66.3 mm for Gladstone.

Wind speeds tend to be light across the project area with the prevailing winds typically south-east to east with the highest mean speeds (23.5 km/h) recorded at Gladstone in January.

6.1.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Construction activities in sensitive locations will be scheduled to avoid the wet season, thereby minimising erosion and sedimentation.

6.2 TOPOGRAPHY, GEOLOGY AND SOILS

6.2.1 EXISTING ENVIRONMENT

6.2.1.1 Topography

Landforms range from level to very gently sloping plains, alluvial flats, drainage floors, backswamps and abandoned channels. The Brigalow Bioregion comprises undulating to rugged ranges and alluvial plains to the east of the Great Dividing Range. The southern areas are dominated by extensive sandstone ranges and lowlands with ridges. The majority of the proposed pipeline route traverses predominantly flat and undulating topography.

6.2.1.2 Geology

Geologically, the pipeline lies predominantly over the Bowen basin which occupies about 160,000 km² of eastern Queensland. The southern portion of the Bowen Basin lies beneath the younger Surat Basin and was formed up to 290 million years ago (in the Early Permian to Middle Triassic periods). The Bowen Basin was formed by fluvial and lacustrine sediments and volcanics being deposited in the east, while a thick succession of coals and non-marine clastics were laid in the western portion of the basin. It has a maximum sediment thickness of about 10,000 m concentrated in two N trending depocentres, the Taroom Trough to the east and the Denison Trough to the west.

Over 100 hydrocarbon accumulations have been discovered in the Bowen Basin, of which about one third are producing fields. Accumulations occur throughout the succession, but the most important reservoirs are in the Early Permian and Middle Triassic. Source rocks have been identified throughout the Permian and in the Middle Triassic and are mostly non-marine. Proven plays comprise mostly anticlinal closures sometimes enhanced by a stratigraphic component, as well as fault rollovers. Other plays are largely untested. The Bowen Basin also has vast coal resources, with major open cut and underground coal mines in the north of the basin. Large volumes of CSG are held at shallow depths within Permian coals in the north with the potential to support expanded CSG developments (Geoscience 2008).

6.2.1.3 Soils

Initial desktop assessment has identified that sections of the preferred pipeline alignment are moderately to highly susceptible to wind, sheet and/or gully erosion. The risk is greatest on steeper slopes where more dispersive soils occur. Similarly, stream banks at pipeline crossing points are also identified as having significant erosion risks.

The Brigalow country is generally known for its clay soils that are relatively fertile and regarded as productive agricultural areas. They are predominantly deep to very deep cracking clays, sometimes with gilgai or texture contrast soils with sandy surface (particularly where *Eucalyptus populnea* is present) (DERM 2010c).

A review of existing data (ASRIS 2010) has determined that the most significant soil types in relation to erosion, are alkaline and neutral duplex soils (solodised solnetz, solodic soils or sodosols. These soils are prone to dispersions and gully erosion but not susceptible to sheet erosion if the slope is <2%.

Dominant soils, broadly grouped into soil orders, through which the ABP will travel, include Vertosols, Sodosols, Rudosols and Chromosols with limited intrusion into Kandosols and

possibly Hydrosols as illustrated in Appendix 1, Map 4. Key characteristic of these soils are described in Table 5 (DERM 2010e).

Table 5: Dominant soils intersected by ABP

Dominant Soil	Characteristics
Vertosol	Vertosols are the most common soil in Queensland, covering 29% of the State—characteristics include: brown, grey or black soils—which crack open when dry; commonly formed hummocky relief called gilgai; very high soil fertility—ability of soil to supply plant nutrients; and large water holding capacity. Vertosols have been voted by the Australian Society of Soil Science Inc. as Queensland's 'state soil'.
Sodosol	Sodosols are texture contrast soils with impermeable subsoils, due to an elevated concentration of sodium. These soils occupy a large area of inland Queensland, covering 12% of the State. Generally Sodosols have a low nutrient status and are very susceptible to erosion and dryland salinity if vegetation is removed.
Rudosol	These soils orders are generally of low fertility and low water holding capacity. Rudosols are poorly developed but widespread and can be shallow and stony. These soil types cover 12% of the State — with the most extensive areas of these soils inland from Cairns.
Chromosol	These soil orders are texture contrast soils with permeable subsoils and are not strongly acid. They cover 7% of the State.
Kandosols (minimal intrusion)	Kandosols are red, yellow and grey massive earthy soils. They generally have a sandy to loamy surface soil, grading to porous sandy clay subsoils with low fertility and poor water holding capacity. A wide range of crops can be grown on these soils where rainfall is higher or where irrigation is available. This soil type covers 29% of the State.
Hydrosols (possible intrusion)	Hydrosols are soils that are saturated with water for long periods of time (at least several months), typically of grey (or greenish-grey) colour or contain strongly contrasting iron stained colours (mottles). This soil covers 0.5% of the State and is mainly found near coastal areas. However, many inland wetlands are also dominated by Hydrosols even though these areas may only be intermittently inundated.

A more detailed review of available mapping and literature on soils, as well as field investigations at key locations along the proposed pipeline route, will be undertaken during the ensuing EIS to consider:

- the susceptibility of the different soil types to erosion;
- the ease of handling and rehabilitation of the various soil types;
- areas of Good Quality Agricultural Land (GQAL), as defined under the State Planning Policy 1/92) and Strategic Cropping Land that might be affected by the Project; and
- Potential Acid Sulphate Soils (PASS).

Maps (1:100 000) will be prepared to better describe the soils traversed by the proposed route in order to determine erodibility and develop appropriate mitigation measures.

Acid sulfate soil (ASS) causes damage to buried structures through pyrite oxidation and release of acid leachates. Deposits of ASS are commonly found less than 5 m above sea level, particularly in low-lying coastal areas including mangroves, salt marshes, floodplains, swamps, wetlands, estuaries, and brackish or tidal lakes. The pipeline traverses extremely low and low probability ASS for almost the entire length of the route (ASRIS 2010). There are some soils classed as high probability for ASS in the low lying areas around Gladstone and further investigation may be required during detailed design to avoid or mitigate potential effects in these areas.

Good Quality Agricultural Land

State Planning Policy (SPP) 1/92, Development and Conservation of Agricultural Land, seeks to protect GQAL from subdivision into uneconomic units and to minimise the potential for land use conflicts between agricultural and non-agricultural land uses.

Strategic Cropping Land

Draft trigger maps prepared by DERM (DERM 2010a), using land suitability data represent versatile cropping lands, agricultural land class A, indicate the potential for Strategic Cropping Land to occur in the vicinity of ABP. Further field assessment against specific criteria will be used during the EIS investigation to identify the presence and extent of any strategic cropping land on the ABP route.

6.2.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Construction of the pipeline will be progressed sequentially, with clean-up, restoration and rehabilitation initiated as soon as backfilling is complete, while trenching and the other activities described in Section 3.2 are advanced.

With the implementation of detailed soil protection measures (including those described below), impacts associated with soil disturbance should be minimal.

6.2.2.1 Good Quality Agricultural Land and Strategic Cropping Land

Although GQAL and strategic cropping land will be avoided wherever possible, the preferred pipeline route will inevitably pass through some lands classified as GQAL and may pass through strategic cropping land due to site-specific limitations preventing its avoidance (e.g. avoidance of threatened communities or essential habitat).

Impacts are, however, expected to be limited and of short duration as they are only foreseeable during pipeline construction. Normal agricultural activities occur over buried pipelines following construction and thus the presence of a buried pipeline would not create any long term adverse impact upon GQAL and strategic cropping land. Construction of ABP will not result in the permanent alienation of GQAL or strategic cropping land. Compensation is offered to the landowner for any temporary disruption to agricultural production during construction and rehabilitation of the pipeline. Further information is provided in Section 6.10.2.

6.2.2.2 Erosion and Sediment Control

To reduce soil impacts and potential erosion and sedimentation issues, the pipeline ROW may be narrowed and clearing minimised in sensitive areas such as the banks of watercourses containing riparian vegetation and erosion-prone soils. Watercourse banks will

be stabilised and drainage patterns re-established at creek crossings within the shortest practical period. The timing between clear and grade and restoration will be limited to reduce the duration of soil exposure, while construction works will be minimised during high rainfall and flood events. In areas of high slope and erosion prone soils, the use of stormwater diversion drains and other erosion control measures will be implemented. Sediment control devices may be installed to minimise erosion and sediment loading to waterways. Site-specific mitigation measures will be further developed during the EIS process and presented in the EMP contained in the ensuing EIS.

Pipeline easement maintenance will be regularly undertaken to ensure that the integrity of soil conservation works installed during restoration are maintained and vegetative cover is promoted to ensure minimal soil loss. Progressive revegetation will occur during construction and operations to reduce potential erosion risk.

An EMP for the operational phase outlining appropriate maintenance requirements with regards to sediment and erosion control along the pipeline route will be developed.

6.2.2.3 Spill Prevention

Any diesel or oil spills that may occur during construction activities will be contained within the construction location and managed in accordance with the EMP in the EIS to prevent any impact on the surrounding environment, particularly watercourses, drainage lines, state forests and other conservation areas alongside the alignment.

Without appropriate controls, Project-related activities may result in localised soil contamination from:

- Minor spills of fuel or chemicals;
- Stormwater / runoff from disturbed areas; or
- Discharged treated sewage effluent and hydrostatic test water.

Environmental controls, including spill prevention and cleanup measures and quality assurance systems will be implemented throughout construction and operations.

Construction activities will use relatively small quantities of chemicals and fuel, thus potential spill volumes are low. Construction equipment will be refuelled by appropriately trained and qualified staff on the pipeline ROW or inside purpose built areas at camps or facility compounds, as applicable. Diesel storage tanks at the construction camps will be designed and operated in accordance with AS 1940, The Storage and Handling of Flammable and Combustible Liquids. All waste will be periodically removed from site.

The pipeline will be internally lined minimising the need to add corrosion inhibiting chemicals (e.g. biocides and/or oxygen scavengers) to the hydrostatic test water. This increases the options for hydrostatic test water disposal as such water will not then require treatment prior to disposal.

Detailed procedures for hydrostatic testing of the pipeline will be developed to address the following disposal options:

- Disposal on-site after assessment or analysis (provided the water meets relevant ANZECC and relevant DERM criteria);

- Containment and/or treatment on site, to existing facilities, or a new evaporation pond in accordance with DERM requirements; or
- Removal from site.

Packaged sewage treatment units that meet applicable legislation and standards are likely to be utilised at temporary construction camps. Following treatment, effluent will be disposed to land, well away from watercourses, infrastructure, residential dwellings or sensitive areas and in accordance with relevant standards and regulatory water quality limits.

6.2.2.4 Hydrostatic Test Water Management

Management of hydrostatic test water (including discharge) will be in compliance with all regulatory and landholder requirements and will not result in environmental harm.

Water used in hydrostatic testing of the pipeline will be evaluated before discharge to ensure that there is no risk of contamination to watercourses, water bodies and groundwater. If chemicals have been added, or if there are concerns about water quality, it may be necessary to test the water prior to discharge over land. Discharge or recycling of test water for secondary uses, such as pasture irrigation, will be undertaken only where water quality is within relevant statutory water quality guidelines.

6.2.2.5 Acid Sulphate Soil

Best management practices will be adopted for any ground disturbance sites in areas of PASS in accordance with Queensland Acid Sulphate Soil Investigation Team (QASSIT) guidelines.

6.3 TRAFFIC AND TRANSPORT

6.3.1 EXISTING ENVIRONMENT

Major highways and main roads in the area will be used to deliver construction materials and supplies to the ROW.

The proposed pipeline alignment crosses the Bruce, Peak Downs, Burnett and Capricorn Highways.

Details of other roads and operational railway lines in the Project area are listed in Section 3.2.12.

There are a number of smaller local roads which will be used during construction and operation of the pipeline by staff and contractors.

6.3.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

The use of existing arterial and local roads for transporting pipe, materials and construction equipment reduces the need for additional land disturbance. Such transport however, may temporarily increase and disrupt local traffic flow and may reduce road integrity. Site staff will also utilise local roads and cleared tracks to travel from the construction camp to the ROW.

Access routes for line pipe delivery will be proposed and assessed in the EIS.

A Road and Traffic Management Plan will be developed in collaboration with local government authorities and implemented during construction. Where required, existing roads may be upgraded and maintained for heavy vehicle and equipment movement.

Any predicted increase in traffic volume and the impact of heavy vehicle access will be determined as part of the EIS process. Any upgrade of existing roads or establishment of new roads (if necessary) will be assessed and include consultation with stakeholders including local councils, the Department of Transport and Main Roads (DTMR) and landholders.

Increased traffic volumes may result in cumulative effects on the road network due to construction of other linear infrastructure, gas field development and LNG facilities as the CSG industry expands in the region.

6.4 WASTE

6.4.1 EXISTING ENVIRONMENT

Relatively small amounts of domestic and industrial wastes will be generated during the construction and operation of the proposed pipeline.

Regulated waste such as low volume, low level contaminated soil / gravel (e.g. oil contaminated) may be generated during pipeline operations.

6.4.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Waste management will be based on a hierarchy beginning with waste avoidance, minimisation and recycling before disposal. This system will be outlined in the waste management strategies in the EIS for the management of all wastes associated with construction and operational activities of the pipeline. Regulated waste, if produced, may be disposed of at licensed facilities, or treated in-situ on site.

6.5 WATER RESOURCES

6.5.1 EXISTING ENVIRONMENT

6.5.1.1 Surface Water

The proposed pipeline route traverses the Isaac and Fitzroy Rivers and a number of creeks and gullies within the Burdekin, Fitzroy and Calliope drainage basins forming part of the North East Coast Drainage Division. It has been aligned to avoid permanent standing water and watercourses where possible. Some minor watercourses, all of which are believed to be ephemeral, flowing only occasionally following rainfall events, are also traversed.

Water Resource Plans identifying the allocation and sustainable management of water have been developed for the following river basins in the regional area of the proposed pipeline:

- Burdekin Basin;
- Fitzroy River Basin; and
- Calliope River Basin.

Watercourses

The watercourses to be intersected by the preferred pipeline route include are listed in Section 3.2.13 and include the Isaac and Fitzroy Rivers.

Most of the watercourses anticipated to be traversed by the pipeline are typical of many Australian inland waters being ephemeral and intermittent with little to no flow during the drier months. Inland watercourses generally meander with slow to moderate flows and often have long periods of low or zero flows during which the watercourses can become a series of waterholes. The field survey will include an assessment of the riparian vegetation and aquatic ecology at all significant watercourse crossings.

There are also a number of dams, storages and weirs that have been constructed within each catchment / river basin to supply water for irrigation, urban, stock and industrial uses throughout the region. The pipeline alignment has avoided these areas during the route selection process.

Environmental values for watercourses within the study area will be protected.

Water Quality

The Queensland Water Quality Guidelines (QWQG) identifies the importance of biological indicators as a direct measure of ecosystem health. The Australian Natural Resources Atlas (ANRA, 2009) indicates that turbidity, salinity and high nutrient levels are of concern in this region.

A targeted search of Water Quality Summary by Site and Flow Statistic Reports (DERM 2010g) was carried out to identify DERM Gauging Stations on major rivers intersected by the proposed pipeline route. Three sites were identified. While the stations are not situated at the proposed crossing locations of the Isaac and Fitzroy Rivers, historical results provide an overview of the status of surface waterways in the area. The results (summarised in Appendix 2, Table A-2) indicate that high turbidity / total suspended solids, high nutrient levels and elevated nutrient levels are common, but that salinity is generally low.

Environmental values associated with water quality include turbidity, temperature, dissolved oxygen content and contaminant content. Parameters listed in the QWQG selected for further desktop assessment will be based on potential impacts associated with the construction and operation of CSG transmission pipelines, typically salinity, erosion and sedimentation.

