CHAPTER 17

GLADSTONE – FITZROY

PIPELINE PROJECT

Environmental Impact Statement

Landscape and Visual Impact Assessment

Gladstone Area Water Board

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17. Landscape and Visual Impact Assessment

17.1 Introduction

The purpose of this chapter is to assess the potential landscape and visual effects associated with the proposed Gladstone–Fitzroy Pipeline (the project).

This chapter addresses some of the requirements of the Terms of Reference (ToR) for the project. Items within the ToR specifically relating to landscape and visual amenity and addressed within this chapter are:

- Discussion of significant features of the landscape, including topographical features
- A description of any special landscape values of any natural vegetation communities
- A description of the environmental values of any nature conservation areas that may be impacted in terms of conservation of resources and integrity of landscapes and places including wilderness and similar natural places
- Discussion within the context of major topographic features and any measures taken to avoid or minimise impact to such (if required)
- Objectives for re-contouring and *landscaping*, including consideration for the use of Threatened plant species during any landscaping and re-vegetation
- Discussion of potential impacts to scenic amenity
- Provision for the protection and reasonable restoration of the visual amenity of the locale prior to the pipeline implementation, should the pipeline or any associated infrastructure be situated above ground.

The chapter is structured to include the following:

- A description of the methodology adopted for the assessment of effects upon landscape and visual amenity
- A description of the assumptions and limitations of this method
- A description of the relevant consultation, legislation, policies and guidelines that have been used to inform the assessment
- An evaluation of the baseline landscape and visual context
- Discussion of visual receptor sensitivity within the project area through the use of representative publicly accessible viewpoints
- An assessment of the significance of effects upon landscape and visual amenity as a direct result of the proposal based upon an evaluation of publicly accessible viewpoints
- Proposed mitigation strategies
- Discussion of residual impacts
- Discussion of cumulative and interactive effects
- A summary of the results of the assessment.

The assessment process aims to be objective and describe the changes factually. Potential changes as a result of the project have been defined however the significance of these changes requires qualitative (subjective) judgements to be made. The conclusions of this assessment therefore combine objective measurement and subjective professional interpretation. As with other chapters in the EIS, the baseline and impact assessment are described for the project area in two sections: Fitzroy to Bajool; and Bajool to Gladstone.

Generally, the pipeline will follow a narrow linear corridor - the right-of-way (ROW) and remain largely underground. Views of the project will be limited to close receptors, and users crossing the pipeline corridor on roads and/or railways. Landscape and visual impacts will be prevalent in a few key areas (intake site, water treatment plant, pump stations and storage facilities) where structures will be above ground and/or vegetation clearance will be required. There are also likely to be temporary visual impacts during construction as a result of storage yards, site facilities and construction works.

The project area for this chapter includes all areas directly within the project footprint and any surrounding lands within the zone of visual influence (ZVI, defined in Section 17.2.1.1).

17.2 Methodology

This section describes the methodology adopted to establish the baseline environment in the project area and then to assess the potential landscape or visual impacts that could result from the project during the construction and operational phases.

17.2.1 Establishment of Baseline

17.2.1.1 Zone of Visual Influence (ZVI)

An indicative ZVI, defined as the area from which the project may be viewed, was initially determined through a desktop study examining aerial photographs and topographic maps where landform and land cover (screening) were considered in tandem.

17.2.1.2 Site Survey

A site survey was undertaken by two landscape planners in order to build consensus and thus limit subjectivity. The site visit was conducted in August 2007 during conditions of good visibility. A further site visit was conducted in June 2008 at the site of the Alton Downs Water Treatment Plant (WTP).

The survey verified the desktop study, and provided more detailed information about the site and likely impacts.

17.2.1.3 Selection of Representative Viewpoints

Representative publicly accessible viewpoints have been identified in a range of locations. These have been recorded, photographed and included in the appraisal of significance. Photographs of viewpoints within Section 17.6 represent a range of typical views possible from that locality to the project (e.g. Viewpoint one from the Rockhampton Waterskiing and Powerboat Club describes views from the water, recreational grounds and jetty). These viewing situations reflect particular landscape and/or visual features of importance within the visual environment. Generally, they represent views from key visual receptors (residents and road users) where potentially significant changes in view may occur.

17.2.1.4 Description of Existing Conditions

The description of existing landscape and visual environment establishes a baseline situation against which the project has been assessed. This has been based upon a desktop study of relevant published documents and site surveys. The principal data sources used are set out in the bibliography, referenced within relevant sections of the text, and include:

- Survey mapping
- Aerial photographs
- Information from local planning authorities
- Site survey, comprising a photographic record of landscape features, key views and receptors
- Observations on the way in which the public realm (open space, roads etc.) is used.

17.2.2 Impact Assessment

A qualitative assessment of landscape and visual impacts has been undertaken. The effect of the proposal has been evaluated on the basis of a combination of two factors that inform the significance of the impact: *visual modification*; and *visual sensitivity*. Their definitions and use in identifying severity of the impacts are outlined in Sections 17.2.2.1 and 17.2.2.2.

17.2.2.1 Visual Modification

Visual modification refers to the extent of change to the landscape and visual amenity that would occur as a direct result of the project from a given viewpoint. Assessment of these changes includes identification of:

- The nature of the change (i.e. degree of contrast, or integration of, any new features with existing features)
- Context and quality of the views including the extent to which the proposals will be visible in the wider landscape (with consideration of the presence of intervening vegetation or features)
- The scale or degree of change i.e. obvious/imperceptible with respect to loss or addition of features
- The nature of the impact (adverse or beneficial).

For the purposes of this assessment the definitions in Table 17.1 are used to describe visual modification.

Table 17.1 Visual Modification Definitions

Visual Modification Level	Definition
Large Reduction or Improvement	A substantial/obvious change to the view due to total loss of, or change to, elements, features or characteristics of the landscape.
Moderate Reduction or Improvement	Discernible changes in the view due to partial loss of, or change to the elements, features or characteristics of the landscape so that alteration to the view is clearly visible.
Small Reduction or Improvement	Minor changes in the view due to minor loss of, or change to the elements, features or characteristics of the landscape. The proposals are either not visible, or the change in the view is not clearly visible.
No Perceivable Reduction or Improvement	Almost imperceptible or no change in the view as there is little or no loss of/or change to the elements, features or characteristics of the landscape.

17.2.2.2 Visual Sensitivity

Visual sensitivity refers to visual receptors (e.g. residents, users of transport routes) and their sensitivity to their visual environment. Generally, this is dependent upon:

- Receptors' interest in the visual environment (i.e. high, medium or low interest in their everyday visual environment)
- Receptors' duration and viewing opportunity (i.e. prolonged, regular viewing opportunities)
- Number of viewers and their distance from the source of the effect, where relevant.

For the purposes of this assessment, the terminology set out in Table 17.2 has been used to describe visual sensitivity.

Table 17.2 Visual Sensitivity

Sensitivity	Definition
High	Large number of viewers with a passing interest in their surroundings and momentary viewing periods.
Medium	Medium number of viewers with moderate interest in their environment, and/or discontinuous and/or irregular viewing periods. or Small number of viewers with proprietary/high interest in their everyday visual environment and/or with prolonged and regular viewing opportunities.
Low	Small number of viewers with a passing interest in their surroundings and momentary viewing periods.
Neutral	Few viewers with minimal or no interest/ awareness in their environment.

17.2.2.3 Impact Assessment

Representative viewpoints are described qualitatively, with the severity of residual impacts (following mitigation) assessed in accordance with the impact significance criteria applied across this EIS but made specific to this Chapter (described in Table 17.3).

Table 17.3 Impact Significance Criteria for Landscape and Visual Assessment

Impact Significance Level	Description
Major Adverse	Large reduction (modification) in the amenity of a view of high visual sensitivity.
High Adverse	Large reduction (modification) in the amenity of a view of medium visual sensitivity.
Moderate Adverse	Moderate reduction (modification) in the amenity of a view of a medium level visual sensitivity. or Large reduction (modification) in the amenity of a view of a low visual sensitivity.
Minor Adverse	Moderate reduction (modification) in the amenity of a view of low sensitivity. or Small reduction (modification) in the amenity of a view of moderate sensitivity.
Negligible	Small reduction (modification) in the amenity of a view of low sensitivity.

17.3 Assumptions and Limitations

This chapter is based upon the following assumptions:

- As the pipeline component of the project would be primarily located underground, most landscape and visual impacts relate to the visual appearance of the construction works that would be phased, temporary, and restricted to the construction period, and would be either direct or indirect. This type of impact would generally be consistent across the site and are therefore assessed on a site-wide basis.
- The impact of the WTP is based on the detailed design for costing prepared in June 2008.
- Some areas along the pipeline route would be required on a temporary basis to provide storage areas (stockpiles and equipment) to support construction.
- The intake, water treatment plant and pump stations will have some security lighting at night.
- During operation, maintenance and repair works will only occur on small sections of the pipeline at any one time, and will occur predominately during daylight hours.
- Design of the infrastructure is ongoing. Assumptions regarding the design of the intake site, water treatment plant, pump stations, storage areas and associated infrastructure are based on the best available information at the time of reporting, and likely outcomes of good design principles.
- The pipeline corridor will be kept free of trees during operation.

There are also a number of limitations associated with the assessment. These include:

- There is no guidance on the assessment of landscape and visual effects specific to Australia. Therefore, United Kingdom (UK) publications have been referenced where relevant for Landscape and Visual Impact Assessment (LVIA).
- This chapter responds directly to the requirements of the ToR specifically relating to landscape and visual amenity and as such utilises relevant sections of UK LVIA assessment guidelines (Landscape Institute 2002).
- The exact method of construction and range of equipment that will be used is still to be determined. Informed assumptions have been made based on the best available information in order to appraise the impact of the construction works upon landscape resources and visual amenity (see Chapter 2, Project Description).

17.4 Relevant Legislation and Policy

This section outlines the legislation and policy relevant to the project.

17.4.1 Queensland Legislation

Coastal Protection and Management Act 1995 (Qld)

The main objectives of the *Coastal Protection and Management Act 1995* are to:

- Provide for the protection, conservation, rehabilitation and management of the coast, including its resources and biological diversity
- Have regard to the goal, core objectives and guiding principles of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone
- Provide, in conjunction with other legislation, a coordinated and integrated management and administrative framework for the ecologically sustainable development of the coastal zone
- Encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.

Coastal management is to be achieved by coordinated and integrated planning and decision-making, involving, among other things, the following: Coastal Management Plans; Coastal Management Districts; and through use of other legislation. This project falls within the Curtis Coast Coastal Management District, which under the *Coastal Protection and Management Act 1995* requires special controls and management practices.

State Coastal Plan

The State Coastal Plan (EPA and QPWS 2006) describes how the coastal zone will be managed as required by the *Coastal Protection and Management Act 1995*. The State Coastal Plan provides State-wide direction and guidance through policies for coastal management which are detailed under several topic areas. Of relevance to this chapter are coastal landscapes and conserving nature. The State Coastal Plan provides coastal management policy direction and defines how these directions should be implemented by government, industry and the community.

Development Scheme for the Gladstone State Development Area (GSDA)

The GSDA Development Scheme sets out the objectives and guidelines for future land use in the area as well as establishing procedures for assessment of applications. There is no specific policy within the Scheme that relates to the visual impact of development within the GSDA; however, the policy identifies that there are visual amenity benefits from having a dedicated heavy industry estate as opposed to having industry located at various sites throughout the region.

Development Scheme for the Stanwell – Gladstone Infrastructure Corridor (SGIC) State Development Area

A SGIC Development Scheme sets out the objectives and guidelines for future land use in the area as well as establishing procedures for assessment of applications (see Chapter 1, section 1.9). Among the outcomes that are sought to be achieved, the scheme states that infrastructure should not be visually intrusive. It also states a potential solution is that infrastructure should be located underground, with the exception of limited locations where it is either impractical or operationally necessary for the proper functioning of the infrastructure (for example pump station and balance tank locations) (Policy 1 of the Scheme). In this regard, the project is consistent with the Scheme.

Curtis Coast Regional Coastal Management Plan

The Curtis Coast Regional Coastal Management Plan (EPA and QPWS 2005) (Curtis Coastal Plan) is an area requiring special development controls and management practices (s. 4 and schedule 2) and has been developed under the *Coastal Protection and Management Act 1995.* Implementation of the Curtis Coastal Plan is also a key mechanism for achieving the State Coastal Plan's coastal management outcomes, principles and policies. The plan describes how the coastal zone of the Curtis Coast region is to be managed. Key initiatives within the plan developed in response to the key challenges of relevance to this chapter include: identification and protection of significant scenic coastal landscapes in the region; and identification and protection of habitat for significant species.

Rockhampton City Plan

The Rockhampton City Plan (Rockhampton City Council 2005) is a planning scheme prepared under the *Integrated Planning Act 1997* and aims to advance the purpose of the Act. The Rockhampton City Plan states a number of Desired Environmental Outcomes (DEOs) parts of which are of relevance to this study. DEOs considered within this chapter include: DEO 3 Nature Conservation; DEO 4 Environmental Management; DEO 8 Cultural and Urban Heritage; and DEO 14 Open Space and Recreation.

Fitzroy Shire Council Planning Scheme

The Fitzroy Shire Council Planning Scheme (Fitzroy Shire Council 2005) is a planning scheme prepared under the *Integrated Planning Act 1997* and aims to advance the purpose of the Act. The Planning Scheme states a number of DEOs, parts of which are of relevance to this study. DEOs considered within this chapter include Social Elements and Environmental Elements.

Calliope Shire Council Planning Scheme

The Calliope Shire Council Planning Scheme (Calliope Shire Council 2007) is a planning scheme prepared under the *Integrated Planning Act 1997* and aims to advance the purpose of the Act. This Planning Scheme under Part 3 Desired Environmental Outcomes Division 1 Preliminary states that development should not adversely affect the Shire's natural environment. This desired environmental outcome is to be achieved, amongst other means, via the protection, maintenance and enhancement of a number of items of relevance to this study detailed under: Environment and Conservation; Community Development; and Development Patterns and Infrastructure.

17.4.2 Standards and Guidance

There is no guidance on the assessment of landscape and visual effects specific to Australia. However, the industry typically refers to guidance offered by the British Institute of Landscape Architects in the United Kingdom (UK). This assessment has been conducted in response to the ToR and in accordance to the LVIA published by The Landscape Institute and the Institute for Environmental Management and Assessment in the UK.

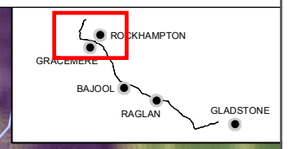
17.5 Baseline (Existing Conditions)

17.5.1 Regional Landscape Character

The project traverses approximately 115 km of landscape between Rockhampton and Gladstone. Creeks dissect the landscape which is primarily rural in character and utilised as an agricultural resource, with a predominance of beef cattle grazing. The topography is generally gently undulating landform of low hills and flat plains, rising to the northeast of the project area to coastal ranges providing a prominent and scenic green backdrop to the project area (see Figure 17.1).

Major urban centres occur at Rockhampton to the north of the project, and Gladstone to the south, with small settlements and individual rural residential properties scattered throughout.