Wetlands

The ABP route is located within the Great Barrier Reef Catchment and therefore subject to the conditions described in the Temporary State Planning Policy 1/10 *Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments*. Wetlands protected by this policy are known as Wetland Protection Areas (WPAs). The pipeline also transects a number of Wetland Management Areas (WMAs). WPAs and WMAs are mapped by DERM and collectively comprise referable wetlands, which are regulated as a Category C ESA. The ROW contains:

- up to 18.9 ha of WPAs, comprising two palustrine wetlands covering 1.3 ha and 17.6 ha of trigger areas (which are 500 m buffers around each wetland)

- up to 80.8 ha of WMAs, including 36 riverine wetlands covering 14.9 ha, four palustrine wetlands covering 1.3 ha, two estuarine wetlands covering 0.7 ha and 64 ha of trigger areas (which are 100 m buffers around each wetland).

The only RAMSAR wetland that lies within the same catchment as the ABP is the Shoalwater and Corio Bays area, which is located approximately 60 km north-east of the proposed pipeline route. The ABP lies within 5 km of three nationally important wetlands (Fitzroy River Delta, Fitzroy River Floodplain, and Lake Elphinstone) and within 10 km of Port Curtis (Miller and Deacon, 2005; DSEWP&C, 2010a). RAMSAR wetlands and nationally significant wetlands are not transected by the proposed pipeline ROW, so are unlikely to be impacted by construction or operating activities provided that appropriate mitigation measures are implemented. Wetlands within the ABP are mapped in Map 5 of Appendix 1.

6.5.1.2 Groundwater

Groundwater in the region lies primarily within the Tasman Province, with limited excursion into the Great Artesian Basin Water Resource Plan area. Each province comprises a number of Groundwater Management Units (GMUs). The majority of the groundwater is of marginal or poor quality as is typical of the coal bearing strata particularly in the Bowen Basin Stratigraphy. However, supplies of good quality groundwater are common from the alluvial and basalt aquifers (ANRA 2009).

The Isaac River groundwater management unit (GMU), located in central Queensland, approximately 135 km north west of Rockhampton covers an area of approximately 6 370 km² and is flanked on the east by the Connors Range and on the west by Denham Range. The Isaac River and its major tributaries Bee Creek, Funnel Creek and Connors River drain the groundwater management unit. The Isaac River GMU falls within the Fitzroy Basin (1304). The alluvial aquifer is the primary source of groundwater in the Isaac River groundwater management unit. Supplies obtained from the alluvial aquifer are highly variable, with minimal available drawdown limiting the use and development of the groundwater resource. The groundwater resources of the Isaac River GMU are mostly limited, and only able to meet the requirements of stock watering and domestic use. There is limited scope for irrigation/industrial development of groundwater resources within the GMU (www.anra.gov.au/topics/water/overview/qld/gmu-isaac-river.html).

Groundwater recharges through two primary processes. The first is shallow alluvial groundwater which is intermittently recharged during flood events through river flats and floodplains. In the second, the bedrock aquifers are recharged by incident rainfall and river infiltration. Groundwater is predominantly well below the surface level and therefore not impacted by the construction activities, although some seasonal dewatering may be necessary.

The proposed transmission pipeline route traverses a wide range of hydrogeological environments which will be further investigated during the EIS process.

No natural springs are traversed by the pipeline and all artificial bore heads and landholder dams have been avoided to minimise disruption to stock and property facilities. Water drawn from bores for construction purposes will not diminish the supply to landholders.

6.5.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

6.5.2.1 Surface Water

Potential impacts from the pipeline on surface water can be expected during the construction phase. The design and construction of the pipeline will include controls to minimise the potential environmental impact on surface water bodies. The EMP to be developed for the project will outline appropriate environmental controls to be adopted during the project (e.g. erosion and sediment controls) and accordingly the degree of environmental impact is expected to be low.

A number of watercourses are expected to be unavoidably intersected by the construction of the pipeline. The final route alignment and location of the crossings will be dependant on the findings of the EIS and engineering design constraints. Appropriate construction techniques will be adopted based on hydrology, soils and ecological studies to minimise construction impacts and remediation works. Watercourses will be crossed using standard open cut trenching or HDD (where open cut methods are not feasible and where suitable geotechnical conditions exist). By appropriately timing construction activities (i.e. in dry periods), and installing and maintaining appropriate erosion and sediment control structures (e.g. diversion berms and cross ditches), significant long term impacts (including flow diversion and sedimentation) to watercourses, will be prevented.

An assessment of surface water hydrology, to be undertaken as part of the EIS, will consider the impact of flooding on the pipeline and will assess possible flood mitigation measures where necessary.

Sediment mobilisation during construction may enter surface water during rainfall events with a resulting detrimental impact on water quality and aquatic habitat. Targeted assessment of ecosystem health indicators will be conducted as appropriate during the EIS field surveys in order to quantify impacts associated with the construction and operation of ABP on surface water quality.

Extraction of water for hydrostatic testing, camp use or other construction use (e.g. road maintenance) has the potential to impact groundwater or surface water flows if not appropriately managed. If extraction of water from local rivers or creeks is required, it will be carried out in a manner that will minimise flow impacts (e.g. only extract if water was flowing at a certain rate). Any water extraction will also be subject to obtaining necessary approvals under the *Water Act 2000* and compliance with associated permit conditions.

The use of treated CSG associated water for hydrostatic testing (subject to a beneficial use permit if necessary) will be investigated as an alternative source.

No internationally or nationally significant wetlands are expected to be impacted by the pipeline construction. Impacts to State significant referable wetlands will be assessed and appropriate mitigation measures developed during the EIS.

6.5.2.2 Groundwater

The groundwater structures are unlikely to be affected by the construction of the pipeline. The pipeline is buried at a shallow depth (minimum 750 mm cover except at watercourse crossings and road crossings where the minimum depth of cover will be 1 200 mm) and is unlikely to disrupt any sub-artesian supplies.

The construction of the pipeline is considered to have very little impact on groundwater recharge while the shallow depth of the trench and the physical disturbance of the surface is unlikely to cause groundwater contamination. To prevent contamination through recharge areas, the ensuing EMP will detail construction measures to control water used for hydrostatic testing and watering of access tracks and waste disposal.

Should groundwater be extracted for any construction or commissioning activity, existing bores will be utilised wherever possible (and where permitted) in preference to installing new bores.

There is also a small but potential risk that Project-related activities may result in localised groundwater or surface water contamination. The main potential sources of contamination are:

- Minor spills of fuel or chemicals; and
- Discharged hydrostatic test water.

Providing management procedures related to spill prevention are implemented, associated impacts to groundwater and surface water resources as a result of pipeline and facility compound activities are considered unlikely.

Groundwater levels in the vicinity of Gladstone are expected to be high given the low RL of the surrounding terrain. Accordingly, management strategies will be outlined in the ensuing EMP should the trench require dewatering in this area and in the event that PASS is encountered.

6.6 AIR QUALITY

6.6.1 EXISTING ENVIRONMENT

Air quality along most of the pipeline route is likely to be typical of the rural areas of central Queensland and influenced by a range of activities such as:

- Dust from pastoral activities, including stock and vehicle movements;
- Environmental factors (including wind-borne dust, seed, pollen and smoke); and
- Vehicle and equipment exhaust fumes from roads and operating industries and towns.

DERM has a network of air quality monitoring stations in Queensland (including West Mackay, Rockhampton and South Gladstone) chosen to measure pollutants typical of the region and its activities. Pollutants include carbon monoxide, nitrogen dioxide, ozone, particles (PM₁₀), sulphur dioxide, and visibility. Index values for these parameters indicate that the air quality is generally 'Very Good' with PM₁₀ reporting as 'Good' (50% of targeted maximum) on a number of occasions (DERM 2009b).

Due to the rural nature of much of the pipeline route, background air quality data is not available for much of its length, however air quality is expected to be generally 'Very Good' due to the lack of significant industries in the majority of the pipeline area.

6.6.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Atmospheric dust will be the main impact to air quality during the construction of the pipeline. Dust will principally arise from clearing, grading, pipeline trenching and backfill, as well as from general vehicle movements during construction. During operational maintenance, it is

expected that rehabilitation will have progressed sufficiently that, after a short period, dust will not represent a potential issue. Dust generation is expected to be generally localised and short-term as construction progresses along the alignment. Measures will be implemented to minimise the nuisance experienced by local residents and the workforce and dust will be managed through the application of water in dry and windy periods (or when working in proximity to residences).

Exhaust fumes will be emitted during construction and operations by light vehicles, trucks, machinery and equipment. Such equipment will be fitted with operational exhaust systems that will control these emissions. Emissions during pipeline operations would predominantly arise from venting small amounts of natural gas during routine maintenance and is not expected to result in significant pollutant loads in the local air shed. CSG is lighter than air and any such emissions would readily dissipate.

Given the context of existing land uses in the region (including pastoral, petroleum production and transport), potential air quality impacts associated with dust and emissions from pipeline construction, are considered minimal.

During pipeline construction, greenhouse gases (GHGs) will be emitted by vehicles, machinery and equipment. The primary GHG emissions during construction will be carbon dioxide and non-methane volatile organic compounds originating from the vehicle fleet, camp generators and electricity consumption. These will be temporary and limited to localised areas. Minor GHG emissions associated with transmission pipelines may occur during maintenance, and any major emission will be as a result of accidental releases, leakage or loss of integrity of the pipeline. Accidental natural gas fugitive emissions can be minimised through good operating practice and preventative maintenance programs. Shut-off valves will be connected at regular intervals and an automatic gas leak detection cut-off system will be designed into the pipeline operations. The quantity of greenhouse gases emitted during all these activities is considered to be very small and will not have a significant greenhouse impact.

Arrow Energy is required to report greenhouse gas emissions for all its operations (including any associated with the ABP) in accordance with the *National Greenhouse and Energy Reporting Act 2007* consistent with the Australian Government's proposed future Carbon Pollution Reduction Scheme.

6.7 NOISE AND VIBRATION

6.7.1 EXISTING ENVIRONMENT

The existing noise environment in the region is expected to be typical of sparsely populated pastoral areas, with generally low levels of background noise dominated by natural sources (e.g. wind, animals and insects).

Typical ambient background noise levels to be adopted will be based on AS 1055, Acoustics - Description and measurement of environmental noise (parts 1-3). The majority of the pipeline route would fall into the noise area category "very rural (R1)" as defined by this standard. The region from Rockhampton to Gladstone is considered to be class R4.

Estimated average background A-weighted sound pressure levels ($LA_{90,T}$) for different times for noise area category R1 and R4 (extract from AS 1055.2) are presented in Table 6. These averages reflect the estimated maximum values for planning noise levels (PNL) for noise

area category Z1 and Z3 as per the Ecoaccess Guideline - Planning for Noise Control respectively (EPA 2004).

Table 6: Estimated average background A-Weighted sound pressure levels ($L_{A90,T}$)

Noise Area Category	Description of Neighbourhood	Average background A-weighted sound pressure level, $L_{A90,T}$					
		Monday to Saturday			Sundays and Public Holidays		
		0700 - 1800	1800 - 2200	2200 - 0700	0900 - 1800	1800 - 2200	2200 - 0900
R1	Areas with negligible transportation	40	35	30	40	35	30
R4	Areas with dense transportation or with some commerce or industry	55	50	45	55	50	45

Those sections of the pipeline corridor in close proximity to industrial, mining, oil or gas production facilities may be characterised by intermittent background noise from associated infrastructure (e.g. diesel power generators, compressors, and production facilities). For example, ambient noise levels in the Gladstone area are expected to be significantly higher due to the alignment traversing primarily industrial land use.

6.7.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Construction activities will result in a temporary increase in noise levels within the immediate vicinity of the ROW and access roads from the operation of light vehicles and construction equipment (including excavators, graders and bulldozers). Other sources may include campsites, drilling (HDD or boring) and noise from rock saws in areas where hard rock is present.

Campsites will not be situated in close proximity to sensitive noise receptors, and will be located to minimise impacts to local residents. The residents in close proximity to the pipeline will be kept informed regarding Project activities and timing of noisy activities will generally be scheduled between 7am and 6pm where practical. Given the relative isolation of the pipeline from large communities and the short duration of construction in any given area, construction noise impacts are considered unlikely.

Noise mitigation measures employed during construction will be in accordance with AS 2436, Guide to noise and vibration control on construction, demolition and maintenance sites.

Standard pipeline operation is silent and not typically associated with generating a noise nuisance. Except in an emergency, or for major pipeline excavations, the movement of large plant and equipment along the easement will not be required although minor noise will arise from vehicle movements and occasional pipeline surveillance and maintenance activities (e.g. weed or erosion control). Planned maintenance activities will occur during normal working hours and thus operational nuisance is further reduced. Landholders will be advised of any planned venting / blowdown which occur occasionally during commissioning and operation.

No compressor stations are proposed along the pipeline route at this time.

6.8 ECOLOGICAL ENVIRONMENT

6.8.1 OVERVIEW

A detailed desktop assessment of the proposed ABP alignment and ROW has been undertaken to characterise the existing environment and identify environmental sensitivities (presented in Appendix 3). This assessment included:

- collation of mapping data from DERM, including regional ecosystems (REs), regrowth vegetation, referable wetlands, watercourses, biodiversity significance and corridors, protected area estate and environmentally sensitive areas (ESAs);
- collation of wetland mapping and descriptions from the Australian Wetlands database;
- interrogation of DERM databases, including Wildnet and the Regional Ecosystem Description Database;
- interrogation of Commonwealth databases, including the EPBC Protected Matters Search Tool and Species Profile And Threats Database;
- Flora specimen data from the Queensland Herbarium Herbrecks database;
- Fauna specimen data from the Queensland Museum database;
- comparison of the preferred route with mapped areas of State significance, including ESAs, REs, referable wetlands, protected areas and habitat for threatened species;
- comparison of the preferred route with matters of National Environmental Significance (NES), which are protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), including Threatened Ecological Communities (TECs) and habitat for EPBC listed species;
- a review of published and unpublished literature for existing pipelines and similar projects; and a review of on-line resources (e.g. Google Earth, Bureau of Meteorology and local council websites).

The proposed pipeline route has been located to avoid environmental constraints and sensitivities, and to coincide with existing tracks, roads and other areas that are already cleared or disturbed, as much as possible. The majority of the proposed pipeline route traverses areas that have been substantially cleared of vegetation and are mostly utilised for agricultural purposes, such as cropping and grazing, as well as for petroleum purposes.

Detailed flora and fauna studies will be undertaken along the preferred route during the development of the EIS to verify the presence of species and habitat.

6.8.2 BIOREGIONAL CONTEXT

The survey area lies within the Brigalow Belt Bioregion, a large complex area dominated by eucalypt woodland, with acacia forests and woodlands in the west of the region. The Bioregion is characterised by *Acacia harpophylla*, however large areas of the bioregion are dominated by other communities, including eucalypt and cypress pine forests and woodlands, grasslands and other Acacia dominated ecosystems. Along the eastern boundary of the Brigalow Belt are scattered patches of semi-evergreen vine thickets. Grasslands, melaleuca communities and mangroves occur in the east, towards the coast (ANRA 2002a).

The survey area falls predominantly in the Brigalow Belt North Bioregion, a sub-coastal belt which occurs east of the Great Dividing Range and includes the Fitzroy and Burdekin Rivers. It has a tropical to subtropical, dry winter climate and is dominated by eucalypt woodland, eucalypt open woodland, acacia forests and woodlands and patches of eucalypt open forests, rainforest and vine thickets and tussock grasslands. Coastal communities include melaleuca, acacia open woodlands, mangroves and samphires. This bioregion has been substantially cleared (47%). The major land uses are grazing of native and modified pastures, native forestry, dryland and irrigated cropping and some nature conservation. Major vegetation groups cleared are acacia forests and woodlands, eucalypt woodlands, eucalypt open woodlands and patches of tussock grasslands, rainforests and vine thickets, eucalypt open forests and melaleuca communities on the coast (ANRA 2002b).