Viewpoint ID	Viewpoint Description
1	Rockhampton Ski Club and Fitzroy River
2	Corner of McNamara and Klaproth Roads
3	Ridgelands Road (west of water treatment plant)
4	Ridgelands Road (at pipeline crossing)
5	Capricorn Highway
6	Meura Road
7	Roope Road and River Road
8	Bajool Port Alma Road
9	Darts Creek Road
10	The Narrows Road
11	Aldoga



Fitzroy River Intake Site
Alton Downs Water Treatment Plant Site (including temporary site office)
GRACEMERE
GRACEMERE LAGOON
FROGMORE LAGOON
RIDGELANDS ROAD
STANWELL WAROULA ROAD
DEEP CREEK ROAD
HARDING ROAD
REID ROAD
NINE MILE ROAD
LION MOUNTAIN ROAD
FAIRY BOWER ROAD
CAPRICORN HIGHWAY
HOPPER ROAD
BOONGARY ROAD
LAKES CREEK ROAD
EMU PARK ROAD
BELMONT ROAD
YAAMBA ROAD
NORMAN ROAD
MOORES CREEK ROAD
THOZET CREEK
LAKES CREEK
RIVER ROAD
FITZROY RIVER
RAMSAY CREEK
LIMESTONE CREEK
DEL ROSARIO ROAD
SOUTH YAAMBA ROAD
O'BRIAN ROAD
MCKENZIE ROAD
WEDER ROAD
WEDEL ROAD
BLACK GIN CREEK
STANWELL WAROULA ROAD
DEEP CREEK
NICHOLSON ROAD
HUNTER ROAD
LAGOON 1
LAGOON 2
NINE MILE ANTON DOWNS ROAD
LION MOUNTAIN ROAD
LION CREEK
MALCHI NINE MILE ROAD
NEWMAN ROAD
SIX MILE ROAD
RIDGELANDS ROAD
NINE MILE ROAD
LION CREEK
GLADSTONE ROAD
FITZROY RIVER
BOWLIN ROAD
GAVIAL CREEK
NANKIN CREEK
GRACEMERE CREEK
NEERKOL CREEK
CAVIAL CREEK
RIVER ROAD
FITZROY RIVER
1
2
3
4
5
6
7

Viewpoints
Elevation Model:
956m AHD
-14m AHD

Gladstone - Fitzroy Pipeline Project

Figure 17.1 - Topography and Visual Viewpoints Assessment of the Project Area

Sheet 1 of 4

The Right of Way
Project Infrastructure
Railway Line
Road Reserve
Waterways
LGA Boundary
SGIC
GSDA

0 2 4 6 8 km

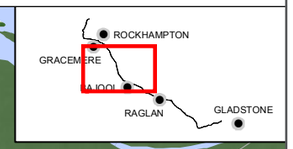
1:100,000 at A3

N

Gladstone Area Water Board

ARUP

Viewpoint ID	Viewpoint Description
1	Rockhampton Ski Club and Fitzroy River
2	Corner of McNamara and Klaproth Roads
3	Ridgelands Road (west of water treatment plant)
4	Ridgelands Road (at pipeline crossing)
5	Capricorn Highway
6	Meura Road
7	Roope Road and River Road
8	Bajool Port Alma Road
9	Darts Creek Road
10	The Narrows Road
11	Aldoga



Viewpoints

Elevation Model:

956m AHD

-14m AHD

Gladstone - Fitzroy Pipeline Project

Figure 17.1 - Topography and Visual Viewpoints Assessment of the Project Area

Sheet 2 of 4

The Right of Way
Project Infrastructure
Railway Line
Road Reserve
Waterways
LGA Boundary
SGIC
GSDA

0 2 4 6 8 km

1:100,000 at A3

N

Gladstone Area Water Board

ARUP

Viewpoint ID	Viewpoint Description
1	Rockhampton Ski Club and Fitzroy River
2	Corner of McNamara and Klaproth Roads
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4	Ridgelands Road (at pipeline crossing)
5	Capricorn Highway
6	Meura Road
7	Roope Road and River Road
8	Bajool Port Alma Road
9	Darts Creek Road
10	The Narrows Road
11	Aldoga

Viewpoints

Elevation Model:

956m AHD

-14m AHD

Gladstone - Fitzroy Pipeline Project

Figure 17.1 - Topography and Visual Viewpoints Assessment of the Project Area

Sheet 3 of 4

The Right of Way
Project Infrastructure
Railway Line
Road Reserve
Waterways
LGA Boundary
SGIC
GSDA

0 2 4 6 8 km

1:100,000 at A3

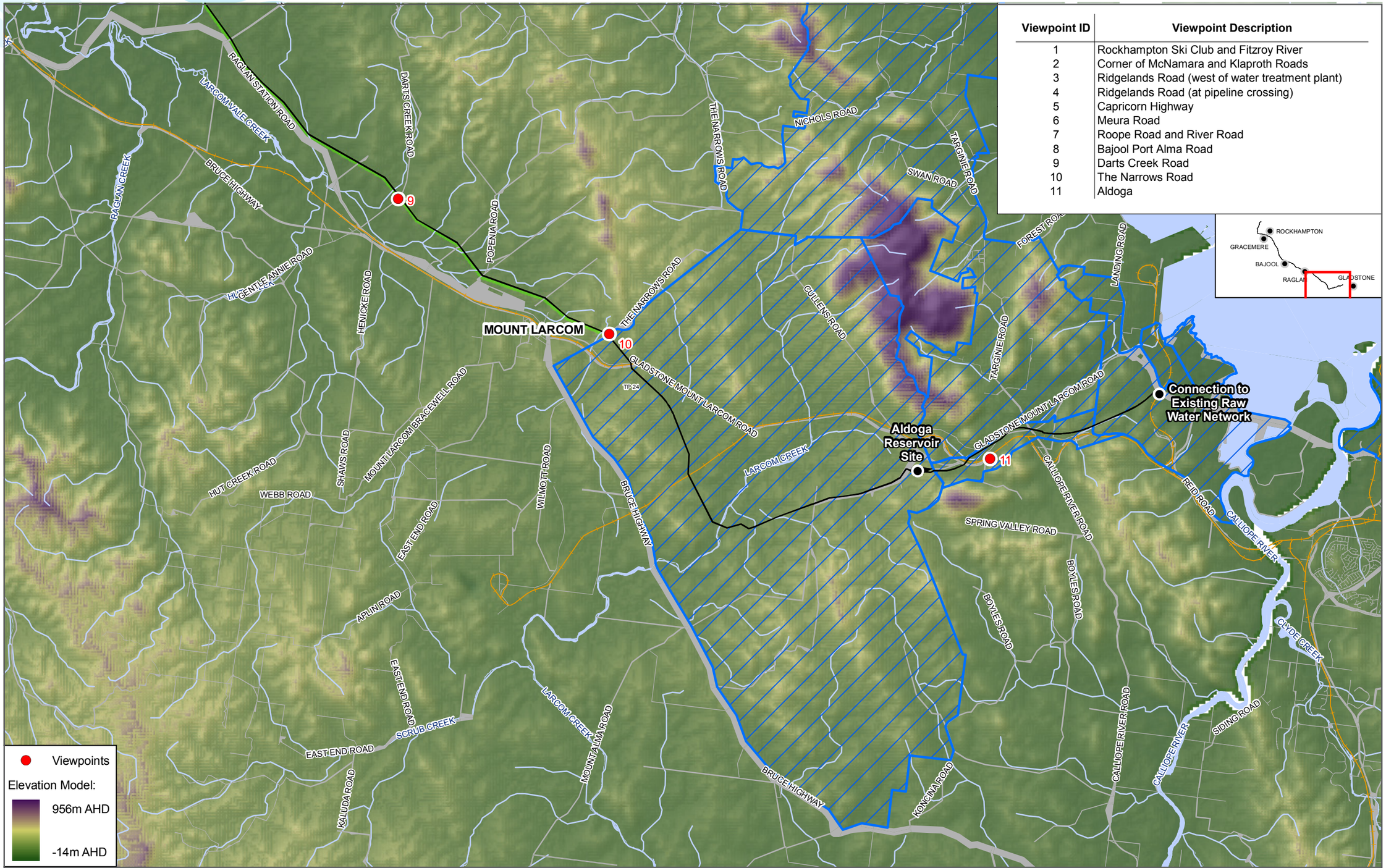
N

Gladstone Area Water Board

ARUP

While every care is taken to ensure the accuracy of this data, the Gladstone Area Water Board (GAWB) makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which might be incurred as a result of the plan being inaccurate or incomplete in any way and for any reason. It should also be noted that final survey of the pipeline alignment and SGIC boundary are yet to occur and may result in changes to the alignments depicted here.

Viewpoint ID	Viewpoint Description
1	Rockhampton Ski Club and Fitzroy River
2	Corner of McNamara and Klaproth Roads
3	Ridgelands Road (west of water treatment plant)
4	Ridgelands Road (at pipeline crossing)
5	Capricorn Highway
6	Meura Road
7	Roope Road and River Road
8	Bajool Port Alma Road
9	Darts Creek Road
10	The Narrows Road
11	Aldoga



Viewpoints

Elevation Model:

956m AHD

-14m AHD

Gladstone - Fitzroy Pipeline Project

Figure 17.1 - Topography and Visual Viewpoints Assessment of the Project Area

Sheet 4 of 4

The Right of Way
Project Infrastructure
Railway Line
Road Reserve
Waterways
LGA Boundary
SGIC
GSDA

0 2 4 6 8 km

1:100,000 at A3

N

Gladstone Area Water Board

ARUP

Grazing land is sparsely vegetated throughout the region, with individual trees, some scrub and grazing fodder. The agricultural weed Parthenium is prevalent across the majority of the project area. Coastal foothills and ranges tend to be densely vegetated with native bushland.

The southern area of the pipeline route falls within the Curtis Coastal Plan from Raglan Creek to Gladstone. It also forms part of the Calliope and Fitzroy River coastal catchments and the GSDA. The Curtis Coastal Plan states that elements of the Curtis Coast landscape have been identified as contributing to the scenic coastal landscape values of the region and are identified as the 'areas of State significance (scenic coastal landscapes)' and include: riverine corridors and creeks; coastal mountain ranges; urban/industrial settings and edges.

The GSDA to the south of the project is composed of major industrial development and associated infrastructure. It is used for urban development, primary industries, mining, heavy and light manufacturing industries, port activities, residential and public facilities, tourism and recreation (EPA and QPWS 2005).

The area from which the various elements of the project are likely to be seen, while not including large numbers of residential areas, is sensitive in parts due to the route's visibility within a predominantly sparse, flat landscape. Visual impacts resulting from the project will be derived primarily from non-pipeline infrastructure (potentially including the WTP, pumping stations, intake point and storage reservoirs) as the pipeline itself will be mainly underground. Construction activities including the clearing of vegetation, earthworks and construction vehicles use and movement are likely to cause the most significant visual intrusion.

17.5.2 Local Landscape Context

17.5.2.1 Fitzroy to Bajool

The project commences at the intake point on the Fitzroy River, approximately 15.5 km upstream of Rockhampton Bridge, northwest of the major urban centre of Rockhampton.

The Fitzroy River is one of Queensland's largest river systems. Its catchment area includes natural assets such as waterways, wetlands, and natural reserves which contribute to local biodiversity, recreational, landscape and scenic quality. The area local to the Fitzroy River forms part of a unique local recreation, landscape and viewing experience. It is characterised by expansive, long views northwest and southeast along the river which are generally framed by riparian vegetation, including native trees and scattered scrub. Aquatic plants line parts of the river margins. The area adjacent to the intake point is the most significant area of recreational land identified within the project area and is associated with leisure facilities comprising of informal open space, a water sports club, a jetty, and walking tracks and well managed naturalistic native planting.

Due to its close proximity to Rockhampton, the area provides an important leisure facility and open space resource for the local community. It is recognised as a key resource within the Fitzroy Planning Scheme and is valued due to its attractive features, distinctiveness and recreational function.

Also within the Rockhampton City limits are the Berserker Ranges and Mt Archer National Park which provide a prominent and scenic green backdrop to the local area.

Small rural settlements occur along and/or adjacent to this section of the route including Alton Downs, Gracemere, Midgee, and Bajool. This region is generally broadacre grazing land, with scattered vegetation on gently undulating topography and rural properties/residences scattered throughout. Creeks (or dry creek beds) lined with riparian vegetation, dams, fences and irregular bush blocks dissect the landscape in parts. A number of minor roads connecting isolated properties and small communities to larger urban centres also cross the landscape. There is also an important rail freight corridor and the Bruce Highway. The gently undulating topography and scattered vegetation provides a variety of framed and/or open views from distant, middle distance and close locations. The vegetation structure, height and form are valuable, contributing to landscape character (local and regional) and sense of place.

17.5.2.2 Bajool to Gladstone

South of Bajool, small settlements along the pipeline route include Marmor, Raglan, Epala, Ambrose, Mt Larcom and Yarwun.

From Bajool to Mt Larcom the landscape is sparsely vegetated, gently undulating, with rural residential properties scattered throughout. The agricultural landscape is divided by creeks/dry creek beds lined with riparian vegetation, dams and irregular bush blocks. Primarily, the agricultural land is broadacre grazing land, with expansive paddock structures. The area is crossed by a number of minor roads connecting isolated properties and small communities to larger urban centres. There is also an important freight rail corridor and the Bruce Highway that traverse the landscape. The gently undulating topography and sparse vegetation provides a variety of framed and/or open views from distant, middle distance and close locations. The vegetation structure, height, form and composition are valuable, as they contribute to the character (local and regional) of the landscape, and to a sense of place.

Surrounding Yarwun, the landform provides a transition between the foothills and steep escarpments of Mt Larcom and the lower lying grazing land to the northwest. Ridge slopes of Mt Larcom give way to dense native bushland, restricting and enclosing views. This change in topography provides a buffer to the broader agricultural landscape from the Gladstone industrial area edge. It aids in increased levels of tranquillity and quiet enjoyment of the landscape and may be a respected resource for the local community.

The project terminates adjacent to Yarwun, northwest of the Gladstone major urban centre, inland of Fisherman's Landing. In this area, large industrial developments become predominant. However, the Gladstone area is identified as a coastal resource with values of coastal landscape, scenic amenity, recreational amenity, habitat for plants and animals.

The Curtis Coastal Plan states that coastal mountain ranges including the landscapes of the Rundle Range and Mt Larcom Range to the northeast contribute to scenic coastal landscape values by providing a prominent and scenic green backdrop to the local (and project) area. Rundle Range and Mt Larcom form State owned land, with Rundle Range also being a National Park and part of the Rundle Range Resources Reserve Management Plan. Mt Larcom is a distinctive focal point in the landscape. Mt Stowe is recognised within the Calliope Planning Scheme as a State Forest. The vegetated escarpments are highly significant in the landscape and form prominent backdrops to all views. Their landform contrast and naturalness are major contributors to scenic quality.

The Curtis Coastal Plan also addresses riverine corridors and creeks. It recognises the landscape values of riverine creeks and corridors from elevated lookouts and from recreational use on the water (e.g. fishing, boating etc.). Creek systems and riparian vegetation cross the coastal plain and provide a visual contrast in an otherwise largely modified rural landscape. These areas often form the visual edge and link to local views (EPA and QPWS 2005).

In addition, the Curtis Coast Plan discusses the value of the urban/industrial setting and edge – "The settings and edges of all coastal towns and major developments are important to the character and identity of the Curtis Coast Region". The edges of the places often have distinct character as seen from approach roads, lookouts and other viewpoints. It states that the city of Gladstone itself is unique as an industrial landscape providing a strong visual contrast to the adjacent natural areas, such as Mt Larcom.

However, it must be noted that the landscape character of the coastline has also been greatly modified through vegetation disturbance for residential and industrial development.

17.5.3 Visual Character of the Project

The majority of viewers will be motorists travelling along roads that cross the proposed pipeline corridor. Other receptors may include residents, rail users, agricultural workers, industrial workers and users of recreational open space.

During operation, the pipeline will generally be an underground linear feature within a largely rural environment. Landform surrounding the project and elevation of structures are the key determinants of visibility of the project. Vegetation, built form and environment have a localised influence. Views of the project will generally be limited to close receptors, and those crossing the pipeline corridor from roads and/or rail. Aboveground elements or processes that will be visible from a limited number of locations will include:

- Intake structure, pump station and associated security fencing and access road
- Water treatment plant and security fencing
- Storage reservoirs
- Valve and valve pits
- Storage facilities and associated infrastructure at Raglan and Aldoga
- The treeless pipeline corridor width – during operations, some of the ROW will be maintained to keep it clear of vegetation and to provide access for maintenance
- Access by maintenance vehicles and workers (vegetation, weed and pest management and repair works) and by deliveries and workers at the WTP
- Replacement planting and any landscape mitigation works (including earthworks).

During construction, areas that will be affected are likely to be viewed from a distance, as prescribed by the gently undulating topography defining the route corridor. However, at Yarwun the steeper topography and dense bushland of the Mt Larcom Ranges will restrict and screen scope of views to the site. The main visual impacts during construction are likely to include:

- Stockpiles (pipe, vegetation, soil)
- Construction vehicles and workers
- Vegetation clearance
- Fencing removal and construction
- Lighting during night time construction activities (if required)
- Additional vehicular traffic generated by construction workers, materials delivery and disposal along adjacent transport routes.

17.6 Assessment of Impacts

The following sections describe the assessment of landscape and visual impacts for the construction and operation of the project.

Due to their short-term duration and similarity of impacts across the project area, construction impacts are assessed for the entire route and are not split into two sections (Fitzroy to Bajool and Bajool to Gladstone) as with the assessment of operational impacts.

Impacts during operation are assessed from individual representative viewpoints.

17.6.1 Construction Phase

The construction of the project would create short-term impacts. These impacts would primarily relate to the visual appearance of the construction works that would be temporary, restricted to the construction period. Some areas would be used on a temporary basis for storage areas to support the construction.

General assumptions (Section 17.3) have been made in order to make a site-wide assessment of the impact of the construction works. Generally during construction the project is likely to impact the same areas as those affected by the operational phase, however construction impacts will be short-term in nature.

17.6.1.1 Visual Modification

Activities that would constitute the greatest intrusion into receptors' views as a result of changes within the landscape during construction would include:

Site clearance works

- Removal of vegetation
- Demolition of existing structures (e.g. structures at road and rail crossings)
- Earthworks

General construction activities

- Temporary traffic management
- Movement of construction machinery and large scale construction equipment
- Presence of construction workers
- Presence of equipment storage compounds
- Presence of hoarding and protective fencing
- Presence of temporary signage
- Excavations; earthworks
- Site preparation
- Construction of the pipeline
- Construction and fit out of concrete structures and reservoirs
- Soil stripping
- Installation of new pipeline infrastructure and landscaping elements
- The presence of major and minor site facilities
- Temporary offices and washrooms
- Laydown areas
- Pipe stockpiles and associated hard standing

Off-route impacts on landscape may also arise from physical changes to surrounding road network utilised during construction (e.g. traffic calming measures, road upgrades). Additional vehicles using these roads could potentially have a visual impact to normal users, including:

- Vehicles moving materials to/from site, and between construction sites
- Workers travelling to/from work, and moving between different areas of the site.

Impacts to traffic in the project area are assessed in Chapter 13, Transport and Access Arrangements.

The prominence of the site wide construction works and loss of some landscape ele ments suggests that there would be a Moderate Reduction in visual amenity during this phase.

17.6.1.2 Visual Sensitivity

The construction site will generally be experienced by a range of viewers including:

- Small numbers of residents with a high interest in their visual environment
- Large numbers of motorists with a passing interest in their visual environment
- Small numbers of outdoor workers (including farmers and maintenance workers) with a moderate interest in their environment
- Small numbers of recreation-site or activity-focused users (i.e. fishing, nature conservation, water-based activities, social clubs) with a high interest in their visual environment.

Although the site is not of particularly high scenic quality, the variety and number of people experiencing it suggests that it contains views of medium sensitivity.

17.6.1.3 Significance of Impact

The significance of the landscape and visual impact during construction and without mitigation measures has therefore been assessed as moderate adverse in accordance with the significance criteria in Table 17.3.

17.6.2 Operational Phase – Fitzroy to Bajool

Impacts are described below in terms of an assessment of each of the identified representative viewpoints. The process of selecting representative viewpoints is described in Section 17.2.1.3. The location of the viewpoints is shown in Figure 17.1.

17.6.2.1 Viewpoint - 1 Rockhampton Ski Club and Fitzroy River

Location	Photo direction northwest along Fitzroy River approximately 300 m upstream from the intake point at the Rockhampton Water Ski and Power Boat Club approximately 15.5 km upstream from Rockhampton Bridge. GIS coordinates Lat –23.297045 Long 150.438516.
Modification	This view is of an attractive, semi-natural landscape with distinctive landscape elements that contribute to high degrees of amenity and tranquillity. The nature of this view is unique to the local and regional area, and is characterised by expansive, long views northwest and southeast along the river. Views are generally framed by riparian vegetation (approximately 15 m buffer zone to the river) including native trees and scattered scrub. Aquatic plants line parts of the river margins. This view has a strong sense of place as a managed, green recreational 'oasis' within a surrounding sparsely vegetated, dry, flat landscape. The scenic amenity forms part of the recreational experience as the Fitzroy River and adjacent open space is used for outdoor recreational pursuits (boating, water skiing, fishing, picnics etc.). The project will not be a prominent feature in this view, but will cause localised change to the existing landscape. Project elements would be visible within the landscape, but would be seen within the context of the existing SunWater pump station. The intake and pump station will consist of a combined single structure located in the river bank, with a separate plant room adjacent to the existing SunWater pump station and at the same level. Although the intake point is submerged, associated pipeline infrastructure (pipe, pumping station, etc.) are likely to be visible from the water and from the bank opposite. The ultimate form, material and colour of the infrastructure would play some role in determining its influence on visual amenity. Vegetation removal would also constitute an obvious change in view. The project would cause change through minor loss of landscape elements (trees), inclusion of infrastructure and maintenance activities. However, there is scope for mitigation, in the short- to medium-term It is anticipated that the project would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is experienced by: • Small number of residents with a high interest in their visual environment and prolonged viewing opportunities. However, and views that do occur would be filtered through scattered vegetation and are located approximately 150–200 m in distance away from the pipeline, intake point and pump station • Small numbers of recreational users both on the water and within recreation facilities at the ski club with a high interest in their visual environment on a regular basis • Small numbers of outdoor workers (maintenance workers, gardening) with a medium interest in their visual environment on a regular basis. This view is of locally high scenic quality, and although a small number of people experience it, it is for prolonged periods, and is rare in the local and regional area suggesting that this is a view of minor sensitivity.
Significance of Impact	Minor adverse

17.6.2.2 Viewpoint 2 - Corner of McNamara and Klaproth Roads

Photographic simulation of the view to the proposed water treatment plant

Location	View southeast to the proposed water treatment plant from near the corner of Corner of McNamara and Klaproth Roads. GIS coordinates -23.309226° Long 150.410268°.
Modification	This view is of flat grazing country with scattered trees, rural residences and other rural structures such as sheds and fences. The corridor of semi-mature and mature Eucalypts along Ridgelands Road provides an immediate backdrop, while the Berserker Range to the east of Rockhampton forms much of the horizon and adds to the overall variety and quality of the view. The water treatment plant would be approximately 1 km from this viewpoint. It would be prominent in the view because of its scale and the openness of the landscape. Most components of the water treatment plant would be clearly visible, including the control building, clarifier, sludge dewatering building, sludge balance tanks, and reservoir. Other features such as fencing and parked vehicles are not likely to be prominent because of the distance from the viewpoint. It is not anticipated that the pipeline would create a discernable change in the view from this location, other than the removal of several trees on the side of Ridgelands Road. There are opportunities to integrate the plant into the landscape to some degree with strategic planting. Planting of native tree species, once mature would potentially screen a large proportion of the visible elements of the water treatment plant. The ultimate choice of materials and colour for each structure would play some role in determining its influence on visual amenity. Darker, less reflective tones would be more likely to recede into the landscape. It is anticipated that the project would result in a moderate reduction in visual amenity from this viewpoint.
Sensitivity	This view is experienced by residences of several rural properties on McNamara and Klaproth Roads. It could be expected that these residents place a high value on their rural outlook. It is also experienced for short durations by vehicle users travelling on these two roads. The vehicle users are predominantly residents of rural properties to the north. Although a small number of people experience this view, the presence of residential views and the associated importance placed on the view suggests that this viewpoint is of medium sensitivity.
Significance of Impact	Moderate Adverse

17.6.2.3 Viewpoint 3 - Ridgelands Road (west of WTP)

Photographic simulation of proposed water treatment plant

Location	View east to the proposed water treatment plant from Ridgelands Road. GIS coordinates -23.312482° Long 150.407546°.
Modification	This view is from Ridgeland Road heading east. It is dominated by the informal avenue of semi-mature and mature native trees that have established within the road reserve. It also includes expanses of flat grazing country with scattered trees and rural structures such as sheds and fences. The view is backdropped by the Berserker Ranges which adds to the overall variety and quality of the view. The WTP would be approximately 1 km from this viewpoint. Despite its scale, the plant would be partially screened by foreground trees. This view represents one of the more likely locations on Ridgelands Road from where the plant would be able to be clearly seen. For the most part closer views on Ridgelands Road are subject to greater levels of screening from the roadside vegetation. It is not anticipated that the pipeline would create a discernible change in the view from this location. The removal of trees at the Ridgelands Road crossing point would be obscured by intervening roadside vegetation. There are opportunities to integrate the plant into the landscape to some degree with strategic planting. Planting of native tree species, once mature would potentially screen the water treatment plant to the point where it would be difficult to discern from this viewpoint for viewers that were not specifically focusing on the plant. The ultimate choice of materials and colour for each structure would play some role in determining its influence on visual amenity. Darker, less reflective tones would be more likely to recede into the landscape. It is anticipated that the project would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is primarily experienced by a moderate number of road users with a passing interest in their visual environment. This moderate numbers and short duration of views suggests that this is a view of low sensitivity.
Significance of Impact	Negligible

17.6.2.4 Viewpoint 4 - Ridgelands Road (at pipeline crossing)

Location	View east on Ridgelands Road pipeline intersection. GIS coordinates Lat –23.320563 Long 150.418904.
Modification	This view is of flat to gently undulating agricultural grazing country with scattered trees, rows of trees along fence lines and road sides, and bushland blocks. The landscape is intersected by minor gravel roads, main roads and fence lines. Occasional houses and sheds are scattered throughout. The nature of this view is unique to the local and regional area, and is characterised by expansive, open views across the landscape with some topographical features (Berserker Ranges/Mt Archer National Park) in the distance. The pipeline will not be a prominent feature in this view, as it will be underground. The project would impact upon the composition of this view through permanent loss of trees within the route corridor, and through implementation of a linear maintenance route. Infrequent movement along this route by maintenance vehicles and worker access would form a visual modification. There would be an overall local reduction in the quantity of trees, grassland and dense scrub within the pipeline corridor as a result of the project. Grass would naturally regenerate to earthworks areas over time. It is anticipated that the project in this location would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is primarily experienced by a moderate number of road users with a passing interest in their visual environment. This moderate numbers and short duration of views suggests that this is a view of low sensitivity.
Significance of Impact	Negligible

17.6.2.5 Viewpoint 5 - Capricorn Highway

Location	View northeast on the Capricorn Highway pipeline intersection. GIS coordinates Lat –23.410513 Long 150.478942.
Modification	This view is of flat to gently undulating agricultural grazing country with scattered trees, rows of trees along fence lines and road sides, and bushland blocks. The landscape is intersected by minor gravel roads, main roads and fence lines. Occasional houses and sheds are scattered throughout. The nature of this view is unique to the local and regional area, and is characterised by expansive, open views across the landscape with some topographical features (Berserker Ranges/Mt Archer coastal ranges) in the distance. The pipeline will not be a prominent feature in this view, as it will be underground. The project would impact upon the composition of this view through permanent loss of trees within the pipeline corridor, and through implementation of a linear maintenance route. Infrequent movement along this route by maintenance vehicles and worker access would form a visual modification. There would be an overall local reduction in the quantity of trees, grassland and dense scrub within the pipeline corridor as a result of the project. Grass would naturally regenerate to earthworks areas over time. It is anticipated that the project would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is experienced by: • Large number of road users with a passing interest in their visual environment • Small numbers of outdoor workers (farmers, maintenance workers) with a medium interest in their visual environment on a regular basis. The interest and distance from the pipeline of the viewers, and the project's nature from this viewpoint within the landscape suggests that this is a view of medium sensitivity.
Significance of Impact	Minor adverse

17.6.2.6 Viewpoint 6 - Meura Road

Location	View north along Meura Road easement to pipeline intersection. GIS coordinates Lat –23.437614 Long 150.523167.
Modification	This view comprises flat to gently undulating agricultural grazing, low scattered scrub and tussocks. The landscape is intersected by minor gravel roads and fence lines. Occasional houses and sheds are scattered throughout. The nature of this view is unique to the local area, and is characterised by filtered views through open bushland. In this location, views are restricted by vegetative cover. The pipeline will not be a prominent feature in this view, as it will be underground. The project would impact upon the composition of this view through permanent loss of trees from the bushland within the pipeline corridor, and through implementation of a linear maintenance route. Infrequent movement along this route by maintenance vehicles and worker access would form a visual modification. There would be an overall local reduction in the quantity of trees, grassland and dense scrub within the pipeline corridor as a result of the project. Grass would naturally regenerate to earthworks areas over time. It is anticipated that the project in this location would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is experienced by: • Small numbers of residents with a high interest in their visual environment and prolonged viewing opportunities. However, views would be heavily filtered through vegetation and approximately 350 m in distance away from the pipeline route • Small numbers of road users with a passing interest in their visual environment • Small numbers of outdoor workers (farmers, maintenance workers) with a medium interest in their visual environment on a regular basis. The interest, distance and filtered views of the pipeline from this viewpoint, and the project's nature within the landscape suggests that this is a view of low sensitivity.
Significance of Impact	Negligible