The Brigalow Belt South sub-coastal belt has a subtropical to temperate climate in the south. It is dominated by eucalypt woodland, with acacia forests and woodlands in the west. Rainforest and vine thickets, heath and eucalypt open woodlands are scattered throughout with small pockets of eucalypt open forests and grasslands, melaleuca communities and mangroves occur on the coast. The region has been substantially cleared with major land uses of grazing, state forests, nature conservation, cropping (dryland cereals and cotton, legumes and oilseeds), grazing on modified pastures and some irrigated cotton in the south). Land use is further detailed in Section 6.10. The major vegetation groups cleared are acacia forests and woodlands, eucalypt woodlands, eucalypt open woodlands, tussock grasslands and rainforests and vine thickets (ANRA 2002b). The major impacts to biodiversity in the Brigalow Belt South Bioregion to date have included historical vegetation clearance, introduction and spread of weeds and animal pests, changed fire regimes and altered hydrology regimes (ANRA 2002c).

DERM has conducted comprehensive biodiversity planning assessments (BPAs) for the Brigalow Belt Bioregion (EPA, 2008). Areas identified as having State, Regional or Local Biodiversity significance in the BPA were generally mapped as remnant REs and were consistent with identified ESAs.

6.8.3 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The DSEWP&C Protected Matters Search Tool was used to identify matters of NES protected under the EPBC Act. The route was divided into two lengths with a 10 km buffer for the route north of the Broadsound Range (to accommodate the greater route uncertainty and proposed lateral lines in this section) and a 5 km buffer for the route south to the Bruce Highway.

The following matters of NES have been identified as occurring or potentially occurring in the vicinity of the proposed pipeline route:

- 18 threatened flora species;
- 21 threatened fauna species;
- 94 migratory species; and
- 4 Threatened Ecological Communities (TECs).

Whilst the distribution of these threatened and migratory species may coincide with the proposed pipeline route, targeted ecological surveys are proposed to assess their actual presence (or absence).

Invasive species recorded within the vicinity of the proposed pipeline route include eight Weeds of National Significance and six feral animals.

The ABP does not transect or lie adjacent to any world heritage areas or RAMSAR wetlands. The Great Barrier Reef World Heritage Area adjoins the coast of north and central Queensland. Although the ROW does not directly impact the Great Barrier Reef region, it runs through the Calliope, Fitzroy and Burdekin catchments, which flow into the Great Barrier Reef lagoon. The only RAMSAR wetland that lies within the same catchment as the ABP is the Shoalwater and Corio Bays area, which is located approximately 60 km north-east of the proposed pipeline route.

The ABP lies within 5 km of three nationally important wetlands (Fitzroy River Delta, Fitzroy River Floodplain, and Lake Elphinstone) and within 10 km of Port Curtis. World heritage areas, RAMSAR wetlands and nationally significant wetlands are not transected by the proposed pipeline ROW, so are unlikely to be impacted by construction or operating activities provided that appropriate mitigation measures are implemented.

6.8.4 EXISTING ENVIRONMENT – FLORA (TERRESTRIAL / AQUATIC)

6.8.4.1 Regional Ecosystems

Desktop assessment of RE mapping, satellite imagery and helicopter reconnaissance information within a 5 km buffer of the proposed centreline has been used to minimise the clearing of remnant vegetation that would be required for pipeline construction. Wherever possible, the route has been located in cleared or degraded areas, or aligned along vegetation boundaries to limit impacts to edge effects.

As shown in Map 6 of Appendix 1, the pipeline transects 41 REs and passes within 5 km of 79 REs. Pipeline construction will require clearing of a maximum of 474 ha of remnant vegetation within the 40 m ROW. This figure represents only 20% of the total area within the ROW and route refinements developed during the EIS are expected to reduce this figure further. The current ROW will require:

- clearing of up to 11 REs of Endangered Biodiversity Status, with a maximum area of 16.3 ha within the ROW, which represents about 0.13% of the area of Endangered RE within the 5 km buffer; and
- clearing of up to 14 REs of Of Concern Biodiversity Status, with a maximum area of 130.3 ha within the ROW, representing about 0.23% of the area within the 5 km buffer.

REs transected by the proposed pipeline route are shown in Table 7.

Table 7: Regional Ecosystems in proximity to the proposed pipeline route

RE ID	EPBC Status	VMA Status	Biodiversity Status	Description
11.1.4		Least concern	No concern at present	Mangrove forest/woodland on marine clay plains
11.3.1	Endangered	Endangered	Endangered	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on alluvial plains
11.3.2	Endangered (where <i>Acacia pendula</i>)	Of concern	Of concern	<i>Eucalyptus populnea</i> woodland on alluvial plains

RE ID	EPBC Status	VMA Status	Biodiversity Status	Description
	dominant)			
11.3.3		Of concern	Of concern	<i>Eucalyptus coolabah</i> woodland on alluvial plains
11.3.4		Of concern	Of concern	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. tall woodland on alluvial plains
11.3.7		Least concern	Of concern	<i>Corymbia</i> spp. woodland on alluvial plains.
11.3.11	Endangered	Endangered	Endangered	Semi-evergreen vine thicket on alluvial plains
11.3.21	Endangered / Critically Endangered	Endangered	Endangered	<i>Dichanthium sericeum</i> and/or <i>Astrebula</i> spp. grassland on alluvial plains. Cracking clay soils
11.3.25		Least concern	Of concern	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines
11.3.26		Least concern	No concern at present	<i>Eucalyptus moluccana</i> or <i>E. microcarpa</i> woodland to open forest on margins of alluvial plains
11.3.27		Least concern	Of concern	Freshwater wetlands
11.3.36		Of concern	Of concern	<i>Eucalyptus crebra</i> and/or <i>E. populnea</i> and/or <i>E. melanophloia</i> on alluvial plains. Higher terraces
11.4.2		Of concern	Of concern	<i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. grassy or shrubby woodland on Cainozoic clay plains
11.4.8	Endangered	Endangered	Endangered	<i>Eucalyptus cambageana</i> woodland to open forest with <i>Acacia harpophylla</i> or <i>A. argyrodendron</i> on Cainozoic clay plains
11.4.9	Endangered	Endangered	Endangered	<i>Acacia harpophylla</i> shrubby open forest to woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains
11.5.3		Least concern	No concern at present	<i>Eucalyptus populnea</i> +/- <i>E. melanophloia</i> +/- <i>Corymbia clarksoniana</i> on Cainozoic sand plains/remnant surfaces
11.5.8		Least concern	No concern at present	<i>Melaleuca</i> spp., <i>Eucalyptus crebra</i> , <i>Corymbia intermedia</i> woodland on Cainozoic sand plains/remnant surfaces
11.5.9		Least concern	No concern at present	<i>Eucalyptus crebra</i> and other <i>Eucalyptus</i> spp. and <i>Corymbia</i> spp. woodland on Cainozoic sand plains/remnant surfaces.
11.5.12		Least concern	No concern at present	<i>Corymbia clarksoniana</i> woodland and other <i>Corymbia</i> spp. and <i>Eucalyptus</i> spp. on Cainozoic sand plains/remnant surfaces
11.5.15	Endangered	Least concern	Endangered	Semi-evergreen vine thicket on Cainozoic sand plains/remnant surfaces
11.7.2		Least concern	No concern at present	<i>Acacia</i> spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone
11.7.3		Least	No concern	<i>Eucalyptus persistens</i> , <i>Triodia mitchellii</i>

RE ID	EPBC Status	VMA Status	Biodiversity Status	Description
		concern	at present	open woodland on stripped margins of Cainozoic lateritic duricrust
11.8.5		Least concern	No concern at present	<i>Eucalyptus orgadophila</i> open woodland on Cainozoic igneous rocks
11.8.11	Endangered	Of concern	Of concern	<i>Dichanthium sericeum</i> grassland on Cainozoic igneous rocks
11.8.13	Endangered	Endangered	Endangered	Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks.
11.8.15		Endangered	Endangered	<i>Eucalyptus brownii</i> or <i>Eucalyptus populnea</i> woodland on Cainozoic igneous rocks.
11.9.2		Least concern	No concern at present	<i>Eucalyptus melanophloia</i> +/- <i>E. orgadophila</i> woodland on fine-grained sedimentary rocks
11.9.5	Endangered	Endangered	Endangered	<i>Acacia harpophylla</i> and/or <i>Casuarina cristata</i> open forest on fine-grained sedimentary rocks
11.9.7		Of concern	Of concern	<i>Eucalyptus populnea</i> , <i>Eremophila mitchellii</i> shrubby woodland on fine-grained sedimentary rocks
11.9.9		Least concern	No concern at present	<i>Eucalyptus crebra</i> woodland on fine-grained sedimentary rocks
11.10.4		Least concern	No concern at present	<i>Eucalyptus decorticans</i> , <i>Lysicarpus angustifolius</i> +/- <i>Eucalyptus</i> spp., <i>Corymbia</i> spp., <i>Acacia</i> spp. woodland on coarse-grained sedimentary rocks.
11.10.12		Least concern	No concern at present	<i>Eucalyptus populnea</i> woodland on medium to coarse-grained sedimentary rocks
11.11.1		Least concern	No concern at present	<i>Eucalyptus crebra</i> +/- <i>Acacia rhodoxylon</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding
11.11.5		Least concern	No concern at present	Microphyll vine forest +/- <i>Araucaria cunninghamii</i> on old sedimentary rocks with varying degrees of metamorphism and folding
11.11.10		Of concern	Of concern	<i>Eucalyptus melanophloia</i> woodland on deformed and metamorphosed sediments and interbedded volcanics
11.11.14	Endangered	Endangered	Endangered	<i>Acacia harpophylla</i> open forest on deformed and metamorphosed sediments and interbedded volcanics
11.11.15		Least concern	No concern at present	<i>Eucalyptus crebra</i> woodland on deformed and metamorphosed sediments and interbedded volcanics.
11.11.16		Of concern	Of concern	<i>Eucalyptus cambageana</i> , <i>Acacia harpophylla</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands

RE ID	EPBC Status	VMA Status	Biodiversity Status	Description
11.11.18	Endangered	Endangered	Endangered	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding.
11.12.1		Least concern	No concern at present	<i>Eucalyptus crebra</i> woodland on igneous rocks
11.12.2		Least concern	No concern at present	<i>Eucalyptus melanophloia</i> woodland on igneous rocks

Table 8 summarises the areas of each RE category within the ROW, the proportion of each category within the total ROW and the percentage of each category in relation to the area of that category within the 5 km buffer. Endangered REs comprise only 0.7% of the total area within the ROW, while Of Concern REs comprise 5.6%.

Table 8: Summary of RE status and areas identified along preferred ABP

Biodiversity Status of RE	Area to be Cleared Assuming 40 m ROW ha	Proportion of Total Area within ROW to be Cleared %	Proportion of RE within 5 km of Preferred Pipeline %
Endangered	16.26	0.70	0.11
Of Concern	130.30	5.58	0.22
Not of Concern	327.70	14.04	0.27
Non-remnant	1,859.66	79.68	0.49
TOTAL	2,333.93	100.00	0.40

Fragmentation patterns determined from mapping of the REs illustrate that the landscape is generally highly fragmented with the majority of the pipeline route previously cleared for other land uses. Larger tracts of regional ecosystems which are less susceptible to ecological edge effects, and more likely to sustain viable populations of native flora and fauna, are mainly restricted to areas of higher elevations and steeper slopes.

6.8.4.2 Regulated Regrowth Vegetation

The ABP route also transects areas mapped by DERM as regulated regrowth. The ROW contains 125.5 ha of high value regrowth (HVR) vegetation, which includes 40.6 ha of HVR of Endangered RE, 61.5 ha of HVR of Of Concern RE and 23.4 ha of HVR of Least Concern RE. The ROW also contains 11.7 ha of regrowth watercourse vegetation, which is located only in the northern 39 km of the ABP. Mapped HVR vegetation within the study area is shown in Map 6 of Appendix 1.

6.8.4.3 EPBC Threatened Ecological Communities

An EPBC protected matters search identified four Endangered Ecological Communities (EECs) that may occur within or adjacent to the ABP. For each EEC, the EPBC nomination recommendation lists REs that are considered to form components of the EEC.

Table 9 describes EECs, REs included in the EEC and areas of those REs within the ROW and 5 km buffer. The ROW contains 67.9 ha of remnant REs that form components of EECs (approximately 0.2% of the area within the 5 km buffer). However, 42.4 ha of this total is

poplar box woodland (RE 11.3.2). The Weeping Myall Woodlands EEC forms only a very small proportion of the area mapped as RE 11.3.2, so it is likely that none of the 42.4 ha within the ROW contains this EEC. This would reduce the area of EEC mapped within the ROW to 25.5 ha. Field surveys will be conducted to ground-truth the presence of Weeping Myall Woodlands and other EECs within the ROW.

Table 9: EPBC listed EECs and equivalent REs within the ROW and the 5 km buffer

EPBC Community Description	EPBC Act Status*	Equivalent RE	Area in ROW (ha)	Area in 5km Buffer (ha)	% in Buffer^
Brigalow (<i>Acacia harpophylla</i> dominant and co-dominant)	E	11.3.1	3.22	4,408.24	0.07
		11.4.8	0.54	852.31	0.06
		11.4.9	1.92	2,462.09	0.08
		11.9.5	4.66	1,771.21	0.26
		11.11.14	0.88	602.06	0.15
Natural grasslands of the Qld Central Highlands and the northern Fitzroy Basin	E	11.3.21	0.13	363.67	0.04
		11.8.11	9.51	6,144.08	0.15
Semi-evergreen vine thickets of the Brigalow Belt	E	11.3.11	0.44	191.31	0.23
		11.5.15	0.24	411.25	0.06
		11.8.13	3.08	1,063.04	0.29
		11.11.18	0.88	368.46	0.24
Weeping Myall Woodlands (only small component of RE)	E (where <i>A. pendula</i> dominant)	11.3.2	42.37	14,682.15	0.29
Total			67.87	33,319.87	0.2

* Status under EPBC Act: E = Endangered

^ Percentage of area in 5 km buffer that lies within the 40 m ROW.

6.8.4.4 Threatened Flora Species

Results of the DERM WildNet and Queensland Herbarium flora searches (DERM 2010a) are summarised in Table 10. Flora listed under the EPBC Act include five Endangered species and 13 Vulnerable species. Flora listed under the Queensland NC Act include six Endangered species, 11 Vulnerable species and 12 Near Threatened species. Queensland Herbarium threatened species records are mapped in Map 7 of Appendix 1.

Table 10: Database search results - Flora

Species Class	Number of Threatened Species	
	NCA Status ¹	EPBC Status ²
Gymnosperms	3 (3 E)	2 (2 E)
Monocotyledonous Angiosperm	6 (3 V, 3 NT)	4 (1 E, 3 V)
Dicotyledonous Angiosperm	20 (3 E, 8 V, 9 NT)	12 (2 E, 10 V)
Total Threatened Species	29 (6 E, 11 V, 12 NT)	18 (5 E, 13 V)

¹ E – Endangered, V – Vulnerable, NT - Near Threatened (*Nature Conservation Act 1992*)

² CE – Critically Endangered, E – Endangered, V – Vulnerable (*Environment Protection and Biodiversity Conservation Act 1999*)

Table 11 lists all threatened flora species identified by Queensland Herbarium, Wildnet and EPBC protected matter databases and their presence within 1 km, 5 km and 10 km buffers of the pipeline route. The 10 km buffer recorded 29 species and the 5 km buffer had 24 species. The 1 km buffer contained only 5 species. No threatened species were recorded within the 40 m ROW.