17.6.2.7 Viewpoint 7 - Roope Road and River Road

Location	View north along Roope Road (at intersection of River Road) and pipeline intersection. GIS coordinates Lat –23.456068 Long 150.537543.
Modification	This view comprises flat to gently undulating agricultural grazing land, scattered trees, low scattered scrub and tussocks. The landscape is intersected by minor roads and fence lines. Occasional houses and sheds are scattered throughout. The nature of this view is unique to the local area, and is characterised by filtered views across grazing land through scattered trees and bushland blocks. Distant topographical features (Berserker Ranges/Mt Archer coastal ranges) form a backdrop to the view. The pipeline will not be a prominent feature in this view, as it will be underground. The project would impact upon the composition of this view through permanent loss of trees from the bushland and scattered trees within the pipeline corridor, and through implementation of a linear maintenance route. Infrequent movement along this route by maintenance vehicles and worker access would form a visual modification. There would be an overall local reduction in the quantity of trees, grassland and dense scrub within the pipeline corridor as a result of the project. Grass would naturally regenerate to earthworks areas over time. It is anticipated that the project in this location would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is experienced by: • Small numbers of residents with a high interest in their visual environment and prolonged viewing opportunities. However, views would be filtered through vegetation and range from approximately 400 m distance away from the pipeline route • Small numbers of road users with a passing interest in their visual environment • Small numbers of outdoor workers (farmers, maintenance workers) with a medium interest in their visual environment on a regular basis. The interest, distance and filtered views of the pipeline from this viewpoint, and the project's nature within the landscape suggests that this is a view of low sensitivity.
Significance of Impact	Negligible

17.6.3 Operational Phase – Bajool to Gladstone

17.6.3.1 Viewpoint 8 - Bajool Port Alma Road

Location	View south along Bajool Port Alma Road to pipeline intersection. GIS coordinates Lat –23.640647 Long 150.696287.
Modification	This view comprises flat to gently undulating agricultural grazing, low scattered scrub and tussocks. The landscape is intersected by minor roads, rows of trees along road edges and fence lines. Occasional houses and sheds are scattered throughout, with a steel works adjacent to the pipeline route. The nature of this view is unique to the local area, and is characterised by open views across grazing land. The pipeline will not be a prominent feature in this view, as it will be underground. The project would impact upon the composition of this view through permanent loss of trees from the road side within the pipeline corridor, and through implementation of a linear maintenance route. Infrequent movement along this route by maintenance vehicles and worker access would form a visual modification. There would be an overall local reduction in the quantity of trees, grassland and dense scrub within the pipeline corridor as a result of the project. Grass would naturally regenerate to earthworks areas over time. It is anticipated that the project would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is experienced by: • Small numbers of residents with a high interest in their visual environment and prolonged viewing opportunities. However, views would be filtered through scattered vegetation. The closest residence is approximately 500 m in distance away from the pipeline route • Small numbers of road users with a passing interest in their visual environment • Small numbers of outdoor workers (farmers, maintenance workers) with a medium interest in their visual environment on a regular basis. The interest, distance and filtered views of the pipeline from this viewpoint, and the project's nature within the landscape suggests that this is a view of low sensitivity.
Significance of Impact	Negligible

17.6.3.2 Viewpoint 9 - Darts Creek Road

Location	View northeast along Darts Creek Road to pipeline route intersection. GIS coordinates Lat –23.775616 Long 150.939982.
Modification	This view comprises flat to gently undulating bushland, low scrub and tussocks with some areas cleared for agricultural grazing land. The landscape is intersected by minor roads, rows of trees along road edges and fence lines. A small residential subdivision exists to the northeast of the pipeline route. This view would be seen within the context of an existing easement along which the pipeline route will follow that is already clear of vegetation. The nature of this view is unique to the local area, and is characterised by views filtered and enclosed by vegetation. The pipeline will not be a prominent feature in this view, as it will be underground. The project would impact upon the composition of this view through permanent loss of trees from the road side, bushland, and from within the pipeline corridor, and through implementation of a linear maintenance route. Infrequent movement along this route by maintenance vehicles and worker access would form a visual modification. Natural vegetation regeneration may be encouraged locally along the pipeline corridor margins to screen adjacent residents. Initially, regeneration would be immature. However, over time planting would mature, and vegetation would re-establish (including self-seeded growth) aiding in screening of the project from residents. However, there would still be an overall local reduction in the quantity of trees, grassland and dense scrub within the pipeline corridor as a result of the project. It is anticipated that the project in this location would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is experienced by: • Small numbers of residents with a high interest in their visual environment and prolonged viewing opportunities. However, views would be filtered through vegetation. One residence is located approximately 100 m from the route, with others 250 m or greater distance away • Small numbers of road users with a passing interest in their visual environment • Small numbers of outdoor workers (farmers, maintenance workers) with a medium interest in their visual environment on a regular basis. The interest, distance and filtered views of the pipeline from this viewpoint, and the project's nature within the landscape suggests that this is a view of medium sensitivity.
Significance of Impact	Minor adverse

17.6.3.3 Viewpoint 10 - The Narrows Road

Location	View southwest along The Narrows Road to pipeline intersection. GIS coordinates Lat –23.812308 Long 151.000514.
Modification	This view comprises undulating bushland, low scrub and tussocks and is unique to the local area character. In parts, areas have been cleared for agricultural grazing land. A billabong in the valley floor is directly north of the route. The landscape is intersected by minor gravel roads, bushland, rows of trees along road edges and fence lines. The nature of this view is unique to the local area, and is characterised by views filtered and enclosed by vegetation. The pipeline will not be a prominent feature in this view, as it will be underground. The project would impact upon the composition of this view through permanent loss of trees from the road side, bushland, and from within the pipeline corridor, and through implementation of a linear maintenance route. Infrequent movement along this route by maintenance vehicles and worker access would form a visual modification. Natural vegetation regeneration may be encouraged locally along the pipeline corridor margins to screen adjacent residents and maintain the local landscape character. Initially, regeneration would be immature. However, over time planting would mature, and vegetation would re-establish (including self-seeded growth) aiding in screening of the project from residents. However, there would still be an overall local reduction in the quantity of trees, grassland and dense scrub within the pipeline corridor as a result of the project. It is anticipated that the project in this location would result in a small reduction in visual amenity from this viewpoint.
Sensitivity	This view is experienced by: • Small numbers of residents on hilltops with clear views southwest over the route with a high interest in their visual environment and prolonged viewing opportunities. However, views would be filtered vegetation and local undulating topography. One residence is located approximately 150 m from the route, with others 300 m, or greater, distance away • Small numbers of road users with a passing interest in their visual environment • Small numbers of outdoor workers (farmers, maintenance workers) with a medium interest in their visual environment on a regular basis. The interest, distance and filtered views of the pipeline from this viewpoint, and the project's nature within the landscape suggests that this is a view of medium sensitivity.
Significance of Impact	Minor adverse

17.6.3.4 Viewpoint 11 - Aldoga

Location	View northeast across proposed Aldoga Reservoir. GIS coordinates Lat –23.846962 Long 151.110313.
Modification	This view comprises undulating to steep slopes covered with bushland, low scrub and tussocks. A large quarry site is adjacent. The landscape is intersected by major roads, railways, above ground pipelines, overhead power lines and fence lines. The nature of this view is unique to the local area, on the industrial outskirts of Gladstone and is characterised by views filtered and enclosed by vegetation and topography. The storage facility and associated infrastructure will form a prominent component of this view due to its hill top location. It will cause localised change due to: the removal of trees and vegetation; new site access; earthworks; and inclusion of new infrastructure (it is expected that the detailed design for construction shall be two circular shaped structures, approximately 90 m diameter.). The project in this location would be seen within the context of the existing industrial facilities in close proximity to the site and large infrastructure (road, rail, etc.). The ultimate form, material, colour and layout of the proposed infrastructure would play some role in determining its influence on visual amenity. There is some scope for mitigation through orientation, form, location and various forms of screening (vegetation/earthworks), but the proposal cannot be completely mitigated for because of its nature and location within the landscape. It is anticipated that this part of the project would be seen within the existing context of an industrial zone, but due to its hill top location would result in a moderate reduction in visual amenity.
Sensitivity	This view is experienced by: • Small numbers of road users with a passing interest in their visual environment • Small numbers of outdoor workers (quarry workers, maintenance workers) with a low interest in their visual environment on a regular basis. The interest and filtered/enclosed views of the storage facility from this viewpoint, and that the project would be viewed within the context of an existing industrial environment suggests that this view is of low sensitivity.
Significance of Impact	Minor adverse

17.7 Mitigation

17.7.1 General

The pipeline will be buried for the majority of its length. Generally, the project will have a minor impact upon landscape character and visual amenity altering parts of the local environment. Impacts vary according to local context, and construction and operational phases. The aim of this section is to highlight project wide, general mitigation measures that would reduce and/or manage adverse impacts of construction work and operation upon landscape and visual amenity.

Specific measures for key areas, including the WTP, Raglan Pump Station and Reservoir and the Aldoga Reservoir will be considered once detailed design for construction is completed and are likely to include the measures outlined below for the construction and operational phases. Any mitigation measures for the WTP would be discussed with the landowner and adjacent landowners and may include:

- Screening of the site with vegetation
- Design of the WTP to sit within existing topography
- Use of appropriate colours and finishings to minimise the visual impact.

17.7.2 Construction Phase

The construction of the pipeline would create short-term impacts. These impacts would primarily relate to the visual appearance of the construction works that would be phased, temporary, and restricted to the construction period. Some areas along the project (and within the project boundary) would be required on a temporary basis to provide compounds and storage areas to support the construction.

Specific objectives and methodologies for mitigation during construction will be further developed within the construction strategy and Environmental Management Plan (EMP) developed prior to construction. Mitigation measures are also proposed in Chapter 20, Planning Environmental Management Plan which forms the precursor to the Construction EMP.

For the purpose of this chapter, general assumptions (Section 17.3) have been made in order to appraise the impact of the construction works upon landscape resources and visual amenity. Essentially, the construction of the project would impact upon the same areas as those affected by the operational phase of the project. However the landscape and visual impacts from construction activities are likely to be similar across the project and occur on a temporary basis.

For the purposes of this assessment, construction phase mitigation strategies will include:

- Existing trees and vegetation to the pipeline corridor margins, or trees identified as important to retain, would be protected prior to construction
- Vegetation clearance at sensitive sites would be minimised
- Temporary hoardings, barriers, traffic management and signage would be removed when no longer required
- Work on site would be restricted to agreed working hours
- Lighting of compounds and works sites would be restricted to low impact lighting for security purposes, where and when required
- Storage facilities would be located away from residential areas
- Materials and machinery would be stored tidily during the works, and where possible behind solid hoardings
- Roads providing access to site compounds and works areas would be maintained free of dust and mud as far as reasonably practicable
- Upon completion of construction, all construction materials would be removed to a suitable location.

17.7.3 Operational Phase

Mitigation of landscape and visual impacts as a result of the project would strive to achieve a balance between all other design disciplines including engineering, ecology, hydrology/ hydrogeology and noise to achieve an optimum design outcome. The mitigation strategy for this project would primarily focus on screening the various elements from view, and designing the pipeline components in a way that minimises detrimental effects on visual amenity. Measures will include:

- The design of above ground structures (i.e. WTP, Aldoga Reservoir) to be considered to achieve the best fit with the existing contours, vegetation and earthworks features (mounding) to assist in screening and integration
- Optimise visual protection of residential properties and rural settlements
- Seek to achieve a cut and fill balance of material on site, with reuse of excess material on site as part of the landscape mitigation proposals where appropriate
- Avoid loss or damage to landscape features, including minimisation of the width of vegetation clearance in bushland areas. Where possible, trim trees to avoid total removal, particularly in environmentally sensitive areas and at creek crossings
- Screen planting and encouragement of natural regeneration around the pipeline corridor, particularly where structures are above ground and where the pipeline corridor is in close proximity to residences
- Screen planting and/or encouragement of natural vegetation regeneration at key locations outside the pipeline corridor, particularly where the alignment is in close proximity to residences and trees have been removed for construction (i.e. Viewpoint 8 and Viewpoint 9 described in Section 17.6.3)
- Careful consideration of the form and finish of structures, including minimisation of the bulk of the WTP and supply structures, including use of darker colours for the structures and less reflective materials
- Consideration of the appearance of other features such as signs and fencing
- Careful consideration of any lighting requirements and any potential increase in light pollution.

17.8 Residual Impacts

17.8.1 General

Some impacts resulting from the project are unavoidable and cannot be mitigated. The project would alter the surrounding landscape and the visual experience of receptors. However, these changes would be seen within the context of the existing local environment. Foremost amongst residual impacts is the addition of non-pipeline infrastructure (intake point, WTP, pumping stations, storage facilities), permanent removal of trees along the pipeline corridor, and new planting primarily impacting upon visual amenity.

This assessment of residual impacts assumes that mitigation measures described in the section above would be implemented. Impacts are outlined in Section 17.8.2 and 17.8.3, with significance of residual impacts at specific viewpoints outlined within Table 17.4 and Table 17.5.

17.8.2 Construction Phase

With the implementation of suitable mitigation measures as described in Section 17.7, the construction of the proposed development is considered to have a low environmental risk with regard to landscape and visual effects. However, although the significance of impacts would be reduced, they would still occur and elements that would still be visible include:

- Tree and vegetation removal
- Temporary hoardings, barriers, traffic management and signage
- Onsite works and workers, stored facilities, materials, and machinery
- Mud and dust resulting from works
- Spoil and construction materials storage.

Contractors would be required to 'make good' all work sites prior to/at the end of the construction period. The extent of landscape and visual impacts arising from 'making good' would be dependent upon the level of disturbance required for construction of the project.

In terms of the significance criteria described in Section 17.2.2, residual landscape and visual impacts arising from the construction phase have been assessed as negligible to minor adverse.

17.8.3 Operational Phase

Initially, the new pipeline elements, access roads and landscaping at key sites (WTP and Aldoga Reservoir) would have an impact upon the viewing experience of visual receptors. The visual amenity of the area would be, in parts, affected by the project intruding into views. As the pipeline itself will be largely underground the visual impact of this aspect of the project will be limited to the loss of vegetation in the ROW. Residential receptors near the WTP site would experience the most significant changes due to their respective viewing opportunities and proximity to the project. The change in view would be permanent and initially prominent, but would become less dominant over time as the project would become part of the existing view as vegetation naturally regenerates, or screening matures. In terms of the significance criteria this equates to a minor adverse to negligible impact, with the exception of the WTP which, based on the current understanding of its design, may have a moderate adverse impact even after mitigation.

17.9 Cumulative and Interactive Impacts

There is potential for cumulative effects, with regard operational effects. It is known that there may be other pipeline projects implemented within the same corridor as this project. However, operationally, this is not likely to be significant (depending on the number of vehicle movements anticipated during operation along the corridor, the width of clearance, and earthworks required). It is also known that there are no significant aboveground structures proposed by other projects (in planning at present) within the project area, except for the Powerlink-proposed high voltage powerlines in the Alton Downs area. As far as reasonable, the pipeline and other infrastructure has been located in the vicinity of this infrastructure. Significant adverse effects may be avoided through the implementation of mitigation measures as outlined in Section 17.7.