Table 11: Threatened Flora Species listed under EPBC and NCA

Scientific name	Group	Family Name	Status* EPBC	Status* NC Act	Buffer^(km)			Source^^
					1	5	10	
<i>Bertya pedicellata</i>	Angiosperm	Euphorbiaceae		NT	1	1	1	QH, W
<i>Bosistoa transversa</i> (syn. <i>B. selwynii</i>)	Angiosperm	Rutaceae	V			1		EPBC
<i>Capparis humistrata</i>	Angiosperm	Capparaceae		E		1	1	QH, W
<i>Cerbera dumicola</i>	Angiosperm	Apocynaceae		NT		1	1	QH, W
<i>Corymbia xanthope</i>	Angiosperm	Myrtaceae	V	V		1		W
<i>Cossinia australiana</i>	Angiosperm	Sapindaceae	E	E		1		EPBC
<i>Cupaniopsis shirleyana</i>	Angiosperm	Sapindaceae	V	V		1	1	QH, EPBC
<i>Cycas megacarpa</i>	Gymnosperm	Cycadaceae	E	E		1	1	QH, W
<i>Cycas ophiolitica</i>	Gymnosperm	Cycadaceae	E	E			1	EPBC
<i>Cyperus clarus</i>	Angiosperm	Cyperaceae		V		1	1	QH
<i>Dansiea elliptica</i>	Angiosperm	Combretaceae		NT			1	W
<i>Desmodium macrocarpum</i>	Angiosperm	Fabaceae		NT	1	1	1	QH, W
<i>Dichanthium queenslandicum</i>	Angiosperm	Poaceae	V	V	1	1	1	QH, W
<i>Dichanthium setosum</i>	Angiosperm	Poaceae	V	NT			1	QH, W
<i>Digitaria porrecta</i>	Angiosperm	Poaceae	E	NT			1	EPBC
<i>Eucalyptus raveretiana</i>	Angiosperm	Myrtaceae	V	V	1	1	1	QH, W
<i>Graptophyllum ilicifolium</i>	Angiosperm	Acanthaceae	V	V		1	1	W
<i>Hernandia bivalvis</i>	Angiosperm	Hernandiaceae		NT			1	W

Scientific name	Group	Family Name	Status* EPBC	Status* NC Act	Buffer^(km)			Source^^
					1	5	10	
<i>Lepidium hyssopifolium</i>	Angiosperm	Brassicaceae	E				1	W
<i>Leucopogon cuspidatus</i>	Angiosperm	Ericaceae	V			1	1	EPBC
<i>Lissanthe brevistyla</i>	Angiosperm	Ericaceae		V		1	1	QH, W
<i>Macropteranthes leiocaulis</i>	Angiosperm	Combretaceae		NT	1	1	1	QH, W
<i>Macrozamia serpentina</i>	Gymnosperm	Zamiaceae		E		1	1	QH, W
<i>Marsdenia hemiptera</i>	Angiosperm	Apocynaceae		NT		1	1	QH, W
<i>Ozothamnus eriocephalus</i>	Angiosperm	Asteraceae	V	V		1	1	QH, W
<i>Paspalidium scabrifolium</i>	Angiosperm	Poaceae		NT		1	1	QH, W
<i>Paspalidium udum</i>	Angiosperm	Poaceae		V			1	W
<i>Pimelea leptospermoides</i>	Angiosperm	Thymelaeaceae	V	NT		1	1	QH, W
<i>Pultenaea setulosa</i>	Angiosperm	Fabaceae	V	V		1	1	QH, W
<i>Quassia bidwillii</i>	Angiosperm	Simaroubaceae	V	V			1	EPBC
<i>Sannantha brachypoda</i>	Angiosperm	Myrtaceae		NT			1	QH, W
<i>Solanum elachophyllum</i>	Angiosperm	Solanaceae		E		1	1	QH, W
<i>Taeniophyllum muelleri</i>	Angiosperm	Orchidaceae	V			1		EPBC

*Status under the Environment Protection and Biodiversity Conservation Act 1999 (E = Endangered, V = Vulnerable) and under the Nature Conservation Act 1992 (E = Endangered, V = Vulnerable, NT = Near Threatened).

^ Presence within 1km, 5 km and 10 km buffer surrounding ABP.

^^ W = DERM Wildnet, EPBC = EPBC Protected Matters Search, Queensland Herbarium = Queensland Herbarium.

The preferred habitat for all threatened species potentially occurring in the subject site is shown in Table 12. Five species are considered likely to occur within the ROW, 24 species may possibly occur and four species are considered unlikely to be present.

Table 12: Preferred habitat and likelihood of occurrence for all Threatened Species potentially occurring within the subject site

Scientific name	Preferred Habitat	Likelihood of occurrence
<i>Bertya pedicellata</i>	Restricted to central Queensland. Associated with <i>Corymbia trachypholia</i> (brown bloodwood), <i>Acacia catenulata</i> , <i>A. curvinervia</i> , and <i>A. shirleyi</i> (lancewood)	Possible
<i>Bosistoa transversa</i> (synonym of <i>B. selwynii</i>)	Alluvial flats in rainforest areas	Unlikely
<i>Capparis humistrata</i>	Stony hard ridges and serpentinite soils in eucalypt woodland with a shrubby understorey. Also occurs on the margins of brigalow forest on sandy soil.	Possible
<i>Cerbera dumicola</i>	Vine thickets and lancewood thickets throughout Central Queensland	Probable
<i>Corymbia xanthope</i>	Restricted between Rockhampton and Marlborough and on South Percy Island. Occurring on soils derived from serpentinite	Possible
<i>Cossinia australiana</i>	Vine forests	Possible
<i>Cupaniopsis shirleyana</i>	Depauperate rainforests from Brisbane to Bundaberg	Possible
<i>Cycas megacarpa</i>	Stony clay loams on hill tops and steep slopes. Commonly in spotted gum and ironbark open forest and woodland with a grassy understorey	Probable
<i>Cycas ophiolitica</i>	Tall open forest dominated by <i>Lophostemon confertus</i> and on complex notophyll vine forest margins. Grows on rocky soils derived from tertiary basalts on hill slopes and crests from 25-73 m altitude.	Possible
<i>Cyperus clarus</i>	Grows in grassland or open woodland, on heavy soils derived from basalt	Possible
<i>Dansiea elliptica</i>	Sandy granitic soils on rainforest margins, dry rainforests and vine thickets	Possible
<i>Desmodium macrocarpum</i>	Occurs in open woodland and open forest communities.	Probable
<i>Dichanthium queenslandicum</i>	Component of Queensland Bluegrass grasslands on black cracking clay soils.	Possible
<i>Dichanthium setosum</i>	Grassy woodland and open forest.	Possible
<i>Digitaria porrecta</i>	Grows on rich soils in grasslands, grassy woodlands or grassy forests	Possible
<i>Eucalyptus raveretiana</i>	Creek beds and riverbanks in coastal and subcoastal areas from Ayr and Charters Towers south to Duaringa in central Queensland	Probable
<i>Graptophyllum ilicifolium</i>	Drainage lines with rocky substrates including Quartz, Feldspar, Blackwood Quartz Suenite and sedimentary rocks. Found in vegetation dominated by tall to very tall mixed notophyll forest.	Possible

Scientific name	Preferred Habitat	Likelihood of occurrence
<i>Hernandia bivalvis</i>	Dry rainforest and vine scrubs	Possible
<i>Lepidium hyssopifolium</i>	Originally occurred in eucalypt and/or <i>Allocasuarina</i> woodland with a grassy understorey, and native temperate grasslands. Now inhabits heavily modified, non-natural environments, usually amongst exotic pasture grasses and weed species.	Possible
<i>Leucopogon cuspidatus</i>	Mountain tops on poor skeletal soils, amongst granite or serpentinite outcrops	Possible
<i>Lissanthe brevistyla</i>	Steep hillsides in eucalypt woodlands usually on red gravelly soil or on loose stony slopes.	Possible
<i>Macropteranthes leiocaulis</i>	Deciduous vine thickets, semi-evergreen vine thickets and araucarian microphyll vine forests on red ferrosols or sandstone talus	Probable
<i>Macrozamia serpentina</i>	Leichardt and Port Curtis Districts between Marlborough and Yaamba, north of Rockhampton. It grows at altitudes between 8 and 16 m in low woodland with a mixed grassy and shrubby understorey in red clay loams over serpentinites. Associated canopy species include <i>Corymbia xanthope</i> and <i>Eucalyptus fibrosa</i> .	Possible
<i>Marsdenia hemiptera</i>	Notophyll vine forests in gorges or low lying areas near watercourses	Unlikely
<i>Ozothamnus eriocephalus</i>	Known from elevations of between 38 and 95 m in a range of habitat types, including disturbed notophyll vine forest, margins of gallery rainforest, microphyll vine forest, open eucalypt forest and on rocky ridges within Eucalypt and Acacia scrub	Possible
<i>Paspalidium scabrifolium</i>	Brigalow forests and woodlands	Possible
<i>Paspalidium udum</i>	Floodplains and poorly drained swampy areas up to 1 m deep.	Possible
<i>Pimelea leptospermoides</i>	Restricted from near Marlborough to Balnagowan near Yeppoon in central Qld, in tall to low open forests and woodland growing on serpentine soils	Possible
<i>Pultenaea setulosa</i>	Wet to dry sclerophyll forest, subalpine woodland to heaths (often dominated by <i>Eucalyptus albens</i> , <i>E. crebra</i> , <i>E. macprhyncha</i> , <i>E. mannifera</i> , <i>E. polyanthemos</i> or <i>E. rossii</i>). Sandy loam on sedimentary rock, granite, porphyry, volcanic substrates, siliceous soil or serpentinite soils.	Possible
<i>Quassia bidwillii</i>	Below 65 m in rainforests, open forest, woodland and mangroves	Possible
<i>Sannantha brachypoda</i>	Known from sites near Rolleston, Woorabinda and Theodore in sandstone gullies or on the sandy alluvials adjacent to sandstone ridges	Unlikely
<i>Solanum elachophyllum</i>	Cracking clay soils associated with Brigalow (<i>Acacia harpophylla</i>), Belah (<i>Casuarina cristata</i>), <i>Macropteranthes</i> or <i>Eucalyptus cambageana</i> .	Possible
<i>Taeniophyllum muelleri</i>	Epiphytic vine on the branches of rainforest trees in coastal areas	Unlikely

6.8.4.5 Aquatic Flora

The majority of the waterways and wetlands intersected by the pipeline are likely to be ephemeral and contain limited habitat for aquatic species. Nevertheless, numerous aquatic and semi-aquatic flora species have been recorded in wetlands within the pipeline buffer. The majority of these aquatic species are common and widespread. One grass, *Paspalidium udum*, is considered to be Vulnerable under the NC Act, and could potentially occur in freshwater wetlands along the pipeline.

Several aquatic and semi-aquatic weeds are present in the pipeline buffer, including Hymenachne, Water Hyacinth and Salvinia.

6.8.4.6 Weeds

Invasive species, including weeds of national significance (WoNS) and other introduced plants considered to pose a particular threat to biodiversity, that may occur in the ROW are listed in Table 13. No plants listed as Class 1 under the *Land Protection (Pest and Stock Route Management) Act 2002* have been identified from the desktop assessment (WildNET, Queensland Herbarium and Declared Plants of Qld Fact Sheet Feb 2010). Searches identified 22 weeds listed as Declared Class 2 weeds and 12 weeds listed as Class 3 within the pipeline buffer. Eight Weeds of National Significance also occur within the subject area.

Table 13: Invasive plants

Scientific Name	Common Name	National Status	LP Act Status
<i>Acacia nilotica subsp. indica</i>	Prickly Acacia	WoNS	2
<i>Asparagus aethiopicus</i>	Asparagus Fern		3
<i>Asparagus africanus</i>	Asparagus Fern		3
<i>Asparagus plumosus</i>	Climbing Asparagus Fern		3
<i>Baccharis halimifolia</i>	Groundsel Bush		2
<i>Bryophyllum delagoense</i>	Mother of Millions		2
<i>Bryophyllum x houghtonii</i>	Mother of Millions hybrid		2
<i>Cascabela thevetia</i>	Yellow Oleander		3
<i>Cinnamomum camphora</i>	Camphor Laurel		3
<i>Cryptostegia grandiflora</i>	Rubber Vine,	WoNS	2
<i>Eichhornia crassipes</i>	Water Hyacinth		2
<i>Harrisia martini</i>	Harrisia Cactus		2
<i>Hymenachne amplexicaulis</i>	Hymenachne	WoNS	2
<i>Jatropha gossypifolia</i>	Bellyache Bush		2
<i>Lantana camara</i>	Lantana	WoNS	3
<i>Lantana montevidensis</i>	Creeping Lantana		3
<i>Macfadyena unguis-cati</i>	Cat's Claw Creeper		3
<i>Opuntia streptacantha</i>	Cardona Pear; Westwood Pear		2
<i>Opuntia stricta</i>	Common Pest Pear		2
<i>Opuntia tomentosa</i>	Velvety Tree Pear		2

Scientific Name	Common Name	National Status	LP Act Status
<i>Parkinsonia aculeata</i>	Parkinsonia	WoNS	2
<i>Parthenium hysterophorus</i>	Parthenium	WoNS	2
<i>Pennisetum setaceum</i>	Fountain Grass		3
<i>Prosopis pallida</i>	Mesquites	WoNS	2
<i>Salvinia molesta</i>	Salvinia	WoNS	2
<i>Schinus terebinthifolius</i>	Broad-leaved Pepper Tree		3
<i>Spathodea campanulata subsp. nilotica</i>	African Tulip Tree		3
<i>Sphagneticola trilobata</i>	Singapore Daisy		3
<i>Sporobolus fertilis</i>	Giant Parramatta Grass		2
<i>Sporobolus jacquemontii</i>	American Rat's Tail Grass		2
<i>Sporobolus natalensis</i>	Giant Rat's Tail Grass		2
<i>Sporobolus pyramidalis</i>	Giant Rat's Tail Grass		2
<i>Thunbergia grandiflora</i>	Blue Thunbergia		2
<i>Ziziphus mauritiana</i>	Indian jujube; Chinee Apple		2

6.8.5 EXISTING ENVIRONMENT – FAUNA (TERRESTRIAL / AQUATIC)

6.8.5.1 Threatened Species

Results of the Queensland Museum, Wildnet and EPBC database searches are summarised in Table 14. A total of 42 threatened species were recorded, including one amphibian, 23 birds, eight mammals and ten reptiles. No threatened species were recorded within the 40 m ROW or the 1 km buffer. Queensland Museum threatened species records are mapped in Map 7 of Appendix 1.

EPBC listed fauna include one Critically Endangered species, three Endangered species and 17 Vulnerable species. Fauna listed under the Queensland NC Act include six Endangered species, 18 Vulnerable species and 14 Near Threatened species.

Table 14: Database search results - Fauna

Species Class	Total Species	Number of Threatened Species	
		NCA Status ¹	EPBC Status ²
Amphibians	25	1 (1 NT)	Nil
Birds	352	22 (5 E, 6 V, 11 NT)	8 (1 CE, 2 E, 5 V)
Bony Fish	28	Nil Reported	Nil Reported
Mammals	74	5 (4 V, 1 NT)	6 (1 E, 5 V)
Reptiles	91	10 (1 E, 8 V, 1 NT)	7 (7 V)
Total Threatened Species	570	38	21

¹ E – Endangered, V – Vulnerable, NT – Near Threatened (Nature Conservation Act 1992)

² CE – Critically Endangered, E – Endangered, V – Vulnerable (Environment Protection and Biodiversity Conservation Act 1999)

The preferred habitat for all threatened species potentially occurring in the subject site is shown in Table 15. Based on analysis of habitat preferences, seven threatened fauna species are considered likely to occur within the ROW, 27 species may possibly occur and eight species are considered unlikely to be present.

Table 15: Threatened fauna species listed under EPBC and NCA

Family Name	Scientific Name	Common Name	EPBC Status ¹	NCA Status ²	Preferred Habitat	Likelihood of Occurrence	Source ³
AMPHIBIANS							
Hylidae	<i>Cyclorana verrucosa</i>	Rough Frog	-	NT	Temporary ponds, flooded depressions and creeks in woodlands after heavy spring and summer rain.	Possible	W
BIRDS							
Accipitridae	<i>Accipiter novaehollandiae</i>	Grey Goshawk	-	NT	Humid forests including dense eucalypt forests	Unlikely	W
Psittacidae	<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	-	V	Woodlands dominated by Mulga (<i>Acacia aneura</i>), mallee and box eucalypts, Cypress Pine or Belah (<i>Casuarina cristata</i>).	Possible	W
Psittacidae	<i>Cacatua pastinator pastinator</i>	Western Corella	V	-	Only found in Western Australia.	Unlikely	W
Psittacidae	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	-	V	Coastal forest and open inland woodland. Feeds primarily on <i>Allocasuarina littoralis</i> or <i>Allocasuarina torulosa</i> .	Probable	W
Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	-	NT	Open freshwater environments along the margins of billabongs, lagoons, swamps, floodplains, dams and their adjacent grasslands, pastures and woodlands.	Probable	W
Meliphagidae	<i>Epthianura crocea macgregori</i>	Yellow Chat	CE	E	Coastal grassy swamps, lagoon margins with reeds and saltbush, inland around bores overflows in swamp cane grass, cambungi, lignum and saltbush.	Unlikely	W, EPBC
Accipitridae	<i>Erythrotriorchis radiatus</i>	Red Goshawk	V	E	Tropical grassy woodlands mostly in undulating stony lands.	Unlikely	EPBC, W
Falconidae	<i>Falco hypoleucos</i>	Grey Falcon	-	NT	Woodlands and open forests, watercourses, scrublands heathlands and farmland.	Possible	W

Family Name	Scientific Name	Common Name	EPBC Status ¹	NCA Status ²	Preferred Habitat	Likelihood of Occurrence	Source ³
Columbidae	<i>Geophaps scripta scripta</i>	Squatter Pigeon (Southern)	V	V	Open grassy woodlands on sandy soils with gravelly ridges	Probable	EPBC, W
Haematopodidae	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	-	NT	Inhabits rocky shorelines, rocky islets, boulders below cliffs and reefs	Possible around estuarine wetlands	W
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite	-	NT	Range of diverse habitats including woodland dominated by eucalypts, <i>Pandanus sp.</i> , gallery forest, heath.	Possible	W
Meliphagidae	<i>Melithreptus gularis</i>	Black-chinned Honeyeater		NT	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially mugga ironbark (<i>Euc. sideroxylon</i>), white box (<i>Euc. albens</i>), grey box (<i>Euc. microcarpa</i>), yellow box (<i>Eu. melliodora</i>) and forest red gum (<i>Euc. tereticornis</i>)	Possible	W
Estrildidae	<i>Neochmia ruficauda ruficauda</i>	Star Finch	E	E	A largely sedentary inhabitant of grasslands and riparian grassy woodlands near water.	Unlikely	EPBC
Psittacidae	<i>Neophema pulchella</i>	Turquoise Parrot	-	NT	Inhabits woodland and open grassland.	Unlikely	W
Anatidae	<i>Nettapus coromandelianus</i>	Cotton Pygmy-geese	-	NT	Deep freshwater dams, swamps and lagoons particularly with lilies of floating vegetation	Possible	W
Strigidae	<i>Ninox strenua</i>	Powerful Owl	-	V	Eucalypt forests, especially tall forests in ranges	Possible	W
Scolopacidae	<i>Numenius madagascariensis</i>	Eastern Curlew	-	NT	Coasts and estuaries	Possible around estuarine wetlands	W
Estrildidae	<i>Poephila cincta cincta</i>	Black-throated Finch (s. ssp)	E	E	Open woodland, scrubby plains, <i>Pandanus sp.</i> flats with deep cover of grasses, never far from water.	Possible	W, EPBC

Family Name	Scientific Name	Common Name	EPBC Status ¹	NCA Status ²	Preferred Habitat	Likelihood of Occurrence	Source ³
Rostratulidae	<i>Rostratula australis</i>	Australian Painted Snipe	V	V	Shallow inland wetlands, brackish or freshwater that are permanently or temporarily inundated	Possible	EPBC, W
Laridae	<i>Sterna albifrons</i>	Little Tern	-	E	Coastal, preferring sheltered environments; may occur several kilometres from the sea in harbours, inlets and rivers	Possible around estuarine wetlands	W
Anatidae	<i>Stictonetta naevosa</i>	Freckled Duck	-	NT	Freshwater swamps or creeks where it feeds on zooplankton, crustaceans and algae. Uses expansive shallow swamps for breeding, and permanent waters for refuge during drought.	Possible	W
Anatidae	<i>Tadorna radjah</i>	Radjah Shelduck	-	NT	Shallow pools and mudbanks or the shallow fringes of deep pools.	Possible	W
Turnicidae	<i>Turnix melanogaster</i>	Black-breasted Button-quail	V	V	Closed rainforest, monsoon scrub and vine thickets	Possible in vine thicket	W, EPBC
MAMMALS							
Vespertilionidae	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	V	Dry forests and woodlands, moist eucalypt forests, caves and mines.	Possible	EPBC
Vespertilionidae	<i>Chalinolobus picatus</i>	Little Pied Bat	-	NT	Dry sclerophyll forest, woodland and scrub in the semi-arid zone of Queensland. It is known to forage along watercourses, and infrequently inhabits caves.	Probable	W
Dasyuridae	<i>Dasyurus hallucatus</i>	Northern Quoll	E	-	Most abundant in rocky eucalypt woodlands but occurs in a variety of habitats. The most successful breeding occurs near creeklines, and dens are usually in hollow tree trunks.	Possible	EPBC, W
Megadermatidae	<i>Macroderma gigas</i>	Ghost Bat	-	V	Caves and mine shafts. Recorded in Rockhampton and Gladstone.	Possible	W

Family Name	Scientific Name	Common Name	EPBC Status ¹	NCA Status ²	Preferred Habitat	Likelihood of Occurrence	Source ³
Vespertilionidae	<i>Nyctophilus corbeni</i> (formerly <i>timorensis</i>)	Greater Long-eared Bat	V	V	Mallee, bullocke (<i>Allocasuarina leuhmanni</i>) and box eucalypt dominated communities. Requires hollows for roosting.	Possible	EPBC
Macropodidae	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	V	V	Inhabits rock piles and cliffs with numerous crevices and ledges in vegetation ranging from rainforest to dry sclerophyll forests.	Possible	W
Pteropodidae	<i>Pteropus conspicillatus</i>	Spectacled Flying-fox	V	-	Rainforests.	Unlikely	EPBC
Pteropodidae	<i>Pteropus poliocephalus</i>	Grey-Headed Flying-fox	V	-	Sub-tropical and temperate rainforest, tall open forest, swamps, heaths and urban areas. Roosting sites usually in dense forest adjacent to waterbodies. Forages within 15 km of camp in flowering trees or rainforests, eucalypts, paperbarks and banksias.	Possible at southern end of the line	W
REPTILES							
Elapidae	<i>Acanthophis antarcticus</i>	Common Death Adder	-	NT	Various habitats including coastal sand dunes, rainforest, shrublands, heaths and woodlands.	Probable	W
Cheloniidae	<i>Chelonia mydas</i>	Green Turtle	V	V	Tropical and warm temperate waters worldwide.	Unlikely	EPBC
Crocodylidae	<i>Crocodylus porosus</i>	Estuarine Crocodile	-	V	Coastal rivers and swamps extending well inland via major rivers and billabongs.	Probable in lower Fitzroy catchment	W
Pygopodidae	<i>Delma torquata</i>	Adorned Delma	V	V	Open eucalypt forest with a sparse understorey of shrubs and tussock grasses, on rocky hillsides with flattish rocks or on deep-cracking soils	Possible	W, EPBC
Elapidae	<i>Denisonia maculata</i>	Ornamental Snake	V	V	Open forests, woodland and riparian habitats, particularly near water with soil cracks, fallen timber on rocky, alluvial or	Possible	W, QM, EPBC

Family Name	Scientific Name	Common Name	EPBC Status ¹	NCA Status ²	Preferred Habitat	Likelihood of Occurrence	Source ³
					black soil.		
Scincidae	<i>Egernia rugosa</i>	Yakka Skink	V	V	Variety of habitats including Poplar box, alluvial soils, low ridges, cypress on sands, belah, mulga and Eucalypt woodland, log piles and rabbit warrens.	Possible	EPBC, W
Elapidae	<i>Furina dunmalli</i>	Dunmall's Snake	V	V	Woodlands and dry sclerophyll forest particularly areas with Brigalow.	Possible	EPBC, W
Elapidae	<i>Hemiaspis damelii</i>	Grey Snake	-	E	Floodplains of the eastern interior, reaching coastal districts near Rockhampton. It shelters under fallen timber and in soil cracks or disused burrows, usually near inland watercourses.	Possible	W
Pygopodidae	<i>Paradelma orientalis</i>	Brigalow Scaly-foot	V	V	Eucalypt woodland and Brigalow scrub and is usually found under logs, rocks and debris.	Possible	EPBC, W
Chelidae	<i>Rheodytes leukops</i>	Fitzroy Turtle	V	V	Riverine species dependent on shallow fast-flowing water (riffle zones). Inhabits the Fitzroy River and its tributaries, including the Dawson River.	Possible along the Fitzroy and Isaac River.	QM, EPBC, W

¹ EPBC Status - CE: Critically Endangered; E: Endangered; V: Vulnerable; R: Rare;

² NCA Status – E: Endangered; V: Vulnerable; R: Rare;

³ W = DERM Wildnet, EPBC = EPBC Protected Matters Search, QM = Queensland Herbarium

6.8.5.2 Migratory Species

A total of 94 species listed as migratory under the EPBC Act were identified by the DERM Wildnet, Queensland Museum and EPBC Protected Matters Search. Of the 94 species identified by the searches as potentially occurring in the subject area:

- 11 are unlikely to occur based on habitat preferences;
- 14 could possibly be recorded as some of their habitat occurs within the subject area;
- 25 will probably be recorded as their habitat occurs within the subject area and they are relatively common;
- 7 will probably be recorded at farm dams;
- 12 will possibly be recorded at farm dams; and
- 25 could possibly be recorded in any estuarine wetlands.

No known significant breeding areas for migratory species have been recorded along the proposed pipeline route.

6.8.5.3 Aquatic Fauna

Numerous native fish species have been recorded within the project area including one species of Rainbow Fish, five species of gudgeon, three species of catfish, perch, garfish, grunters and eels. No threatened fish have been recorded within the project area. One introduced species, the Mosquitofish (*Gambusia ambigua*), has been recorded within the project area.

Threatened aquatic species recorded from within the pipeline buffer include the Estuarine Crocodile, Green Turtle and Fitzroy River Turtle. A number of threatened birds may also utilise aquatic habitats for feeding, roosting and / or nesting, including Freckled Duck, Radjah Shelduck, Little Tern, Australian Painted Snipe, Cotton Pygmy-goose, Sooty Oystercatcher, Yellow Chat and Black-necked Stork.

In Queensland, estuarine crocodiles are known to occur between Gladstone and Cape York Peninsula, and throughout the Gulf of Carpentaria. Although most commonly seen in tidal reaches of rivers, they also occur in freshwater lagoons, rivers, and swamps hundreds of kilometres inland from the coast. Recent surveys by DERM identified crocodiles at four locations in the lower Fitzroy River (Sullivan *et al.*, 2010), all downstream of the proposed ABP route (Figure 7). However, crocodiles have been recorded nesting at the Conroy crossing of the Fitzroy River, about 11 km upstream of the proposed ABP crossing (Inglis and Howell, 2009).

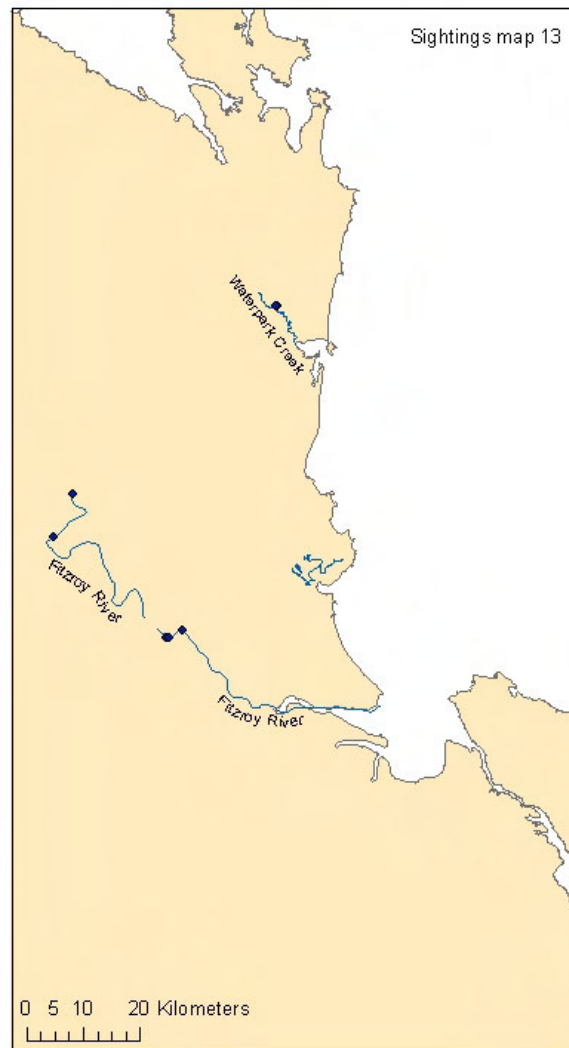


Figure 7: DERM sightings of *C. porosus* in the Fitzroy River

The Fitzroy River Turtle is found in rivers with large deep pools with rocky, gravelly or sandy substrates and connected by shallow riffles, but in the dry season it may be found in large slow-flowing pools and non-flowing permanent water holes. Preferred areas have high water clarity, and are often associated with Ribbonweed (*Vallisneria* sp.) beds. Common riparian vegetation associated with this species includes Blue Gums (*Eucalyptus tereticornis*), River Oaks (*Casuarina cunninghamiana*), Weeping Bottlebrushes (*Callistemon viminalis*) and Paperbarks (*Melaleuca linariifolia*) (DSEWP&C, 2010d). The Fitzroy River Turtle is only known to inhabit the Fitzroy River and its tributaries, including the Dawson, Mackenzie and Connors Rivers and Marlborough Creek. Known sites include Boolburra, Gainsford, Redbank Crossing, Glenroy Crossing, Theodore, Baralaba, Duaringa, and Gogango. This restricted distribution is fragmented by dams and weirs. The closest known locations to the ABP route are the Redbank and Glenroy crossings of the Fitzroy River, which are only 1.5 and 11 km upstream of the proposed ABP crossing of the Fitzroy River, respectively. The sandy banks in this area provide good nesting habitat for the Fitzroy River Turtle (Inglis and Howell, 2009). Estimated distribution of the Fitzroy River Turtle extends beyond the proposed ABP alignment as is illustrated in Figure 8 (DERM, 2010i).