17.10 Summary and Conclusions

The construction effects of the project on landscape and visual amenity will primarily be related to site clearance and general construction activities that would occur during the limited duration of the construction activities. These will be controlled through mitigation measures set out within the Construction EMP to ensure that most adverse effects resulting from the construction of the project on landscape and visual amenity are minimised or avoided.

The landscape and visual impacts once the project becomes operational are generally likely to be minor, with the exception of the WTP. This is considered to have a moderate impact. Mitigation measures in relation to operation are proposed in order to minimise these impacts, as set out above, and would be further detailed following the completion of detailed design for construction.

Table 17.4 Summary of Impacts – Construction Phase

EIS Area: Landscape and Visual Impact Feature/Description/ Viewpoint	**Current value + Substitutable Y:N**	**Description of Impact**		
		Description in Words	Mitigation Inherent in Design/Standard Practice Amelioration Who?/Why?/Scale?	Residual Impact using Significance Criteria
All Viewpoints (site-wide)	Locally and regionally valued views with capacity to accept some change.	Site clearance and general construction activities.	Retain and protect vegetation; hoardings; restricted work hours; tidy storage; dust free access routes; removal of spoil and construction materials upon completion; compounds off-site.	Minor, –ve, D, T, ST

Table 17.5 Summary of Impacts – Operational Phase

EIS Area: Landscape and Visual Impact Feature/Description/ Viewpoint	Current Value + Substitutable Y:N	Description of Impact		
		Description in Words	Mitigation Inherent in Design/Standard Practice Amelioration Who?/Why?/Scale?	Residual Impact using Significance Criteria
1. Rockhampton Ski Club	Regionally and locally valued. In parts substitutable.	Clearing of vegetation and introduction of built elements into the landscape.	Avoid significant vegetation; screen planting; built form to sit within existing topography; built element designed to reduce visibility within landscape.	Minor; –ve; D; P; LT.
2. Corner of McNamara and Klaproth Roads	Locally valued with capacity for the landscape to accept limited change.	Introduction of built elements and associated infrastructure into open landscape. Minor clearing of vegetation and earth works. Movement of workers.	Screening; built form to sit within existing topography; built elements form and design to reduce visibility within landscape.	Moderate; –ve; D; P; LT.
3. Ridgelands Road (west of WTP)	Locally valued with capacity for the landscape to accept limited change.	Introduction of built elements and associated infrastructure into landscape. Partial screening by existing vegetation. Minor clearing of vegetation and earth works. Movement of workers.	Screening; built form to sit within existing topography; built elements form and design to reduce visibility within landscape.	Minor; –ve; D; P; LT.
4. Ridgelands Road (at pipeline crossing point)	Locally valued with capacity for the landscape to accept some change.	Clearing of vegetation. New access road and movement of vehicles and workers.	Encourage natural regeneration of grass and vegetation to pipeline corridor margin.	Negligible
5. Capricorn Highway	Locally valued with capacity for the landscape to accept some change.	Clearing of vegetation. New access road and movement of vehicles and workers.	Encourage natural regeneration of grass and vegetation to pipeline corridor margin.	Negligible
6. Meura Road	Locally valued with capacity for the landscape to accept some change.	Clearing of vegetation. New access road and movement of vehicles and workers.	Encourage natural regeneration of grass and vegetation to pipeline corridor margin.	Negligible
7. Roope Road	Locally valued with capacity for the landscape to accept some change.	Clearing of vegetation. New access road and movement of vehicles and workers.	Encourage natural regeneration of grass and vegetation to pipeline corridor margin.	Negligible
8. Bajool Port Alma Road	Locally valued with capacity for the landscape to accept some change.	Clearing of vegetation. New access road and movement of vehicles and workers.	Encourage natural regeneration of grass and vegetation to pipeline corridor margin.	Negligible

EIS Area: Landscape and Visual Impact Feature/Description/ Viewpoint	Current Value + Substitutable Y:N	Description of Impact		
		Description in Words	Mitigation Inherent in Design/Standard Practice Amelioration Who?/Why?/Scale?	Residual Impact using Significance Criteria
9. Darts Creek Road	Locally valued with capacity for the landscape to accept some change.	Clearing of vegetation. New access road and movement of vehicles and workers.	Encourage natural regeneration of grass within corridor, and vegetation and trees adjacent to corridor to form a screen to properties.	Minor; –ve; D; P; LT.
10. The Narrows Road	Locally valued with capacity for the landscape to accept some change.	Clearing of vegetation. New access road and movement of vehicles and workers.	Encourage natural regeneration of grass within corridor, and vegetation and trees adjacent to corridor to form a screen to properties and maintain local character.	Minor; –ve; D; P; LT.
11. Aldoga Reservoir	Locally valued with capacity for the landscape to accept some change.	Introduction of built elements and associated infrastructure into the landscape. Minor clearing of vegetation and earth works. Movement of workers.	Reduce visual intrusion through; vegetation screening and earthworks; sensitive built form to sit within existing topography; built elements form and design to reduce visibility within landscape.	Minor; –ve; D; P; LT.

KEY:
Significance criteria: Major, High, Moderate, Minor, Negligible
+ve = positive; –ve = negative impacts
D = direct; I = indirect
C = cumulative; P = permanent; T = temporary
ST = short-term; MT = medium-term; LT = long-term

Relative Duration of Environmental Effects

Temporary:	Up to one year
Short-term:	From one to seven years
Medium-term:	From seven to 20 years
Long-term:	From 20 to 50 years
Permanent:	Period in excess of 50 years

17.11 References

Calliope Shire Council, 2007. Calliope Shire Planning Scheme 2007, Calliope Shire Council, 27 April 2007

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Landscape Institute, 2002. Guidance for Landscape and Visual Impact Assessment (GLVIA) published by The Landscape Institute and the Institute for Environmental Management and Assessment, Spon Press.

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CHAPTER 18

GLADSTONE – FITZROY

PIPELINE PROJECT

Environmental Impact Statement

Summary of Impacts and Cumulative Effects

Gladstone Area Water Board

Contents

Gladstone Area Water Board

18. Summary of impacts and cumulative effects

18.1 Introduction

Each chapter of the EIS contains a summary of the impacts relevant to that subject area. That summary information is not repeated here, however high level summary and conclusions are provided in relation to the impacts of the project.

This chapter also provides a summary of the likely cumulative effects that could occur as a consequence of the project in conjunction with the development of other proposals that are currently under study and any interactive effects that may occur as a result of the interrelationship of impacts.

18.2 Summary of impacts

Throughout the site selection and design processes for the project, attention has been paid to the minimisation of adverse effects on the environment and communities during construction and operation of the project. For example, the alignment of the pipeline and siting of infrastructure has taken into account sensitive environmental sites such as Yellow Chat habitat and remnant vegetation, and has avoided residential areas where possible.

Iterations of the design process have allowed environmental factors to be considered, for example in the selection of creek crossing methods. Where possible, creeks with permanent water or significant vegetation will be crossed through trenchless methods, reducing in-stream disturbance and disturbance to riparian vegetation.

Community engagement has also been undertaken as part of the project, to inform landowners and the public about the project. This has included a free call 1800 information line and project email to answer queries from interested stakeholders, and newsletters to landowners and GAWB's customers.

The EIS describes the baseline environment in the project area for each topic area considered. This information has been gathered through fieldwork, review of existing mapping, aerial photography, published records and data obtained from statutory and non-statutory bodies such local councils, government departments or local interest groups.

The potential impacts identified in the EIS relate mainly to the following aspects of the project:

- The clearing of the 30 m construction width for the pipeline (the right-of-way (ROW)), with some direct impacts to vegetation and associated habitat areas
- Construction activity (for example clearing and trenching) in the ROW with the potential for temporary dust and noise generation, disruption to land uses, and reduction in visual amenity
- Construction at creek crossings with potential impacts to riparian vegetation, stream banks and water quality
- Traffic generation during construction and operation and the potential impacts to roads in the project area
- The operation of the water treatment plant (WTP) with the potential for noise generation, impacts to visual amenity and transport of waste residue
- The generation of testing water during the commissioning of the WTP and pipeline and the disposal of this water to land or waterways
- Potential for weed and weed seed spread during construction and operation.

Where adverse impacts have been identified, mitigation measures have been proposed to manage the impact. The Australian Pipeline Industry Association Code of Environmental Practice – Onshore Pipelines has been used as a guide for the development of mitigation measures. The residual impact has then been assessed taking into account the proposed mitigation measures. The residual impacts have been assigned a significance using significance criteria developed for each topic area, and can also be beneficial. The majority of impacts arising from the project have been assessed as negligible to minor adverse significance once mitigation measures are considered.

In the case of vegetation clearing, it is not possible to completely mitigate the adverse effects, however vegetation offsets may be secured through the vegetation clearing permit process under the *Vegetation Management Act 1999*.

Carbon emissions from the construction and operation of the project have been assessed as having a negligible impact (see Chapter 10 Air Environment). However, there is the potential for these emissions to be offset through the carbon offsetting program that GAWB is investigating for the whole of its operations.

Two historical cultural heritage sites have been identified as likely to be impacted by the project – the Woolwash to Frogmore Pipeline and Twelve Mile Road. Both sites will be photographically recorded prior to construction commencing, to contribute to the cultural heritage record.

Importantly, the potential impacts to matters of National Environmental Significance (Threatened Species and Ecological Communities) have been assessed against the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* criteria and found that the project is not likely to have a significant impact on these matters.

The mitigation measures described in each chapter have also been included in the Environmental Management Plan (EMP), with other measures where necessary. This EMP included in the EIS (Chapter 20, Planning Environmental Management Plan), forms the basis for the development of the Construction and Operations EMPs which will be developed in those phases of the project.

The economic assessment has assessed the project as having a contribution to the local and regional economy and the provision of employment opportunities during construction and operation. The project also contributes to the continued economic growth of the region through the provision of water to GAWB's Gladstone customers. Consideration has also been given in the design of the pipeline for possible bulk water supply to local authorities along the pipeline, contributing to water supply security in the region.

18.3 Cumulative Effects

The following assessment of cumulative effects is limited by the level of information currently available on the other proposed projects. The proposed projects identified for the area are the Stanwell - Gladstone Infrastructure Corridor (SGIC) and the Gladstone State Development Area (GSDA) described in Chapter 1, Introduction. There are currently no committed projects within the SGIC, limiting the information available for a comprehensive assessment to be undertaken. The assessment predicts the main effects which are likely to occur using the available information and assumptions which have been made in the absence of definitive information are based on best practice and project team experience.

The purpose of the SGIC is to reduce the potential cumulative effects of multiple projects in the fast-growing region by locating infrastructure in one purposely chosen location that will minimise impacts on the environment and community. It is intended to lessen the disruption caused by investigation and construction such as noise, air and transport impacts 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. Future infrastructure projects within this corridor will be required to adequately manage its impacts, which will include consideration of potential cumulative impacts relating to concurrent projects.

Similarly, within the GSDA the land is currently being used for, or is planned for, large-scale industrial development. Again, there are no committed projects within this area with sufficient detail available to enable a comprehensive assessment of cumulative impacts to be undertaken. The use and planning of the area for that purpose will reduce cumulative impacts to other land uses.

The co-location of projects within the GSDA and the SGIC should limit potential cumulative impacts to within their respective boundaries even though it is possible for the impacts of construction or operation of more than one project to occur concurrently. With the exception of the Gladstone Pacific Nickel slurry pipeline which is proposed to align within SGIC, the details of these future projects are not known. It is assumed any future pipeline projects in the SGIC are likely to have similar impacts to those described for this project and when occurring at the same time can have a greater effect on the surrounding environment. The impacts that may potentially have a cumulative effect with other projects include:

- Land use disturbances during construction and maintenance of the project would occur over a greater area and time period as more projects progress
- The potential for erosion and sedimentation, or impacts from the disturbance of acid sulfate soils (ASS) are increased if construction activities occur over a greater area
- The area of vegetation cleared for each project would have a cumulative effect on the loss of habitat for flora and fauna and on the loss of visual amenity
- The area of disturbance to creeks and waterways would increase as future projects are constructed in the same alignment. To some extent this is minimised through the selection of appropriate creek crossing methods
- Air quality impacts from dust generation would be worsened if multiple projects are constructed in similar timeframes
- Noise arising from construction and operation activities of several projects may have a cumulative effect on adjacent sensitive receptors (residential areas)
- Traffic volumes on local and regional roads would increase with each project constructed
- There is greater potential for the loss or damage to items of cultural heritage significance during construction over a wider area
- The economic benefits of many projects occurring at once would have a cumulative benefit in the economic growth and employment in the region
- Increased construction activity in the local area has the potential to increase the pressure on the already strained accommodation market as new workers are attracted to the region.

The management of these types of effects is to be implemented though individual project EISs and Construction and Operational EMPs. As future projects are progressed, cumulative impacts are unavoidable; however the severity of these effects will depend on the environmental management practices of each future project that is to be implemented. These impacts will generally be confined to the width of the SGIC – approximately 100 m.

18.4 Interactive Effects

Interactive effects arise where effects from one environmental element bring about changes in another environmental element. The potential interactive effects identified in the EIS are summarised below:

- There is the potential for noise, air quality, visual amenity and traffic impacts during construction and operation to have an interactive effect on the amenity of residential areas surrounding the WTP. Mitigation measures implemented as part of this project would reduce the severity of these impacts.
- Disturbance to ASS or contaminated land during construction may have an interactive effect by impacting surface or groundwater quality. The implementation of an ASS Management Plan and management of potentially contaminated sites would reduce the risk of this occurring.
- Removal of vegetation during construction could increase erosion and sedimentation of surface or groundwater. Measures to reduce vegetation clearing and implement erosion and sediment controls during construction are described in Chapter 20, Planning Environmental Management Plan, and would reduce this impact.

Appendix G – Potential Impacts on Matters of National Environmental Significance

Gladstone Area Water Board

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G Potential Impacts on Matters of NES

G.1 Introduction

This report forms an appendix to the EIS for the Gladstone–Fitzroy Pipeline project (the project) and describes the likely significant impacts of the project on matters of National Environmental Significance (NES) as defined in the *Environment Protection Biodiversity Conservation Act 1999 (Cth) (EPBC Act).*

There is one matter of NES that functions as a controlling provision for this action. This is the controlling provision on listed Threatened species and communities (*EPBC Act*, Sections 18 and 18a). Hence, the Terms of Reference (ToR) for the EIS require that information be provided specifically on Threatened Species and Ecological Communities.

The assessment of potential impact to *EPBC Act* listed Threatened Species and Ecological Communities has been undertaken through desktop research and detailed fieldwork. The chapters of the EIS that address these matters are Chapter 6 Terrestrial Flora, Chapter 7 Terrestrial Fauna and Chapter 8 Aquatic Flora and Fauna. The findings of these chapters are summarised in this report.