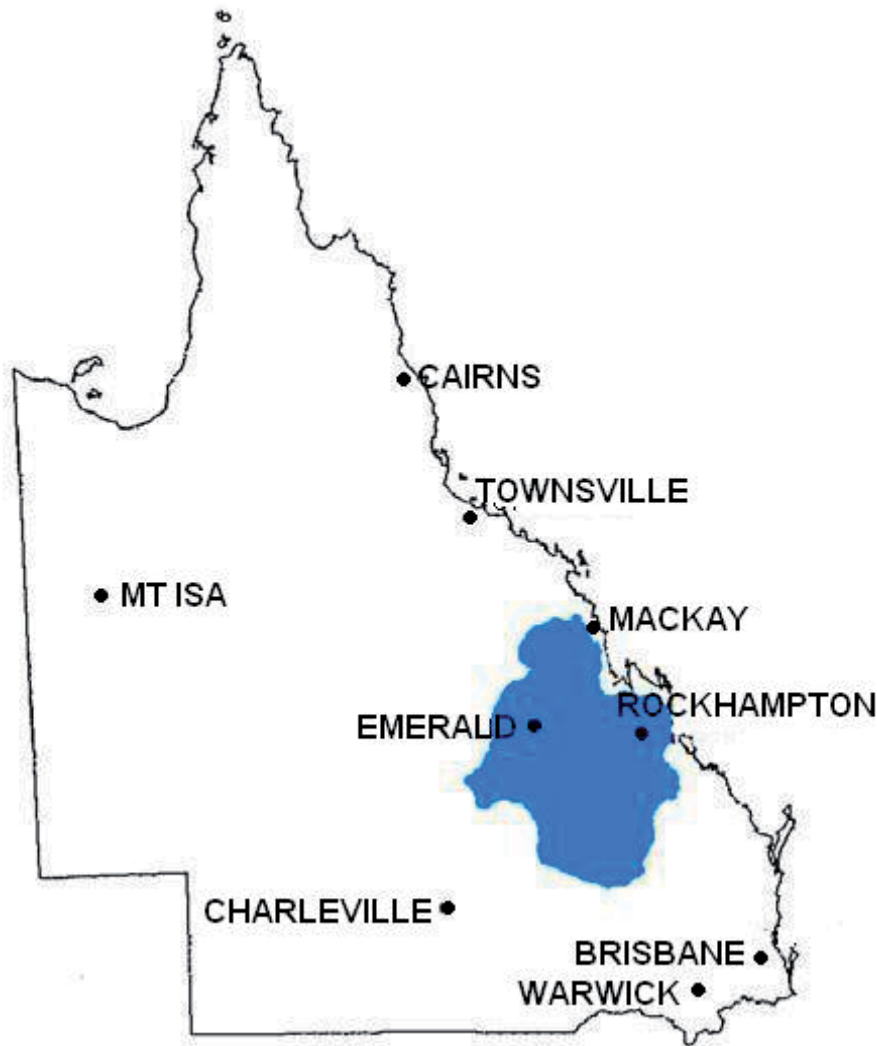


Figure 8: Estimated distribution of *Rheodytes leukops*

Further desktop assessment on the likelihood of this species occurring in the location of the proposed crossing points of the Fitzroy River and its tributaries will be conducted. This information will be used to inform the field survey in order to determine what impact, if any, ABP may have on this species.

Green Turtles are likely to inhabit coastal waters in central and northern Queensland, but these areas will not be significantly impacted by the ABP.

Further desktop assessment on the likelihood of these species occurring in the location of the proposed crossing points of the Fitzroy River and its tributaries will be conducted. This information will be used to target field surveys during the EIS. Measures to avoid, mitigate or offset impacts will be developed where surveys identify the presence of these species or significant areas of suitable habitat.

6.8.5.4 Introduced Species

Feral mammals that are reported in the vicinity of the pipeline include *Capra hircus* (Goat), *Felis catus* (Cat), *Oryctolagus cuniculus* (Rabbit), *Sus scrofa* (Pig) and *Vulpes vulpes* (Fox). The frog species *Bufus marinus* (Cane Toad) is also considered likely to occur within the area.

6.8.6 ESSENTIAL HABITAT

Essential habitat, which is vegetation in which a species that is endangered, vulnerable or near threatened has been known to occur, is mapped by DERM. The Department uses these essential habitat maps to help determine the habitat status of the vegetation under the VM Act to regulate vegetation clearing in such a way as to prevent the loss of biodiversity.

The biological and/or non-biological habitat requirements of a species are covered by specifying essential habitat factors and can include, but are not limited to:

- vegetation—the species or types of vegetation that the species is associated with;
- regional ecosystem—the regional ecosystem(s) with which the species is most commonly associated;
- land zone—the underlying geology associated with a regional ecosystem;
- altitude—the range of altitudes at which the species is found;
- soils—the type of soil on which a species is most commonly found; and
- position in landscape—a precise description of the landscape features the species is commonly associated with (e.g. creek bank, levees, lower slopes, hillsides and ridges).

Essential habitat for two species, Little Pied Bat (*Chalinolobus picatus*) and Black Ironbox (*Eucalyptus raveretiana*), is found within the ROW. The area and location of Essential Habitat for each species within the ROW is shown in Table 16. Only 6.95 ha of Essential Habitat occurs within the ROW, while 3474.1 ha is mapped within the 5 km buffer. Essential habitat within the ABP is mapped in Map 7 of Appendix 1.

Table 16: Area of Essential Habitat within the ROW

Species	Area within ROW (ha)	Location within ROW
<i>Chalinolobus picatus</i>	6.25	KP 77 - 78
<i>Eucalyptus raveretiana</i>	0.70	KP 377 - 378
Total	6.95	

The ROW contains 6.25 ha of essential habitat for Little Pied Bat, which is listed as Near Threatened under the NC Act. The species is associated with areas of dry open forest and woodland (e.g. *Eucalyptus melanophloia*, *E. populnea*, *E. crebra*, *E. moluccana*, *E. tereticornis*, *Corymbia citriodora*, *C. tessellaris*) at altitudes from between 0 and 850 m above sea level. The bat is known to roost in caves, rock outcrops, mine shafts, tunnels, tree hollows and disused buildings. It can tolerate high temperatures and dryness but needs access to nearby open water. It feeds on moths and possibly other flying invertebrates.

The ROW contains 0.7 ha of Essential Habitat for Black Ironbox, which is listed as Vulnerable under the NC Act and the EPBC Act, near the crossing of Limestone Creek. This species occurs along rivers, creeks and watercourses on clay and loam soils. The distribution of the species overlaps with three EPBC listed EECs (Brigalow, semi-evergreen vine thickets and natural grasslands of the Queensland central highlands and the northern Fitzroy basin).

Field assessments along the proposed pipeline route will assess the presence of suitable habitat for these species within the ROW and undertake targeted surveys in areas of suitable habitat. Measures to avoid, mitigate or offset impacts will be developed where surveys identify the presence of significant essential habitat.

6.8.7 CORRIDORS

DERM has conducted comprehensive biodiversity planning assessments (BPAs) for the Brigalow Belt Bioregion (EPA, 2008). A key output of the BPA is identification and mapping of terrestrial biodiversity corridors and riparian wildlife corridors throughout Queensland.

The ABP transects four terrestrial biodiversity corridors and 51 riparian corridors identified in the BPA (Map 8 of Appendix 1). The ROW contains 706.7 ha of mapped corridor, which represents about 0.39% of the total corridor area within the 5 km buffer. However, a large proportion of the area identified within BPA corridors is non-remnant vegetation with low ecological value in its present condition. This is because corridors are buffered lines that connect existing core habitat areas and often traverse extensive areas of heavily cleared and highly fragmented landscape. Terrestrial corridors are typically 10 km wide (i.e. use a 5 km buffer), while riparian corridors are generally 2 km wide.

The impact of the ABP on the current ecological value of corridor areas can be assessed by analysing the area of remnant vegetation in the ROW that is mapped within or adjoining the identified corridors. Remnant vegetation in corridors is also mapped in Map 8 of Appendix 1. The ROW contains 294.8 ha of remnant vegetation within corridors. This figure is less than half the area identified as BPA corridor, indicating that over half of the BPA corridors within the ROW are non-remnant. Nevertheless, field assessments will be undertaken to ground-truth corridors within the ABP and identify potential route revisions that reduce impacts on landscape connectivity, wherever possible.

6.8.8 POTENTIAL IMPACTS AND PROPOSED MITIGATION – FLORA AND FAUNA

6.8.8.1 Habitat Fragmentation and Loss

Flora communities to be cleared for pipeline construction are largely considered to be 'Not of Concern' REs and 'Non-Remnant' (refer Section 6.8.4). Required clearing will be reduced to the greatest extent practicable, especially within areas identified with key environmental constraints and sensitivities such as endangered communities and watercourses. Actual habitat loss and fragmentation will be largely temporary as reinstatement of the easement will occur progressively and natural revegetation will be encouraged.

Rehabilitation will be conducted in accordance with proven industry standards, relevant authorities and recommendations from environmental specialists and will aim to generate similar or better than pre-existing conditions (pending site-specific conditions that may be specified by the landholder). Rehabilitation will include (as a minimum):

- Re-profiling to original or stable contours;
- Re-establishing surface drainage lines and other land features;
- Ripping or scarifying compacted areas where necessary to facilitate vegetation growth (with consideration given to soil type and land system);

- use of geofabric (e.g. jute matting) to hold soil in place during re-establishment, where necessary;
- Stockpiling topsoil and vegetation for later use in reinstatement;
- Replacing sub-soil and topsoil in correct soil horizon profile in trench; and
- Spreading stockpiled topsoil and seed stock (i.e. cleared vegetation) in an even layer on graded surfaces
- seeding with sterile grasses and / or native species, where required;
- monitoring and maintenance (e.g. weed control, repair of erosion control devices) of rehabilitation areas.

Subject to landholder property management practices, significant portions of the construction footprint are expected to naturally regenerate over the medium term (10 to 50 years).

6.8.8.2 Threatened Species and Ecological Communities

Flora

Desktop searches identified 29 NCA listed flora species, 18 EPBC listed flora species, 11 Endangered REs, 14 Of Concern REs and four Endangered TECs that may occur within the survey area. Previous experience in the area suggests a degree of inaccuracy in online ecological community classification, and detailed field assessments will be conducted to support the EIS and Supplementary Report process to better categorise the floral assemblage.

Significant impacts to threatened species and ecological communities will be reduced where possible by using standard construction management measures (e.g. avoidance of critical areas or reduction of ROW width where possible, pre-clearing surveys, flagging and protection of significant species) as well as implementing vegetation protection measures (such as weed control and fire management) throughout all pipeline activities. Subject to the effective implementation of vegetation management techniques, the potential impacts to listed threatened species and ecological communities are expected to be limited to direct impacts from the proposed clearing footprint. Vegetation regrowth is encouraged across the majority of the ROW, excluding the area immediately above and adjacent to the pipeline, so long term impacts are minimised. Further field investigations are required to determine the distribution, likely impacts, and potential avoidance options for threatened species and ecological communities.

Fauna

The main potential impact on fauna arises from habitat loss (particularly of hollow bearing trees that provide a feeding and shelter resource) or mortality from entrapment in the open pipeline trench. Clearing will be minimised where practicable (with habitat trees retained wherever possible) while regular fauna inspections of the open pipeline trench and other excavations will be undertaken throughout construction.

Only seven threatened fauna species and 32 migratory species have been identified with a high likelihood of occurring along the pipeline corridor. Furthermore, the area to be cleared represents only a small fraction of suitable habitat in the surrounding area (0.24% of the area in the 5km buffer surrounding the line). A high proportion of species identified were either

birds (which are highly mobile and can easily avoid areas of disturbance), or marine species (whose habitat will not be present along the pipeline and thus are not considered likely to be affected).

The most significant potential effect to aquatic communities is the threat of decreased water quality caused from point and non-point source discharges and construction activities. Degradation can also be caused by sedimentation during construction and loss of riparian and in-stream habitat and associated reduction in species abundance and diversity.

Other key issues include impacts to fish and macroinvertebrates from any reduction in physico-chemical water parameters such as dissolved oxygen, turbidity and temperature. Increased nutrient levels associated with removal of riparian vegetation and other ground breaking activities may accelerate eutrophication.

It is possible to mitigate these potential impacts by careful management of the construction process and by scheduling construction at waterway crossings during the dry season. Details of mitigation will be presented in the EIS.

Habitat classified as essential for Little Pied Bat, which is listed as near threatened under the NCA, has been identified in the vicinity of the pipeline. Desktop results are to be verified during field surveys to ensure that essential habitat is avoided, where practicable.

Representative fauna surveys (and targeted species surveys in areas of suitable habitat where necessary) will be conducted prior to any pipeline construction activities.

6.8.8.3 Biosecurity

Weeds can out-compete and displace native species, altering established habitats and ultimately threatening a broad range of native flora and fauna, as well as land based agricultural industries. As vehicles and machinery may be sourced from a number of areas (including interstate) and may traverse numerous land tenures and properties during construction and maintenance, a wide range of weeds could be potentially encountered and spread.

Existing weeds will be identified (and mapped if necessary) during field surveys and in consultation with landholders. A Weed Management Plan will be implemented to prevent the spread of declared and environmental weeds during construction and operation of the pipeline. Key mitigation measures will include standard environmental precautions such as vehicle inspections, wash-downs and 'no-go' areas, as appropriate.

Areas of remnant vegetation will be disturbed as a result of construction activities. Loss of native ground cover in the cleared ROW may result in the invasion of feral species. Pest animals and animal diseases will be controlled to the extent possible by rehabilitating the construction ROW promptly to re-establish vegetation and natural habitats. A fauna handler will be employed for the duration of construction and will be appropriately licensed to manage any pest species encountered.

6.8.9 ENVIRONMENTALLY SENSITIVE AREAS

The following ESAs have been identified in the survey area:

- Category B:
 - Endangered Regional Ecosystems

- Category C:
 - Eugene, Develin, Aricia, Morinish, Mount Larcom and Bouldercombe State Forests
 - Newlands, Kemmis Creek, Coolibah and Pindari Nature Refuges
 - Of Concern Regional Ecosystems
 - Essential habitat for two species
 - Referable wetlands

The proposed pipeline route follows existing cleared roads, tracks and existing infrastructure easements where possible and the impact on ESAs is limited to the extent that all ESAs within state forests and nature refuges are avoided by the proposed pipeline. Total avoidance is limited by existing infrastructure, mining leases and topographical constraints but the potential impact on REs, essential habitat and referable wetlands will be further reduced once field survey results are used to ground truth existing mapping.

6.9 CULTURAL HERITAGE

6.9.1 EXISTING ENVIRONMENT

A comprehensive Cultural Heritage Report is presented in Appendix 4.

6.9.1.1 Aboriginal Cultural Heritage

Searches of a series of databases, lists and registers maintained by both State and Commonwealth agencies were undertaken with respect to known Aboriginal cultural heritage areas and objects that may intersect with or be within defined proximity of the ABP. In affecting this, a 5,000 m buffer was placed around the proposed centreline alignment of the pipeline (including its laterals and mainline options).

The total number of places containing Aboriginal cultural heritage areas or objects present on the Commonwealth Indigenous Cultural Heritage Register and Database (ICHR&D) within the buffer search area is 484. However, only 11 places have been identified as occurring within 1 km of the pipeline. With the exception of a contact / camp (ICHR&D ID: JH:J08) relating to Leichhardt's February 1845 travels along the Isaac River (referred to as his 'Thunderstorm Waterhole Camp'), and subsurface stone artefacts found as a result of a test pitting program (HF:D90), the only place-type located within 500 m of the proposed pipeline consist of stone artefacts (66.7%) and scarred trees (27%).

From multiple records for single State IDs, 98 individual entries were found to be located within the 1,000 m buffer of the proposed pipeline. Further review has identified that eight places are located within a 50 m buffer of the pipeline centreline and as such would seem to have a high likelihood of being impacted by the ABP if it were to proceed as currently conceived. These consist of four areas which contain stone artefact/s and four scarred trees (refer Table 5, Appendix 4).

Woorra Consulting Pty Ltd has been undertaking cultural heritage investigations across Arrow Energy's gas field tenements in the Moranbah area for a considerable period. In that time they have maintained a database of capturing the results of that work which they have recently provided to Arrow. This has information regarding 192 Aboriginal cultural heritage places and has also been reviewed here.

Consistent with the results of the ICHR&D presented above, the results of this work is overwhelmingly dominated by places containing stone artefacts accounting for almost 80% of the total. The dominant form of these is as isolated stone artefact/s (generally less than 3 in number) although a considerable number of what have been described as 'low density background scatters' have also been identified. Scarred trees being recorded in number is also highly consistent with the results of previous analyses of Aboriginal cultural heritage data for the region generally, but also for areas that are immediately proximal to the ABP.

Only one of these places was determined to be located within the 1km buffer (i.e. a 2km corridor) of the ABP centreline. As described, this place consisted of a single silcrete scraper. Although the grid references for this placed it some 170m to the west of the Elphinstone Header element of the ABP, it has also been noted that this has been relocated to another, currently unknown, location. With this area containing a range of work done in close proximity to Teviot Brook (a tributary of the Isaac River), several fragments of grindstone have been identified.