The TOR outlines that information be provided on the following list of *EPBC Act* listed species and threatened ecological communities (however it should be noted that EIS chapter 6, 7 and 8, and therefore this report, covers more *EPBC Act* listed threatened flora and fauna species than specified in the TOR):

Fauna

- Yellow Chat (*Epithianura crocea macgregorii*);
- Fitzroy Tortoise (*Rheodytes leukops*);
- Brigalow Scaly Foot (*Paradelma orientalis*);
- Squatter Pigeon (*Geophaps scripta scripta*);
- Yakka Skink (*egernia rugosa*).

Flora

- Semi evergreen vine thickets of the Brigalow belt;
- Brigalow (*Acacia harpophylla* dominant and co-dominant) (note that this refers to brigalow communities, and not individual plants)
- *Atalaya collina*;
- *Cycas megacarpa*;
- *Cycas ophiolitica (Cth)*;

- *Quassia bidwillii*.

As this report covers this controlling provision only, other matters of NES are not discussed here, but are assessed within the EIS itself (e.g. the impact upon migratory species is assessed in Chapter 7).

G.2 Description of Proposed Action (as it would impact on NES matters)

GAWB has been planning for the future water needs of the Gladstone region by preparing contingency plans to secure water within a suitable timeframe if and when additional water supply is required, either through drought or an increase in industrial demand for water.

As part of this forward planning, and although the recent drought urgency has reduced, GAWB is carrying out preparations for the project to ensure a two year construction phase can commence as soon as low dam level or increased demand indicates the need.

The project will be capable of delivering up to 30 GL of water each year (approximately 100 ML/day) from the Fitzroy River at Laurel Bank, providing an additional water source to Awoonga Dam, currently GAWB's sole source of water.

Project works include:

- Underground pipeline of 115 km length and 1 metre diameter from Alton Downs to Gladstone (construction works will occur within a 30.5 – 34.5m Right of Way (ROW));
- River intake pumping station;
- Water treatment plant, reservoir and pumping station at Alton Downs;
- Booster pumping station and reservoir at Raglan;
- Reservoir at Aldoga; and
- Connection works at Yarwun.

The pipeline route from Laurel Bank will traverse mainly freehold land up to the Stanwell Gladstone Infrastructure Corridor (SGIC), in which the pipeline will be located for most of its length, before entering the Gladstone State Development Area (GSDA) where it will terminate at existing water infrastructure.

The pipeline alignment and proposed sites for the associated infrastructure are shown in Figure 1.3 of the EIS [Locality Map]. A detailed description is provided in Chapter 2 of the EIS [Project Description].

The activities associated with the project that have the potential to impact upon *EPBC Act* listed threatened species and threatened ecological communities include:

- Vegetation clearing and habitat disturbance;
- Habitat fragmentation and disturbance to wildlife movement corridors;
- Disturbance to wetlands and waterways; and
- Introduced fauna and flora.

Mitigation measures have been proposed in the EIS to address the identified impacts and these are also included in this Matters of NES Report in Sections G.7.1.3 and G.7.2.5.

G.3 Methodology for Terrestrial Fauna Study

G.3.1 Existing Information Review

Existing information regarding the terrestrial fauna of the project area and surrounding area was collated and reviewed. The following documents and database information were considered in the preparation of this report:

- Fauna databases of the Commonwealth Government (*EPBC Act* Protected Matters database), the Queensland Museum, Birds Australia and Queensland Environment Protection Agency's (QEPA) Wildlife Online database. Note: search area based on a 30 kilometre buffer from the extent of the project area;
- Fauna data and background information derived from relevant studies for the wider area (e.g. Longmore 1978, Driscoll 1997, Sattler and Williams 1999, Young *et al.* 1999, McFarland *et al.* 1999, CZEWM CRC 2003a and 2003b, DEH 2005d, Houston *et al.* 2004a and b, Jaensch *et al.* 2004, RLMS 2006a and 2006b, HLA 2006, Houston *et al.* 2006, Houston 2006);
- QEPA Regional Ecosystem mapping and Essential Habitat mapping;
- Aerial photography to identify vegetation in the local area, comparing patterns observed with existing vegetation mapping;
- QEPA Brigalow Belt Biodiversity Planning Assessment mapping and database; and
- Commonwealth Government's Directory of Important Wetlands database.

G.3.2 Target Species

The findings of the desktop assessments indicated that a number of species of conservation significance may use habitats of the project area and surrounding lands. Consequently, consideration was given to these species (termed *target species*) in the design and implementation of the field survey program and habitat assessments. *EPBC Act* listed threatened target species considered as part of these investigations for the project area are listed in Table 3.

G.3.3 Field Survey Program

The review of existing information assisted in prioritising the variety of habitats and locations for field surveys (e.g. HLA 2006, Houston *et al.* 2006, and Houston 2006). These primarily assisted in the consideration of priority habitat areas for field surveys for *EPBC Act* listed threatened species.

The field survey program was initiated in April 2007 and comprised of the following survey events:

- A preliminary biodiversity investigation undertaken between 1 and 5 April 2007 by Lindsay Agnew and Dr. Ed Meyer;
- A series of monthly surveys to monitor known and potential habitat areas for the *EPBC Act* listed threatened Yellow Chat (*Epthianura crocea macgregori*). The program began in June 2007 and continued through until the final monitoring event undertaken in December 2007. These surveys were conducted by Lindsay Agnew and Dr. Ed Meyer;
- A spring-season avifauna survey conducted on 2–6, 27 and 28 September 2007 by Lindsay Agnew; and
- A comprehensive target species and biodiversity survey undertaken between 18 and 31 November 2007 by Lindsay Agnew and Dr. Ed Meyer.

The field investigators for this study have had extensive experience in surveying the suite of target species and applying the relevant survey methodologies.

G.3.3.1 Preliminary Biodiversity Surveys

The preliminary biodiversity field survey was conducted between 1 and 5 April 2007 by Lindsay Agnew and Dr. Ed Meyer. The latter part of the program was undertaken in conjunction with the project botanist, Derek Johnson (BMT WBM). This work involved morning and afternoon area searches for avifauna, active ground searches for reptiles and amphibians, census of wetlands for waterbirds, and general searches for indirect evidence of fauna occurrence (e.g. scats, tracks, nests, etc.). The full extent of the project area (including several route options) was covered. The location of each survey site is shown in Figure 7.1 and 7.2 of the EIS.

G.3.3.2 Monthly Yellow Chat Habitat Monitoring

As a result of the existing information review and an initial ground-truthing exercise (April 2007), a number of areas were selected to investigate for the presence of the *EPBC Act* listed threatened Yellow Chat (*Epthianura crocea macgregori*). The areas were either part of a wider area of known Yellow Chat habitat, or were considered as potentially suitable habitat (within the species' known range) based on reference to habitat characteristics and local studies (e.g. Houston (2006) and HLA (2006)).

The monitoring program was undertaken over a period of two to three days each month from June 2007 through to December 2007 (inclusive) to assess any seasonal pattern of habitat usage. The amount of time dedicated to surveying each area varied according to the size of the area, though typically ranged from 30 to 90 minutes. These areas were surveyed using either binoculars and/or a spotting scope. The full extent of each area was surveyed during each monitoring event. These surveys were conducted by Lindsay Agnew and Dr. Ed Meyer.

Table 1 identifies each area monitored and the frequency and timing of the monitoring events. A variety of other fauna species were recorded incidental to the survey for Yellow Chat. Those records have been incorporated within the main fauna database results in Chapter 7 of the EIS. The location centroid for each monitoring site is provided in Figure 7.1 and 7.2 of the EIS. The mapped areas considered potentially suitable as habitat for the Yellow Chat are provided in Figure 7.1 and 7.2 of the EIS.

Table 1 Summary of Yellow Chat Investigation Sites

Site #	Central GPS reference	Summary description	Monitoring events
1	248120E 7404586S	Seasonal wetlands associated with Gavial Creek in the vicinity of Roope and Port Curtis Roads. Adjacent to eastern side downstream of corridor.	April, August, September, October, November, December
2	248938E 7403192S - 250173E 7400309S	Seasonal wetlands associated with Serpentine Creek. Adjacent to eastern side and downstream of corridor.	No property access granted.
3	253008E 739693S	Seasonal wetland habitat to the near south of Casuarina Road, Midgee. Eastern sectors transected by corridor. The majority of this site is adjacent and to east of corridor. Downstream of corridor.	April, August, September, October, November, December
4a	250763E 7395925S	A small, semi-permanent constructed wetland. Approximately 1km to west and upstream of corridor.	April, June, July, August, September, October, November, December
4b	251453E 7394380S	A small, semi-permanent constructed wetland. Approximately 1km to west and upstream of corridor.	April, June, July, August, September, October, November, December

Site #	Central GPS reference	Summary description	Monitoring events
5	256251E 7389205S	Seasonal and semi-permanent wetland habitats associated with Station Creek and its tributary Oakey Creek. Includes constructed and semi-natural wetland features. Adjacent and to east of corridor. Downstream of corridor.	No property access granted.
6a	261091E 73848155S	Seasonal wetland habitats comprised of a series of swales and depressions to the near north of disused Port Alma rail link. Part of the Six and Eight Mile Creek systems. Corridor transects area, though largest part is east of corridor.	April, June, July, August, September, October, November, December
6b	262895E 7384194S	Seasonal wetland habitats comprising of a series of swales and depressions to the near south of disused Port Alma rail link. Corridor transects habitat area, though largest part is east of corridor.	April, June, July, August, September, October, November, December
7	265744E 7384554S	Cheetham drain area comprising estuarine/saltmarsh/clay pan habitat complex. Extends to north and south of Toonda Port Alma Road. Approximately 1.3 to 2km east and downstream of corridor.	April, June, July, August, September, October, November, December
8a	270679E 7379990S	Twelve Mile Creek Reserve. An extensive mosaic of large seasonal pools, clay pans and saltmarsh. Adjacent and to east of corridor. Downstream of corridor.	April, June, July, August, September, October, November, December
8b	270530E 7379259S	Bulrush-lined freshwater section Twelve Mile Creek downstream of Twelve Mile Road and contiguous with Twelve Mile Creek Reserve. A series of large pools fringed with *Typha* and *Eleocharis* sp. Corridor traverses this habitat area.	April, June, July, August, September, October, November, December

Site #	Central GPS reference	Summary description	Monitoring events
8c	270111E 7378801S	Freshwater section Twelve Mile Creek upstream of Twelve Mile Road. Includes pools fringed with *Typha* and *Eleocharis* sp. Approximately 800m upstream of corridor crossing of Twelve Mile Creek.	April, June, July, August, September, October, November, December
9a	273668E 7377863S	Seasonal wetlands (both artificial and natural) associated with Pelican Creek. Corridor transects upstream section of wetland. The majority of wetland habitat extends to east.	April, June, July, August, September, October, November, December
9b	273585E 7377768S	Small, semi-permanent constructed wetland fringed with *Typha* and *Eleocharis* sp. On western side of Twelve Mile Road and approximately 100m west and upstream of corridor.	April, June, July, August, September, October, November, December
10a	276457E 7377847S	Saltmarsh environs associated with the Raglan Creek oxbow. Also includes semi-permanent constructed wetlands, adjacent and to the south and southwest. This site is directly to the north of site 10b. Approximately 600m north and downstream of corridor.	April, June, July, August, September, October, November, December
10b	276551E 7377043S	A series of seasonal wetlands associated with Horrigan Creek. Includes natural saltmarshes and shallow, seasonal natural and constructed wetlands and levees. Corridor traverses eastern edge of area. Downstream of corridor.	April, June, July, August, September, October, November, December
11	291225E 7366997S	A large, vegetated semi-permanent billabong associated with Darts Creek. Remnant vegetation surrounds site and includes *Eucalyptus tereticornis*.	April, June, July, August, September and December

Site #	Central GPS reference	Summary description	Monitoring events
12	268699E 7379374S	Two small vegetated freshwater dams adjacent and to the east and west of the Toonda Port Alma Road. Approximately 500m to west and upstream of corridor.	April, June, July, August, September, October, November, December

G.3.3.3 Spring-season Avifauna Surveys

For terrestrial habitats, surveys were undertaken on foot along transects through selected areas representative of the variety of habitat types along the corridor. At each location, surveys were undertaken for a minimum of 30 minutes and the time spent at a location was determined by factors including habitat extent and level of bird activity at the time. Birds were identified from either direct observation and/or their vocalisation.

A variety of wetlands were surveyed for waterbirds. Each census was undertaken using binoculars and/or a tripod mounted spotting scope (25–60 times magnification). In the main, visual coverage of the full extent of the site was completed at least once with the survey duration dependent on factors like size of waterbody and number of birds present. At each location, surveys were conducted for a minimum of 20 minutes.

These surveys were conducted by Lindsay Agnew on 2–6, 27 and 28 September 2007. The location of each survey site is provided in Figure 7.1 and 7.2 of the EIS.

G.3.3.4 Target Species and Biodiversity Survey

A series of rapid biodiversity assessments and target species surveys were undertaken in a range of representative and/or distinctive habitat types throughout the project area. The survey program was undertaken between 18 and 31 November 2007 and implemented by Lindsay Agnew and Dr. Ed Meyer. Greg Ford provided assistance with Anabat call recording analysis.

The timing of the survey program was designed to coincide with warmer conditions when bioactivity is typically higher for all vertebrate fauna groups. The timing was considered particularly important as it enhanced the ability to detect target species, especially reptiles.

The field survey targeted a full suite of remnant, remnant regrowth and cleared habitats representative of those occurring throughout the extent of the project area. These areas were determined from the results of a review of aerial photography and vegetation mapping and

field observations from the previous survey activities (i.e. preliminary biodiversity surveys, monthly Yellow Chat monitoring and spring-season avifauna surveys). The variety of field methodologies deployed and the survey effort applied at each survey area was influenced by the following:

- The presence, extent and condition of preferred habitat types for species of conservation significance;
- The potential of an area to support higher biodiversity values, e.g. those areas forming part of a notably larger wetland or forested habitat area;
- The potential of an area to support higher fauna movement values, e.g. riparian environments.

Survey activities undertaken to assess target species and biodiversity were applied on each survey night and survey day and included:

- *Diurnal ground searches.* These dedicated searches were undertaken for reptiles at selected sites (of approximately two hectares (0.02 km^2) in area) and surveyed for a minimum of one survey person hour. Surveys were undertaken mid-morning to mid-afternoon of each survey day. Active ground searches were undertaken to locate active/inactive reptiles. Ground searches included rolling logs and rocks, raking soil at the base of trees and shrubs, searching under exfoliating bark on logs and standing dead or live trees and examination under debris.
- *Morning and afternoon bird surveys.* Surveys were undertaken along foot transects through selected habitats, typically for a minimum of a 30 minutes. Surveys were conducted within three hours of sunrise and sunset of each survey day. Birds were identified from either direct observation and/or their vocalisation.
- *Call playback surveys.* These surveys were undertaken for owls and a variety of cryptic wetland birds. For nocturnal birds, the procedure included playback of calls in a specified order with each species' call separated by several minutes of listening for responses and visual scanning (in the dark) of the immediate surrounds for birds. After all calls were broadcast, the call site and close vicinity were scanned by spotlight for approximately five to ten minutes. Once a species was detected, no further calls of that species were broadcast for the remainder of the survey program. The procedure included playback of calls for three to five minutes per species. Each species call was separated by several minutes of listening for responses and visual scanning of the immediate surrounds of the call site. Call recordings for wetland avifauna were sourced from Stewart (1999) and those for nocturnal birds were sourced from Stewart (1998)
- *Anabat ultrasonic call detection surveys.* The survey program for insectivorous bat fauna was undertaken using electronic bat detectors. Remote detection techniques with Anabat II detectors were used to record the ultrasonic signals of active bats.