Extending out to the 1,000 m – 5,000 m proximity buffer, an additional eight cultural heritage places have been identified. Again, these are dominated by areas containing low density stone artefact scatters (in all cases containing less than eight artefacts at each). The only other place-type is a box tree that has a single scar measuring 165 cm long and 21 cm wide (refer Figure 4; Appendix 4).

Near Kabra, the Darumbal People identified one area within 250 m of the proposed pipeline consisting of five unmodified stone artefacts.

6.9.1.2 Non-indigenous Cultural Heritage

Searches of online databases (including the Queensland Heritage Register (QHR), Commonwealth (DSEWP&C, 2010c) and National heritage lists and EPBC Act Protected Matters database), identified a number of heritage places within the survey area although none are impacted by the proposed pipeline.

A formal search was also undertaken for any places that may be included on the QHR that may be present within the vicinity of the ABP area. Of the 52 places listed within the full 5,000 m buffer of the pipeline centreline, only one fell within the 1,000 m buffer of the pipeline alignments. This is Raglan Homestead (QHR ID: 600389), the closest point of which is located some 160 m to the southwest of the Mainline (to Bruce Highway) alignment. As such it would seem unlikely that this place would be impacted.

Separate to the QHR, DERM has also compiled a substantial range of information regarding historic heritage places and incorporated this into its Cultural Heritage Information Management System (CHIMS). Again, only one of these was found to be located within 1km of the proposed pipeline. This place (CHIMS ID: 24435) is located on the western side of the Isaac River and to the south of Goonyella. It is described as being a portion of the rim of a shepherd's pot. At its closest, the Goonyella lateral passes in excess of 850 m to the south of this place. Again, it would seem unlikely that this place would be impacted by the ABP.

Searches were conducted of a range of other Commonwealth heritage lists and registers regarding identified and inscribed places that may be located within the ABP search area. These searches included the World Heritage List, the Commonwealth Heritage List, the National Heritage List and the Register of the National Estate. Datasets made available

through the Heritage Division of the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) were used in this analysis.

In all, 6 places were identified as being located within the ABP search area (i.e. a 5,000 m buffer of the revised Project alignments): one each from the World Heritage and National Heritage lists (in both cases the Great Barrier Reef area); and four from the Register of the National Estate. Of these, only one (the Great Barrier Reef Region as registered on the RNE – ID 8320) is located within 1,000 m of the currently conceived pipeline centrelines. At its closest, the proposed mainline (from Bruce Highway) alignment is at least 750 m to the south of any portion of this area.

6.9.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Arrow will, through its CHMPs or ILUAs, be commissioning comprehensive cultural heritage assessments of the entirety of the final pipeline alignment that constitutes the ABP. Its preferred management strategy will be site avoidance using tactical realignment, with mitigation by relocation an option of last resort. Arrow will also subsequently resource sub-surface investigations involving test pitting and excavation where this is considered appropriate. Monitoring of surface disturbing activities will be countenanced where results of the initial field assessments (including any test pitting and excavations) indicate this is warranted.

Arrow will commission an assessment of the historic heritage of the entire pipeline alignment. Where any places containing historic heritage values which have the potential to meet the criteria for listing under the QH Act are identified, the results of this will be discussed with the Heritage Branch, DERM. Again, Arrow's preferred management strategy will be based on site avoidance using tactical realignment, with mitigation by relocation as an option of last resort. Any such management program will be discussed with the Heritage Branch, DERM prior to the commencement of construction activities associated with the ABP.

6.10 LAND TENURE AND USE

The proposed pipeline traverses the Whitsunday, Isaac, Rockhampton and Gladstone Regional Council areas. The majority of the land holdings within the pipeline study area are rural (both freehold and leasehold). Farming enterprises are mainly broad acre cropping and grazing. Land use in the region includes grazing (particularly beef cattle), cropping, tourism, mining (particularly coal), petroleum, oil and gas. The traditional industry base has been agriculture, predominantly pastoral, however petroleum, oil and gas is now a significant contributor to the regional economies.

6.10.1 EXISTING ENVIRONMENT

Existing land use along the route is predominantly rural and rural residential with a number of rural-based communities in the vicinity of the proposed route, including Moranbah, Alton Downs, Midgee and Bajool. The proposed alignment avoids the cities of Rockhampton and Gladstone.

A brief description of each Regional Council Area transected by the proposed route is provided below:

- Whitsunday Regional (Whitsunday 2010);

- A diverse regional economy, with a range of key industry sectors (horticulture, tourism, fishing, grazing, coal mining, power generation) providing employment and wealth creation;
 - The area has well developed community and industry infrastructure, with sufficient facilities to absorb a large amount of additional economic growth.
- Isaac Regional (REDC, 2008)
 - The Isaac LGA is situated west of Mackay, approximately 803 km north of Brisbane;
 - The Isaac LGA covers an area from "Coal to Coast", including the towns of Clermont, Dysart, Glenden, Middlemount, Moranbah, Nebo, Coppabella, St Lawrence, Carmila, Clairview, Greenhill and Ilbilbie;
 - The traditional economic base of the Isaac LGA has been in sugar, beef, agriculture, and mining, however aquaculture, fruit and vegetable growing and goat farming activities are under development in the region;
 - Aside from rural industries, employment in the western localities is largely associated with the coal industry, while coastal areas depend on service industries for a large portion of employment opportunities.
- Rockhampton Regional (RRC, 2010)
 - The Rockhampton Regional Council area is a growing residential area, with significant rural and rural residential areas, and some commercial and industrial land uses;
 - The Council area encompasses a total land area of over 18,300 km², including national parks, state forests, coastline and islands;
 - The main urban centre is Rockhampton, with a smaller centre at Yeppoon. There are numerous small towns and villages, both along the coast and in the rural hinterland;
 - Rural land is used mainly for cattle grazing, pineapple growing, fruit growing, forestry, and mining. Power generation and tourism are also important industries.
- Gladstone Regional (SGS, 2009)
 - The Gladstone Region begins approximately 450 km north of Brisbane and extends up the Central Queensland coast some 200 km;
 - The Gladstone Region is home to a thriving 21st Century industrial base served by one of Australia's busiest ports, the Port of Gladstone;
 - Gladstone Region's strong industrial growth looks set to continue with the recent and continuing investment in the LNG industry expected to play an increasingly important role in global energy markets;
 - Major industry in Gladstone is supported by the region's thriving and world-class engineering, construction and manufacturing sectors while the region's traditional agricultural base in cattle farming and horticultural production continues to underpin the Gladstone Region's economic base.

Map 9A (Appendix 1) provides an overview of the property boundaries and property description sourced from the Digital Cadastral Database (DCDB) and land tenure in the vicinity of the proposed ABP route.

6.10.1.1 Agriculture and Grazing

Much of the pipeline route traverses land primarily used for low intensity beef cattle grazing. Clearing of native vegetation for grazing and cultivation is common in areas where climate and soils allow for regular cropping and grazing.

A variety of pastoral infrastructure is expected to exist along the pipeline including gates, fences, bores, water pipes (polyethylene pipe) and stock yards.

6.10.1.2 Oil, Gas and Mineral Exploration and Operations

Much of the pipeline traverses the Bowen Basin which has been the subject of recent growth and major development as a result of coal and gas exploration and CSG and LNG developments.

Consequently, the pipeline route passes through a number of petroleum production and exploration tenements as illustrated on Map 9B (Appendix 1). Numerous seismic lines, oil and gas wells and gathering lines are also located throughout the region and drilling of new gas wells is ongoing.

Mining and petroleum tenure includes:

- EPC Exploration Permit – Coal;
- EPM Exploration Permit – Minerals;
- EPP Exploration Permit – Petroleum (also known as Authority to Prospect (ATP));
- ML Mining Lease;
- MDL Mineral Development Licence;
- PL Petroleum Lease; and
- PPL Petroleum Pipeline Licence.

MDL areas have generally been avoided, and EPCs have been considered in order to avoid any areas of known, but yet undeveloped, coal reserves. The preferred pipeline route will avoid MLs and PLs, other than those owned by Arrow Energy or its subsidiaries, where possible, however a number are transected by the proposed pipeline as listed in Table 17.

Table 17: Intersected Petroleum and Mining Tenure along the Preferred Pipeline

Owner	Type	Status	Approximate Location of Intersection
Moranbah North Coal Pty Ltd	MDL	Granted	Goonyella Lateral KP10 - KP11
BHP Mitsui Coal Pty Ltd	ML	Granted	Red Hill Lateral KP10 - KP13
Peabody (Bowen) Pty Ltd	ML	Granted	Red Hill Lateral KP10 – KP15
BHP Coal Pty Ltd	ML	Application	Red Hill Lateral KP15 – KP16
Moranbah North Coal Pty Ltd	ML	Granted	Goonyella KP1 – KP2
BHP Coal Pty Ltd	ML	Granted; Renewal lodged	Goonyella KP4 – KP10
Coppabella Coal Pty Ltd	ML	Granted	Main KP103 – KP 104; KP114 - KP116
Xstrata Coal Queensland Pty Ltd	ML	Application	Main KP0 – KP1.8

Owner	Type	Status	Approximate Location of Intersection
Peabody (Burton Coal) Pty Ltd	ML	Granted	Main KP75.8 – KP75.9
Vale Australia (CQ) Pty Ltd	ML	Granted	Main KP77.8 – KP78
Vale Australia (CQ) Pty Ltd	ML	Application	Main KP78 – KP79
Marlborough Nickel Pty Ltd	ML	Application	Main KP335.6 – KP335.7
Cement Australia (Queensland) Pty Ltd	ML	Granted; Renewal lodged	Main KP485.03 – KP485.05
BOW Norwich Park CSG PL Pty Ltd	PL	Application	Dysart Lateral KP2 – KP5; KP4 – KP10
Vale Australia (CQ) Pty Ltd	PL	Application	Main KP78 – KP79
BOW Norwich Park CSG PL Pty Ltd	PL	Application	Main KP146 – KP 158; KP158 – KP176; KP176 – KP177
North Queensland Pipeline No 1 Pty Ltd	PPL	Granted	Laterals - Red Hill KP0; Goonyella KP0
Stanwell Corporation Limited	PPL	Non-current	Laterals - Red Hill KP16.8; Goonyella KP12.3; Saraji KP0; Dysart KP0
Central Queensland Pipeline Pty Ltd	PPL	Granted	Main KP0; KP483; KP484; KP487
AGL Pipelines Investments (QLD) Pty Ltd	PPL	Non-current	Main KP311; KP317; KP323; KP324; KP354
Stanwell Corporation Limited	PPL	Lodged	Main KP401 – KP402
Jemena Queensland Gas Pipeline (1) Pty Ltd	PPL	Granted	Main KP416; KP486
QCLNG Pipeline Pty Ltd	PPL	Granted	Main KP483
Australia Pacific LNG Gladstone Pipeline Pty Limited	PPL	Application	Main KP483
Surat Gladstone Pipeline Pty Ltd	PPL	Granted	Main KP486
LNG International Pty Ltd	PPL	Application	Main KP486

Exploration and resource tenure holders will be approached to determine the extent of the delineation as pipelines may constrain development of deeper coal seams.

6.10.1.3 Conservation

Route selection has avoided formally designated conservation areas, including state forests.

6.10.1.4 Infrastructure

No regional airstrips have been identified within 5 km of the preferred pipeline route based on desktop assessment. Rockhampton Airport is located approximately 10 km east and that at Moranbah 25 km west of the proposed pipeline route. The pipeline construction and operation will not impact on these facilities.

The pipeline will transect a number of roads (the majority being local government roads), stockroutes and 6 railways as described in Section 6.3.1.

The proposed pipeline route also crosses both high voltage and low voltage power lines and associated easements.

6.10.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Pipeline construction has the potential to temporarily disrupt land use due to land disturbance along the ROW and the presence of vehicles and machinery. Of particular note are the potential for impacts from the:

- Introduction, spread or colonisation of weeds;
- Restriction in stock movement;
- Increased access; and
- Potential impacts to third party infrastructure.

The proposed ABP route was selected following a review of several environmental, land, cultural and technical constraints. To minimise impacts to these areas, several mitigation measures will be reviewed in the EIS, including:

- Avoidance of GQAL where practicable;
- Burial of the pipeline to a depth that allows normal agricultural activities to be re-established over the route;
- Minimising the duration of disturbance to reduce impacts; and
- Compensation offered to landowners for any temporary disruption to agricultural production.

The construction methods used for the pipeline will allow rapid rehabilitation of GQAL. It is expected that, with mitigation, the buried pipeline will have negligible long-term impact on GQAL and that impacts will be limited to the short-term associated with the construction phase of the Project. Segregation and stockpiling of soils and returning the soil horizons in reverse order of excavation (i.e. subsoil returned back into the trench before resspreading the topsoil) along the ROW will allow the upper soil layers to be reinstated. Rehabilitation of GQAL will be undertaken to best practice methodologies to ensure that the agricultural productivity of the disturbed area is returned in the shortest time practical.

Plate 32 below shows agricultural production continuing unaffected in black soil country 44 years after burial of the first Roma to Brisbane gas pipeline and eight years since duplication (looping) of this pipeline immediately adjacent to the original pipeline.



Plate 32: Continued agricultural production in black soil country

A number of conservation areas, environmental parks and dams are located within the regional area around the pipeline, however, due to the distance from construction activities and the implementation of appropriate erosion and sediment control measures, adverse environmental impacts are considered unlikely.

Crossing of community infrastructure lines will be further assessed during Front End Engineering and Design (FEED) studies and “Dial Before You Dig”, with appropriate impact minimisation strategies implemented. Landholder consultation will identify private infrastructure such as water pipelines, sewerage, dams, fences etc. for avoidance or other management.

The above issues can be successfully managed through the implementation of detailed management plans and procedures, as well as open and transparent dialogue with landholders and the community. Most impacts are temporary, and will cease once construction is complete and the easement is rehabilitated. Existing land uses (such as cattle grazing and cropping) generally continue unaffected over buried, operational pipelines.

6.11 VISUAL AMENITY

6.11.1 EXISTING ENVIRONMENT

From the helicopter reconnaissance, the visual quality of the area was found to lie in the:

- Naturalness of the area;
- Contrasts in the landform and vegetation;
- Presence of views of landmark hills and ranges; and
- Cultural landscape of open, undulating grasslands.

These features will be further assessed during the EIS process.

6.11.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Pipeline construction activities will result in minor, and largely short-term, disturbance to the visual amenity of the local environment from vegetation clearing and earthworks and the presence of construction vehicles and equipment. Over the longer term, visual impacts of buried pipelines are typically related to breaks in vegetation, line-of-sight along the linear easement, the periodic presence of above ground facilities and the success of rehabilitation. Considering the progressive nature of construction activities, and the location of the pipeline (i.e. relatively isolated and predominantly within existing clearings and easements), long term visual impacts are expected to be minimal.

6.12 SOCIO-ECONOMIC ASPECTS

6.12.1 EXISTING ENVIRONMENT

The proposed pipeline traverses the Whitsunday, Isaac, Rockhampton and Gladstone Regional Council areas, passing within the vicinity of a number of towns including Glenden, Moranbah, Ridgeland, Rockhampton, Gracemere, Mount Larcom, Yarwun and Gladstone. The majority of the land holdings within the pipeline study area are rural (both freehold and leasehold). Farming enterprises are mainly broad acre cropping and grazing. Land use in the region includes grazing (particularly beef cattle), cropping, tourism, mining (particularly

coal), petroleum, oil and gas. The traditional industry base has been agriculture, predominantly pastoral, however petroleum, oil and gas is now a significant contributor to the regional economies and the traditional rural base is being industrialised.

A good road network exists in the ABP area.

6.12.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

The primary socio-economic impacts, largely associated with disturbance to landholders and land use, are expected to be short term and limited to the construction phase of the Project only.