Remote detection (i.e. equipment programmed for unattended, fixed point, overnight detection of microbat calls) was conducted on six survey nights (dusk to dawn).

- *Walking spotlight surveys.* These surveys were undertaken at a variety of potentially suitable forested and wetland sites. Spotlighting surveys on foot were undertaken using 30-Watt spotlights and low-wattage headlamps. Depending on the habitat characteristics, approximately half of the search effort was dedicated to arboreal searches with the remaining time spent on ground searches for nocturnal herpetofauna and ground mammals (e.g. bandicoots). Where applicable, arboreal surveys targeted mammals (e.g. possums and gliders), nocturnal birds (e.g. owls and nightjars), reptiles (e.g. snakes and geckos) and flying mammals (e.g. flying foxes).
- *Driving spotlight surveys.* Driving spotlight searches were undertaken from a 4WD vehicle along the track system within the project area (i.e. driver plus one observer with 100-Watt spotlight). These were conducted for a minimum of 30 minutes on each of the survey nights. Driving spotlight searches were undertaken primarily to survey for larger arboreal and ground mammals (e.g. macropods, foxes, cats and dogs). Additional road transects were also conducted specifically to survey for herpetofauna.
- *Waterbody/wetland surveys.* A variety of waterbodies/wetlands were surveyed for waterbirds, waders and freshwater turtles. For avifauna, a census was undertaken using binoculars and/or a tripod mounted spotting scope (25–60 times magnification). Visual coverage of the full extent of the site was completed at least once with the census duration dependent on factors like the size of the waterbody and number of birds present. At each site, an additional inspection of the waterbody surface and margins was undertaken to assess the presence of freshwater turtles. Binoculars and/or a tripod mounted spotting scope were used to confirm turtle identification.
- *Inferential evidence.* Inferential evidence of fauna occurrence was sought and found throughout the project area. This included: visual inspections of trees for trunk scratches/rubbings; searches for both predator and non-predator scats; fauna tracks; and other signs of fauna occurrence (e.g. feeding debris, shed skins and nests). Only evidence, which could be categorised as definitive, was used to record a species occurrence on the study site. Scats or pellets found were either identified in the field (using Triggs 1996) or collected and sent for identification and content analysis by Barbara Triggs, 'Dead Finish', Victoria (faeces analyst). Results were subsequently categorised into one of three reliability classes: definite; probable; or possible.

The location of each survey site and associated survey activities (e.g. call playback and Anabat surveys) is provided in Figure 7.1 and 7.2 of the EIS.

QEPA was consulted regarding the abovementioned survey program and considered it suitable (including specifically the non-trapping approach) given the nature and condition of habitat within the project area and the nature of the project. Consultation with QEPA was undertaken through the Central Region Planning Division, QEPA Rockhampton.

G.3.4 Assumptions and Limitations for the Fauna Study

All habitat assessments and fauna surveys were conducted during the period April to November 2007. Although there were moderate amounts of rainfall in late winter and early November 2007, rainfall coverage was patchy, and only the early November rainfall promoted reasonable vegetative growth (particularly in relation to diversity and biomass of grasses) in areas where rainfall was heaviest. Much of the region still exhibited the effects of having experienced drought conditions for an extended period (>5 years).

Consequently, there was a scarcity of permanent to semi-permanent waterbodies within the project area at the time of sampling and conditions sampled here should not be considered as representative of conditions at other times. In respect of water birds, whilst aquatic habitats were restricted in number and size, recorded species diversity was considered sound, though abundance was considered depressed.

Several native fauna groups were poorly represented within the recorded assemblage and/or in low abundance. These were the arboreal mammals, bats, frogs (arboreal, ground-dwelling and burrowing taxa) and elapid snakes. A variety of factors may be linked to these results and include:

- the effect of prolonged dry conditions on the presence and/or extent of favourable conditions and resources (e.g. very limited areas of surface water and depressed frog activity); and
- the condition, absence or scarcity of certain key structural habitat resources in parts of the project area, e.g. suitable tree hollows (arboreal mammals), fallen timber (mainly herpetofauna) and sparse ground cover conditions (small ground mammals and skinks).

Several target species for the field investigations are cryptic and difficult to detect (e.g.Yakka Skink [*Egernia rugosa*]). Under optimal conditions, surveys undertaken at multiple time periods would be required to confirm the absence (or otherwise) of these species from a site. This survey limitation has been minimised by the use of previous records, in conjunction with habitat assessment, to predict which species are likely to occur.

It is probable that additional species would be detected with more survey effort, particularly those species whose activity (and thus chances of detection) is higher during wetter periods. Potential limitations of the fauna survey were primarily associated with:

- Several years of dry to very dry (drought) field conditions prior to survey period. Such conditions are likely to have resulted in generally lower abundance of most fauna groups overall and significantly constrained the opportunity to determine the

occurrence of a number of cryptic amphibian and reptile species that are more readily detected at other times of the year or weather conditions; and

- A low abundance of flowering plants throughout the project area, in particularly canopy trees which is linked to the above point. Blossom provides an important source of food (e.g. nectar and pollen) and invertebrate prey for birds, microbats, flying foxes and small glider species. The diversity and abundance of small insectivorous birds (e.g. honeyeaters) are likely to be lower than could be expected as a result.

There were no notable or permanent impediments to accessing the extent of the project area, and where individual property access was not granted, surveys were undertaken at adjacent sites or public areas.

G.4 Methodology for Terrestrial Flora Study

G.4.1 Review of Existing Information

G.4.1.1 Spatial Data

A number of Geographical Information System (GIS) datasets, including the project corridor, were overlaid on rectified aerial photography. The datasets were:

- Rectified aerial photo mosaic (average age of component photos 2005);
- Cadastre (produced by the Department of Natural Resources and Water);
- Regional Ecosystem (RE) vegetation mapping by the Queensland Herbarium (Version 5.0 with December 2006 Amendments) (EPA 2005b); and
- Biodiversity Planning Assessment (BPA) mapping (Version 3.4 – 7 March 2005) (EPA 2005c).

G.4.1.2 Existing Reports

A number of reports pertaining to the project area and surrounds were assessed for relevance and were used for general background information (see bibliography at the end of Chapter 6 of the EIS).

G.4.1.3 Desktop Review of Mapping

Regional Ecosystem mapping (EPA 2005b) was used to locate the larger patches of native vegetation intersected by the corridor. Air-photo interpretation was used to identify any other unmapped patches of native vegetation. Representative remnant Regional Ecosystems were sampled along the entire length of the proposed corridor, with the exception of those private properties where access was not granted. Each vegetation remnant shown in Regional Ecosystem mapping (EPA 2005b) and intersected by the corridor was sampled in detail at least once. Unmapped remnants of sufficient size or width to be mappable according to Queensland Herbarium mapping methodology (EPA 2005a) were also sampled[1]. This was done to verify the mapping, and to check for targeted *EPBC Act* listed threatened flora species known to occur in the area.

[1] According to Herbarium methodology the remnant size can be as small as 0.25 Ha and/or 25m wide.

G.4.1.4 Existing Field Data

Brief site data collected in April 2007 by BMT WBM for a preliminary assessment of the corridor were incorporated into this study and used as the main source of background information. Brief site data included the recording of dominant plant species at each site, and other relevant information such as condition, soil type etc. Conspicuous *EPBC Act* listed threatened species were also targeted as part of the preliminary assessment. For example, for the threatened species listed in the *EPBC Act*, *Cycas* spp. were conspicuous in eucalypt forest during reconnaissance, and *Atalaya* spp. in softwood scrub were also relatively distinctive. Publicly accessible roads were mostly used in this stage of the study, and site data is presented in Appendix E2 of the EIS.

G.4.1.5 Databases

Two publicly accessible databases with restricted locational precision were searched to identify *EPBC Act* listed threatened flora known to occur, or likely to occur, in the project area and surrounds. Both searches were done by specifying coordinates (defining a rectangle) that contained the entire project area:

- Wildlife Online – a Queensland EPA internet database accessible to the public which stores records of plant collections (and other groups including algae and fungi) for a search area defined by the user. This search was used to identify species which are simultaneously listed under the *EPBC Act* as threatened.
- *EPBC Act* Protected Matters Report – a Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) internet database accessible to the public which lists threatened species for a search area defined by the user.

The likelihood of occurrence of individual *EPBC Act* listed threatened flora species (strictly, they are *taxa,* since sub-species levels can apply) was assessed in two ways:

- firstly whether the species was considered likely to occur within close proximity to the corridor (creating a risk of disturbance); and
- secondly whether the species was considered likely to be consistently associated with one or more of the categories defined by the GIS coverages (e.g. a particular RE on the RE mapping).

G.4.2 Field Investigation

A field survey for *EPBC Act* listed threatened species was done concurrently with a Detailed site survey as described below for vegetation community sampling, for which both conspicuous and inconspicuous species were searched. Conspicuous *EPBC Act listed*

threatened species were also searched for during the entire course of survey work, particularly during brief site surveys.

Field surveys were undertaken to assess the following:

- To determine where the mapped remnant vegetation communities would be directly intersected by the corridor, by intensive 50 m x 10 m site survey in a representative location, identifying structure, condition and usually all species (depending on appropriate level of detail). These data were then used to verify the accuracy of the RE mapping and if necessary, revise the mapping in the adjacent area (i.e. approximately a 200 m radius), by broader reconnaissance and/or air-photo interpretation. Vegetation sampling was done in accordance with Queensland Herbarium vegetation survey methodology (EPA 2005a). Sample types were either:
    - Detailed – all plant species present on-site were recorded within a 50 m x 10 m plot, along with structural details such as height and cover. This type of site is consistent with a Queensland Herbarium Secondary site, except stem counts were not included. It is more comprehensive than a Queensland Herbarium Tertiary site, in that all plant species in the plot are recorded. Every Regional Ecosystem (each type, not each remnant) which occurred along the corridor was intended to be sampled at least once, so that correct RE allocation for the RE mapping could be verified. Detailed sites were only considered in remnants of good condition, so that structural data and complete species lists were meaningful, and could be applied (extrapolated) to other remnants within the corridor of the same RE.
    - Short – mid-way between a Detailed site and a Brief site. A short list of the most common species was made of the site but structural details were not formally recorded. Like a Detailed site, a Short site was usually strategically placed, and was often a site that was originally intended to be Detailed. Detailed sites were not done where, on initial field assessment, site conditions indicated that a Detailed site was not necessary or not possible (e.g. due to disturbance such as a selectively thinned canopy, or weed infestation). A Short site was also used to confirm an RE when a Detailed site had been done in a nearby remnant of the same RE, especially to consolidate a detailed species list for the local variation of any particular RE.
    - Brief – only the dominant and indicator plant species present on-site were recorded. This type of site is consistent with a Queensland Herbarium Quaternary site, but some Brief sites were extended species lists similar to a Short site. The data were usually recorded without leaving the vehicle. Brief sites were done to confirm RE mapping, and get an overview of the project area. Brief sites were essential for checking mapped RE polygons.

- To visually check for the presence of *EPBC Act* listed threatened flora as identified by relevant legislation, which may have been identified as occurring somewhere in the area of the proposed corridor. Any *EPBC Act* listed threatened species seen *ad hoc* during the vegetation survey were also recorded.
- To visually check for small remnants of vegetation which may not feature on the RE mapping due to error or scale, and to assess the value of those remnants based on any or all of the criteria in these methods. These unmapped remnants included stands of trees, or other communities (including grasslands and wetlands) and significant trees (e.g. old growth).

Photographs were taken of each site to illustrate vegetation structure (see Appendix E2), and the position was recorded, where possible, with a hand-held GPS. Flora species unable to be identified in the field were collected for later identification. Individual unknown plants were not collected if whole plant removal was required, and instead, close-up photographs and descriptions were taken, along with highly specific location information for return to site if necessary. Public roads and reserves were used to visit all possible publicly accessible sampling points along the corridor, and relevant areas adjacent to the corridor. When areas of interest were on private property, sampling was conducted where permission was granted by land-owners.

The location of each sample site is shown overlaid on the RE mapping in Figure 6.1 of the EIS. Sites are identified by arbitrary numerical allocation, in order (north to south) along the corridor, but with subsequent additions of alphabetical characters to allow for insertion of new sites. Some site numbers have been omitted, indicating that a proposed site was subsequently considered redundant or unnecessary, in the light of further information becoming available (e.g. a revision of the proposed corridor alignment).

G.4.3 Assumptions and Limitations for the Terrestrial Flora Study

Preliminary site survey using Brief site observations was done in April 2007, with subsequent Detailed site survey done from 27 August to 7 September 2007. There was little rainfall before and during surveys resulting in drought conditions throughout the study region. Recent rainfall events in the catchment in January 2008 are likely to have had a positive impact on ground layer flora, but it is not expected that any additional *EPBC Act* listed threatened species would establish following the rain.

Regional Ecosystem mapping (EPA, 2005b) in the study area is relatively coarse and suitable for general planning only. It is not suitable for precise location of infrastructure, and errors of tens or hundreds of metres can occur. The exact extent of some existing vegetation communities is still uncertain due to the age of the aerial photography used in the study. Sources of error that may cause planning problems are:

- *Scale*. Base mapping relies on satellite images in many areas and this is coarser than the aerial photography.
- *Time lapse*. A considerable amount of clearing or disturbance can occur between the time the remote sensing was done and when the planning begins.
- *Remote sensing interpretation error*. This can lead to incorrect REs being applied to vegetation types (due to inability to access ground-truthing areas); and
- *Local variation in vegetation type*. This can render RE classification too coarse to be correct. Sub-REs are developed for this purpose but they are being continually developed.

It was assumed for the purposes of the EIS that the right-of-way for the project is generally 30 m wide, but can be reduced in sensitive areas.

G.5 Methodology for Aquatic Flora and Fauna

G.5.1 Review of Existing Data

G.5.1.1 Information Review

The following key information sources were reviewed:

- Vegetation and Fauna Habitat Assessment for the Stanwell to Gladstone Infrastructure Corridor (SGIC), prepared by HLA Envirosciences (2007) on behalf of the Coordinator-General;
- Queensland Environmental Protection Agency (EPA 2002) Biodiversity Assessment and Mapping Methodology (BAMM). This reference outlines threatened and near-Threatened Species (priority species) within Queensland; and
- Freshwater fish and aquatic macroinvertebrate records for the Fitzroy and Calliope River catchments. Important data sources include Byron *et al.* (1992); Conrick *et al.* (1997); DNR (1998); Duivenvoorden and Roberts (1996); Long and Berghuis (1996); Pusey *et al.* (2004).

All information sources used are referenced in the document, and are documented in the references section at the end of this report.