Proposed sites for construction camps will be discussed with stakeholders with a view to providing facilities that are acceptable to local authorities, State agencies and the community.

Potential socio-economic impacts that may arise from the pipeline relate primarily to the construction phase and include:

- Employment opportunities;
- Economic benefits from local spending;
- Upgrade and development of community infrastructure at proponent's expense (e.g. roads);
- Disruption to existing land uses (including potential damage to third party infrastructure);
- Increased local traffic, use and condition of roads;
- Ability of local business to capitalise on energy industry expansion;
- Competition for skilled labour and technical personnel;
- Competition for limited resources (e.g. equipment, plant, services);
- Competition for accommodation may impact local tourism;
- Risks to the health and safety of the community; and
- Reduction in visual amenity.

Potential adverse socio-economic impacts to the regional communities along the pipeline are likely to be short-term and largely minimal. Communities may benefit both directly and indirectly from local expenditure and employment opportunities during construction, and to a lesser extent, during operations. Any impact on local tourism is expected to be minimal and of short duration. Training and up-skilling of the local work force will be undertaken prior to and during construction, while significant economic opportunities will be provided to benefit local businesses and community groups through their involvement in the project.

6.13 HEALTH AND SAFETY

6.13.1 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Although pipelines are recognised as a safe and efficient means of transporting natural and CSG, all developments present some level of risk. Adverse risks to the health and safety of the community will be reduced by conducting a series of detailed risk assessment in accordance with AS 2885.1. The outcome of this process will be a combination of physical

and procedural measures that aim to ensure the pipeline design, construction, operation, maintenance and management meet appropriate safety standards and minimise the risk to employees, contractors and local communities. Arrow Energy's 12 Life Safety Rules, developed as part of their Zero Harm policy, are presented in Appendix 5.

6.14 HAZARD AND RISK ASSESSMENT

6.14.1 EXISTING ENVIRONMENT

CSG is predominantly methane which is colourless and odourless but highly flammable in certain limited gas / air mixtures. CSG developments, including transmission pipelines, carry an inherent risk of fire and explosion.

6.14.2 POTENTIAL IMPACTS AND PROPOSED MITIGATION

Expansion of the CSG industry in rural communities has the potential to expose the population to hazards not otherwise experienced due to:

- Proximity of dwellings to CSG transmission pipelines;
- Presence of CSG transmission pipelines beneath agricultural land subject to mechanical ploughing / harvesting;
- Traffic accidents due to increased light and heavy traffic on the rural road network.

Risk assessments will be conducted in accordance with AS/NZS ISO 31000, Risk management - Principles and guidelines (previously AS 4360) and AS 2885, Pipelines – Gas and Liquid Petroleum to identify and assess potential risks during the construction, operational and decommissioning phases of the Project. This will include a location analysis of the land use along the route to determine high consequence areas, and a threat analysis of potential hazards. As identified in Section 3.1, a Pipeline Safety Management Study in accordance with AS 2885.1 will be conducted. This will inform a pipeline risk management strategy to ensure that risks are reduced to the level of “as low as reasonably practical” (ALARP). Risk analyses and draft Risk Management Plans will be provided in the EIS for the construction and operational phases.

Hazard identification studies will be carried out during the EIS process to identify the nature and scale of hazards which have the potential to occur if not properly managed such as:

- Construction accidents;
- Pipeline loss of containment and associated explosions and fires;
- Release of liquid, gaseous or particulate pollutants or any other hazardous material used or stored on site; and
- Natural events such as cyclones, earthquakes, bushfire or local flooding.

In accordance with the above standards and Arrow Energy's safety management system, a risk assessment will identify controls to be implemented to manage the identified risks.

7 ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

7.1 ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT SYSTEMS

Arrow operates in accordance with Arrow Energy's Environmental, Health and Safety Management System which provides a framework for continually improving the management system to ensure responsible management practices that minimise any adverse environmental, health or safety impacts arising from its activities, services or products.

Specific environmental management strategies for the Project will be delivered through the following measures:

- Conditions developed for PPL EA issued by DERM;
- EMPs developed for construction and operation; and
- Contractual obligations imposed by Arrow on each of the constructor and operator of the pipeline.

Arrow will uphold the Arrow Energy management systems throughout the Project activities to minimise risks to safety, the environment, and social and heritage values. With the implementation of appropriate management measures, the proposed activities are highly unlikely to have a significant impact on the environment.

All personnel will be required to operate under Arrow Energy's Environmental Management Policy and to undertake a Health, Safety and Environment induction prior to site access. All complaints, incidents and landholder liaison will be recorded, reported and actioned as required.

As a fully owned subsidiary of Arrow Energy, Arrow is committed to responsible environmental management throughout all phases of the ABP Project. All planning, construction and operational activities will be conducted in accordance with Arrow Energy's Environmental Policy which states:

"Arrow Energy's aim is to achieve a high standard of care for the natural environment in all of the activities in which we engage including gas exploration, development, production and decommissioning of gas supply service, planning, design of new infrastructure, management of existing infrastructure, the provision of technical services, and at all times, to minimise the impact of our activities on the environment."

Arrow Energy operates in compliance with Commonwealth, State and Local Government statutes and industry guidelines and has implemented an Integrated Environmental Management System (IEMS) to manage environmental issues linked with all its activities from exploration and development, through operations to de-commissioning and rehabilitation. Based on this, Arrow Energy has developed an Environmental Management System (EMS) which applies to govern the conduct of environmentally relevant activities in the Bowen Basin. In addition to existing plans and procedures, Project-specific documentation, including a CEMP, OEMP and supporting programs will be prepared for ABP.

All personnel have a duty of care for environmental management and compliance, with Arrow, as the holder of the PPL and EA, taking overall responsibility. Arrow will maintain active on-site supervision of construction. Environmental performance of potential contractors will be reviewed as part of the construction tender evaluation. Induction programs and training for all personnel involved in construction will ensure that each individual is aware of their environmental responsibility and remains accountable for their actions.

8 STAKEHOLDER ENGAGEMENT

8.1 STAKEHOLDER ENGAGEMENT PRINCIPLES

Arrow Energy recognises that the support of all their stakeholders, particularly landholders and the local communities in which they operate, is vital to the success of any resources project.

"We treat all people, inside and outside Arrow, with dignity and respect.

We are committed to protecting and promoting the social and environmental values of the communities in which we work."

By engaging with community groups, landholders, Indigenous groups, local businesses and Governments at all levels, Arrow Energy can work towards a plan for a sustainable and shared future. This engagement is not just part of the work for a comprehensive EIS, but it is the cornerstone of a sustainable relationship with stakeholders for decades to come. Likewise, Arrow has developed a Code of Conduct (presented in Appendix 5) to ensure that all staff and contractors conduct their business in an ethical and responsible manner.

8.1.1 STAKEHOLDER ENGAGEMENT OBJECTIVES

The key objectives of the stakeholder engagement program will be to:

- Raise awareness of the Project, its potential impacts and schedule as early as possible;
- Provide an understanding of the regulatory approval process;
- Actively engage stakeholders to ensure a full and early understanding of potential concerns, issues and interests;
- Identify opportunities to work together and encourage stakeholder participation in developing strategies and decision making;
- Foster regular and ongoing communication with stakeholders; and
- Build long-term positive relationships with affected stakeholders.

8.1.2 STAKEHOLDER ENGAGEMENT PROCESS

The following stakeholders have been identified as having a particular interest in the survey area and activities associated with the construction and operation of the ABP:

- Federal and State regulatory agencies and relevant government departments;
- Local governments of Whitsunday Regional Council, Isaac Regional Council, Central Highlands Regional Council, Rockhampton Regional Council and Gladstone Regional Council (Note that whilst the pipeline route itself does not pass through the Central Highlands Regional Council, access to the route will require travelling upon roads within this Local government and it is thus included in this list of affected Local governments);
- Landowners and occupiers;
- Operators of existing utilities and infrastructure;

- Mineral and petroleum tenement holders; and
- Native Title claimant groups with active registered claims.

Other interested parties may be identified through further assessments and ongoing consultation with existing stakeholders. All notification requirements specified in the P&G Act will be complied with prior to entering properties to be accessed through survey activities. This includes issuing formal notices of entry to landholders for relevant survey activities. All stakeholder correspondence will be registered and documented to ensure prompt and appropriate resolution of any issues.

Consultation with landholders and occupiers along the alignment will include letters, phone calls and direct contact meetings to inform relevant parties of the ABP Project development intentions, key proposed activities and proposed timelines. A Land Access Specialist will visit properties to be accessed to agree on access arrangements and obtain feedback about key constraints, land uses, future plans and other property-specific requirements. Arrow Energy's Land Access Rules are presented in Appendix 5.

A Stakeholder Consultation Plan will be developed and implemented to ensure that all stakeholders are informed of project progress.

8.2 NATIVE TITLE

There are a number of areas subject to Native Title Determination Applications which are interspersed with unclaimed areas within the survey area.

The following Native Title Claim groups (refer to Map 10, Appendix 1) have been identified:

- Barada Barna People;
- Birri People;
- Darumbal People;
- Darumbal People 2;
- Jangga People;
- Port Curtis Coral Coast; and
- Wiri People Core Country Claim.

Native Title Claimants and other Aboriginal groups will be consulted regarding management of Native Title interests.

9 AREAS FOR FURTHER INVESTIGATION

This IAS and associated desktop research has identified key areas requiring more detailed investigation and assessment in order to further refine the route, including the need for:

- Targeted ecological surveys particularly to ground-truth flora and fauna results, and identify fauna habitats and presence / absence of threatened species;
- An assessment of watercourse crossings;
- Soil / geotechnical investigations to determine engineering / constructability constraints and identify key areas susceptible to erosion;
- Identification of sensitive receptors, including residential and rural places;
- Cultural heritage assessment;
- Preliminary Pipeline Safety Management Study in accordance with AS 2885; and
- Transport study of local government roads used for the supply of pipe and construction equipment to the ROW.

9.1 DRAFT TERMS OF REFERENCE

Arrow Energy has recently completed a voluntary EIS for the Surat Gladstone Pipeline (now known as the Arrow Surat Pipeline). It is anticipated that the draft Terms of Reference (ToR) for this pipeline would be similar and the draft ToR are attached in Appendix 6.

10 CONCLUSION

Arrow Energy has a proven track record of successfully implementing gas and associated infrastructure projects in central Queensland due to its strong focus on achieving sound environmental outcomes and maintaining close communication with DERM and other stakeholders throughout all project phases.

The route selection process for the proposed high pressure buried steel gas pipeline from the Bowen Basin to Gladstone has focussed on avoidance rather than impact mitigation. During early route selection, particular attention has been placed on the avoidance of 'Endangered' and 'Of Concern' Res. At least 93.7% of the area to be cleared is classified as 'Non Remnant' and 'Not of Concern'. The maximum disturbance area of 16.3 ha of 'Endangered' vegetation represents only 0.13% of the area of similar status vegetation occurring within a 5 km buffer of the preferred alignment. Ecological field surveys will verify these results and, considering the highly fragmented and largely non-remnant vegetation communities observed in aerial surveys of the route, are expected to confirm that the pipeline route has been located predominantly in existing cleared areas, requiring as little vegetation clearance as practicable.

The final alignment, as well as cultural heritage inspections and management techniques, will minimise impacts to culturally significant values.

Subject to further ecological investigations (both desktop and site surveys), Arrow is confident that there is limited potential for the proposed ABP to have a significant impact on the ecological values of the surrounding environment.

Although it is concluded that, subject to the detailed ecological survey, cultural heritage assessment, transport study and safety management study, a formal EIS is unlikely to be triggered either federally under the EPBC Act or under the Queensland EP Act, Arrow seeks voluntary submission of an EIS.

The purpose of this IAS is to provide supporting material for an application to DERM to prepare a voluntary EIS under Chapter 3, Part 2 of the EP Act.

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12 ABBREVIATIONS AND GLOSSARY OF TERMS

ABP	Arrow Bowen Pipeline
ACH Act	<i>Aboriginal Cultural Heritage Act 2003 (Qld)</i>
AGL	Australian Gas Light Ltd
ANRA	Australian Natural Resources Atlas
ANZECC	Australian and New Zealand Environment Conservation Council
APIA	Australian Pipeline Industry Association
Arrow Energy	Arrow Energy Pty Ltd
Arrow	Arrow Bowen Pipeline Pty Ltd
AS	Australian Standard
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulphate Soil
ATP	Authority to Prospect
BIM	Block Identification Map
BOM	Bureau of Meteorology
BPA	Biodiversity Planning Assessment
CEMP	Construction Environmental Management Plan
CG	Coordinator-General
CHIMS	Cultural Heritage Information Management System
CQP	Central Queensland Pipeline
CSG	Coal Seam Gas
DEEDI	Department of Employment, Economic Development and Innovation (Queensland)
DERM	Department of Environment and Resource Management (Queensland)
DIP	Department of Infrastructure and Planning
DIWA	Directory of Important Wetlands in Australia
DSEP&C	Department of Sustainability, Environment, Population and Communities (Federal)
DTMR	Department of Transport and Main Roads
EA	Environmental Authority
EBITDA	Earnings Before Interest, Tax, Depreciation and Amortisation
EC	Electrical Conductivity
EIS	Environmental Impact Study

EMP	Environmental Management Plan
EP Act	<i>Environmental Protection Act 1994</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPC	Exploration Permit Coal
EMP	Exploration Permit Minerals
EMS	Environmental Management System
EPP	Exploration Permit Petroleum
ERA	Environmentally Relevant Activity
ERT	Environmental Reporting Tool
ESA	Environmentally Sensitive Area
EVR	Endangered, Vulnerable, Rare
FEED	Front End Engineering Design
FID	Final Investment Decision
GAWB	Gladstone Area Water Board
GHG	Greenhouse Gases
GMU	Groundwater Management Unit
GPC	Gladstone Ports Corporation
GPNL	Gladstone Pacific Nickel Ltd
GQAL	Good Quality Agricultural Land
GST	Goods and Services Tax
HAZOP	Hazard and Operability
HERBRECs	Queensland Herbarium, Department of Environment and Resource Management
HDD	Horizontal Directional Drill
IAS	Initial Advice Statement
ICHR&D	Indigenous Cultural Heritage Register and Database
IEMS	Integrated Environmental Management System
KP	Kilometre Point
L _{A90T}	A-weighted sound pressure level exceeded for 90% of the measuring period
LP Act	<i>Land Protection (Pest and Stock Route Management) Act 2002</i>
LGA	Local Government Authority
LNG	Liquefied Natural Gas
MCU	Material Change of Use
MDL	Mineral Development Lease

ML	Mining Lease
MRL	Mineral Resource Lease
NCA	<i>Nature Conservation Act 1992</i>
NES	[Matter of] National Environmental Significance
NT Act	<i>Native Title Act 1993</i>
P&G Act	<i>Petroleum and Gas (Safety and Production) Act 2004</i>
PASS	Possible Acid Sulphate Soils
PetroChina	PetroChina International Investment Company Ltd, a subsidiary of PetroChina Company Limited
PL	Petroleum Lease
PNG	Papua New Guinea
PNL	Planning Noise Level
PPL	Petroleum Pipeline Licence
PSL	Petroleum Survey Licence
OEMP	Operational Environmental Management Plan
QASSIT	Queensland Acid Sulphate Soils Resource Information System
QHR	Queensland Heritage Register
QR	Queensland Rail
QWQG	Queensland Water Quality Guidelines
RE	Regional Ecosystem
RNE	Register of the National Estate
ROW	Right of Way
SDA	State Development Area
SGIC	Stanwell to Gladstone Infrastructure Corridor
Shell	Shell Energy Holdings Australia Limited, a subsidiary of Royal Dutch Shell plc
SOP	Standard Operating Procedure
SPP	State Planning Policy
TEC	Threatened Ecological Community
TN	Total Nitrogen
ToR	Terms of Reference
WoNS	Weeds of National Significance
VMA	<i>Vegetation Management Act 1999</i>