G.5.1.2 Spatial Data

Several Geographical Information System (GIS) datasets were used:

- Rectified aerial photo mosaic of the project area and surrounds;
- Cadastre;
- Regional Ecosystem (RE) vegetation mapping (Version 5.0 with Dec 2006 Amendments);
- Biodiversity Planning Assessment (BPA) mapping (Version 3.4 – 7 March 2005);
- Ramsar wetland areas; and
- Queensland EPA estate (National Parks etc).

G.5.1.3 Public Database Records of Listed EVR Species

Two public access databases with restricted locational precision were searched to identify Endangered, Vulnerable and Rare (EVR) aquatic flora and fauna known to occur, or to have occurred, in the project area:

- Wildlife Online (EPA 2007) database. This is a Queensland EPA internet-based database that stores records of plant collections and fauna sightings (and other groups such as algae and fungi) for a search area defined by the user. EVR and other notable flora and fauna species can be selected from the search outputs. Search results are included in Appendix E4; and

- *EPBC Act* Protected Matters Report (DEWHA 2007). This is a Commonwealth Department of Environment and Water Resources (DEWHA) internet-based database, and its associated search tool enables the user to generate a report that will assist with determining whether matters of national environmental significance or other matters protected by the *EPBC Act* are likely to occur in the area of interest. This includes *EPBC Act*-listed EVR species, migratory and other notable species of national significance, Threatened Ecological Communities, and other features of national environmental significance (i.e. Ramsar Wetlands, Commonwealth Marine Areas, World Heritage Places, National Heritage Places, Commonwealth Lands). Search results are included in Appendix E4.

Searches were done in both public domain databases by specifying coordinates (defining a rectangle) that contained the entire project area. Note that these database outputs should be considered as indicative only, and have been considered in this chapter in the context of habitat conditions present within the project area, and the potential for these habitats to support listed species and communities.

G.5.2 Field Investigation and Data Analysis

On the basis of a review of spatial data, six main drainages were identified within the project area, namely Fitzroy River, Gavial Creek, Inkerman Creek, Twelve Mile Creek, Raglan Creek and Larcom Creek (see Figure 8.2 of the EIS). Furthermore, two semi-permanent floodplain lagoons and approximately 24 ephemeral drainages of varying size were identified within the project area.

Of these streams and minor drainages, a total of 16 sites were selected for site assessments (see figure 8.1 of the EIS). Sites were selected on the basis that: (i) they were considered to be representative of the main aquatic meso-habitat types[2] found within the project area; (ii) they encompassed all major creeks within the project area; and/or (iii) they encompassed habitat types utilised by aquatic species of conservation significance (i.e. *EPBC Act* listed) (Table 2).

Marine and aquatic habitat surveys undertaken by BMT WBM ecologists at 16 representative sites situated within the project area. These were undertaken between 23rd to 28th August 2007 inclusive. Note surveys were used to determine presence of available habitat for aquatic Threatened Species listed under the *EPBC Act.*

[2] Meso-habitats are broad habitat types that are roughly the same scale as the channel width and delineated by localised slope, channel shape, and structure. Riffles, runs, glides, shoals, pools, and off-stream wetlands/anabranches represent potential types of meso-habitats.

Table 2 Location (Projection: WGS 84) and Types of Waterbodies Investigated at Representative Sites Located within the Project Area

Section	Catchment	EASTING	NORTHING	Creek name	Description	Water present (> 5 m^2 surface area)
Fitzroy to Bajool	Fitzroy	237757.6	7421346.8	Fitzroy River	Perennial River - Permanent pool	✓
	Fitzroy	234722.3	7415613.7	Lagoon 1	Semi-permanent lagoon	✓
	Fitzroy	234247.0	7411906.5	Lion Creek	Ephemeral drainage	×
	Fitzroy	238770.8	7409818.3	Lagoon 2	Semi-permanent lagoon	✓
	Fitzroy	248222.3	7404730.1	Gavial Creek	Semi-permanent waterbody	×
	Fitzroy	253897.5	7388885.4	Station Creek US	Ephemeral drainage	×
	Fitzroy	254704.2	7388278.4	Oakey Creek US	Ephemeral drainage	×
Bajool to Gladstone	Fitzroy	263824.2	7383895.9	Inkerman Creek	Macro-tidal creek	✓
	Fitzroy	270515.3	7379234.3	Twelve Mile Creek	Permanent pool	✓
	Fitzroy	271564.6	7378956.2	Marble Creek	Ephemeral drainage	×
	Fitzroy	273718.1	7377870.7	Pelican Creek	Ephemeral drainage	✓
	Fitzroy	276719.8	7376800.5	Horrigan Creek	Ephemeral drainage	×
	Fitzroy	277873.1	7376388.1	Raglan Creek	Macro-tidal creek	✓
	Fitzroy	292145.7	7367585.7	Unnamed tributary of	Ephemeral	×

Section	Catchment	EASTING	NORTHING	Creek name	Description	Water present (> 5 m^2 surface area)
				Larcom Vale Creek	drainage	
	Calliope	299816.4	7359922.2	Larcom Creek	Permanent pool	✓
	Calliope	307680.8	7362046.9	Sandy Creek	Ephemeral drainage	×

G.5.3 Aquatic Habitat Survey

To determine the suitable of the habitat for habits for *EPBC Act* listed threatened species, a survey of the habitat characteristics of each site was undertaken, documenting riparian vegetation characteristics, stream substrate composition and profile, adjacent land uses and several other indicators of habitat 'condition'.

Sampling sites were all located on main watercourses within the project area and numerous representative ephemeral drainages and wetlands intersecting the proposed pipeline corridor, as shown in Table 2. Photographs were taken of representative features at each site, and the position was recorded with a hand-held GPS.

Sampling methods were based on Arthington (1996). 50 m long transects (fibreglass tapes) were placed parallel to the littoral edge on each riverbank, with the transect origin (0 m) set at the upstream extent of the site. Two separate but related methods were used to sample habitats and aquatic flora on these transects.

Method 1. The first method involved dividing the stream into five equal segments (perpendicular to the transect line), consisting of two bank segments, a centre-of-stream segment and two segments either side of the centre-of-stream and the banks. Four random points were selected along each of the five sub-transects, to give a total of 20 points.

The following parameters were measured within 1 m^2 quadrats placed at each sample point along each transect:

- Wetted stream width
- Percentage riparian cover (projected foliage cover)
- Depth
- Mean water velocity
- Substrate composition (mud/sand/fine gravel/coarse gravel/cobble/rock/bedrock)
- Percentage cover of each macrophyte species
- Percentage cover of filamentous algae
- Percentage cover of overhanging vegetation

- Percentage cover of emergent vegetation
- Percentage cover of leaf litter
- Percentage cover of large woody debris (more than 15 cm diameter)
- Percentage cover of small woody debris (less than 15 cm diameter).

Method 2. Pusey *et al.* (2004) suggests that Method 1 does not provide an adequate sample of bank and littoral habitats, hence an alternate method was used to supplement the information obtained in Method 1. 50 m long by 1 m wide belt transects were sampled on each stream bank. Each transect was divided into 12.5 m long segments to gain an appreciation of within-site variability and to assist data collection. Sampling was restricted to the littoral zone, and excluded terrestrial vegetation except for the immediate riparian strip. The percentage cover of each of the following parameters was measured within each segment:

- Canopy cover
- Aquatic macrophytes
- Filamentous algae
- Periphyton
- Overhanging vegetation
- Submergent vegetation
- Emergent vegetation
- Leaf litter
- Large woody debris (more than 15 cm diameter)
- Small woody debris (less than 15 cm diameter)
- Undercut banks
- Overhanging roots.

Macrophyte sampling was done by hand due to the shallow nature of the sites. Substrate composition was estimated by eye from hand-gathered samples in shallow areas and by an extended scoop in deeper sections. Depth was measured using a graduated pole. Macrophyte samples were identified in the field or were collected for later identification in the laboratory.

G.5.4 Assumptions and Limitations for the Aquatic Flora and Fauna Study

All habitat and water quality sampling was conducted between 23 and 27 August 2007 between 07:00 and 18:00 hours. Although there were moderate amounts of recent rainfall occurring prior to the survey period, the area is recognised as having experienced drought conditions for an extended period (more than five years) at the time of the survey. Consequently, there was a scarcity of permanent to semi-permanent waterbodies within the project area at the time of sampling, and conditions sampled here should not be considered

as representative of conditions at other times. Drought conditions would directly affect factors such as the distribution and extent of aquatic macrophytes, for example, which were extremely sparse during the field investigations conducted for this EIS.

Note that assessments of aquatic fauna species and communities within the project area were derived from reviews of existing information from the wider area, together with habitat surveys and knowledge of the known habitat requirements of these species. Note that with the exception of the translocated populations of some fish species (e.g. Mary River Cod (*Maccullochella peelii*)) no species of aquatic invertebrates or freshwater fish listed as threatened under the *EPCB Act* are known to occur in the project area. Other listed species known from catchments encompassing the project area include the Fitzroy River Turtle (*Rheodytes leukops*), which is endemic in the Fitzroy River catchment. The project area does not represent optimal habitat for this species, hence targeted surveys were not undertaken for this species.

G.6 Description of the Affected Environment Relevant to the Controlling Provisions

This section describes the *EPBC Act* listed Threatened Species and Threatened Ecological Communities that have been identified as potentially occurring within the project area. The section is divided into *EPBC Act* listed threatened fauna (see G.6.1), and also into *EPBC Act* listed threatened flora and Threatened Ecological Communities (see G.6.2).

G.6.1 *EPBC Act* Listed Threatened Fauna (Terrestrial and Aquatic)

G.6.1.1 Review of Existing Information Sources

The review of existing information sources (including an *EPBC Act* Protected Matters database search) for the wider area within 30 kilometres of the project area provided records for a variety of threatened species as listed under the *EPBC Act*. These species, with relevant conservation status and notes on habitat and distribution are provided in Table 3.

Table 3 List of *EPBC Act* listed Threatened fauna derived from review of existing information

Status:	CE = Critically Endangered; E = Endangered; V = Vulnerable
Primary Sources:	QEPA Wildlife Online Extract and *EPBC Act* Online Protected Matters Report (August 2007)

Species	EPBC status	Species profile notes and regional context
Terrestrial Species		
Semon's Leaf-nosed Bat (*Hipposideros semoni*)	E	Core distribution from Cape York Peninsula to Cooktown, though tentative records suggest that it may also occur in disjunctive populations further south in the Mt. Windsor Tableland area, Kroombit Tops National Park, or even as far south as St. Mary's State Forest near Maryborough (Thomson *et al.* 2002, Schulz and de Oliveira 1995, de Oliveira and Pavey 1995, and Coles *et al.* 1996 cited in Thomson *et al.* 2002). Roosts in cavernous sites and may be an obligate cave dweller, though recorded from other man-made structures, e.g. abandoned mines (Hall 1995). May favour rock escarpment country where it roosts under rock overhangs and in shallow caves (Thomson *et al.* 2002). North Queensland habitats described as rainforest, forest, open woodland and vine thickets (Hall *et al.* 2000).
Grey-headed Flying-fox (*Pteropus polilcephalus*)	V	Occurs along the east coast of Australia, from Gladstone to southwest Victoria and within sub-tropical and temperate forests, including rainforest, tall sclerophyll forest and woodlands, heath, paperbark swamps and also occurs within urban and agricultural areas where food trees are cultivated (Churchill 1998, Duncan *et al.* 1999). Favours fruits of rainforest trees, nectar and pollen of *Myrtaceae*, *Proteacea* and rainforest tree species, though also feeds on fruit from introduced species (Eby 1991 Tidemann 2002). Roost sites (camps) are usually traditional, regularly used and occupied when suitable food resources are available in the surrounding area (Hall and Richards 2000).

Species	EPBC status	Species profile notes and regional context
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V	Northern range limits to about Blackdown Tableland/Rockhampton (Hoye and Dwyer 2000). In region, only recorded from extensive areas dry and wet sclerophyll forest, i.e. Carnarvon Gorge National Park (*pers comm*. G. Ford 2004). Cave dwelling species, though also known to roost in mine tunnels and abandoned Fairy Martins nests (Hoye and Dwyer 2000).
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V	Known current northern range limits in Theodore/Moura district. Few records in southern Brigalow Belt, mainly from shrubby open forest and woodland habitats (McFarland *et al.* 1999). Roost in tree hollows, fissures in branches, and under sheets of bark (Churchill 1998, Parnaby 2000).
Collared Delma (*Delma torquata*)	V	Endemic to SEQ. Highly restricted, disjunct populations from outer Brisbane western suburbs to Blackwater, central Qld (DEH 2005b). A cryptic reptile known from mainly open, rocky terrain on basalt and lateritic soils with open *Eucalyptus* and *Acacia* woodland with a sparse cover of tussock grass and shrubs or semi-evergreen vine thicket (Wilson 2005a, Ryan 2006).
Brigalow Scaly-foot (*Paradelma orientalis*)	V	Endemic to region. Brigalow forest and *Eucalyptus* woodland with tussock grass ground cover (Cogger *et al.* 1993). Ground micro-habitat diversity appears to be an important habitat attribute (Wilson and Knowles 1998).
Yakka Skink (*Egernia rugosa*)	V	Lives in communal burrows within dry open forest and woodland, often featuring coarse gritty soils near low rocky outcrops (Cogger 2000, Wilson 2005a).
Ornamental Snake (*Denisonia maculata*)	V	Endemic to region. Specialist frog predator (Shine 1983). Seasonally inundated areas (esp. gilgai in Brigalow) with deep cracking soils of woodland, shrubland and natural levees (Ehmann 1992, Wilson 2005a, DEH 2005c).
Dunmall's Snake (*Furina dunmali*)	V	Few records in region (e.g. Expedition Range National Park; DEH 2005a). Open forest and woodland (including brigalow, belah and cypress pine) on cracking black clay and clay loam soils (Cogger *et al.*1993, Wilson 2005a). *Eulamprus* skinks may form an important component of diet (Shine 1981).

Species	EPBC status	Species profile notes and regional context
Ornamental Snake (*Denisonia maculata*)	V	Endemic to region (Cogger *et al.*1993). Specialist frog predator diet (Shine 1981). Seasonally inundated areas (especially gilgai in Brigalow) with deep cracking soils of woodland, shrubland and natural levees (Ehmann 1992, Cogger 2000, Wilson 2005a).
Red Goshawk (*Erythrotriorchis radiatus*)	V	These raptors require a very large home range. Distribution uncertain in region, though known from the eastern sector. Very large home ranges (e.g. 50–220km^2 (Debus 2001)) including open forests and woodlands, tropical savannas traversed by riverine vegetation (Garnett and Crowley 2000). In partially cleared areas of eastern Queensland associated with gorge and escarpments (Czechura and Hobson 2000).
Painted Snipe (*Rostratula benghalensis*)	V	Occurrence erratic and unpredictable, seldom remaining long in any locality (Marchant and Higgins 1993). Well-vegetated shallow, permanent or seasonal wetlands where it forages on soft muds and in shallow water for invertebrates (Marchant and Higgins 1993, Geering *et al.* 2007).
Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*)	V	Ground-dweller of drier *Eucalyptus* woodland with sparse grass cover in close proximity to permanent water (Frith 1982a). Known to use improved pasture, though allways near permanent water (Garnett and Crowley 2000, Higgins and Davies 1996).

Species	EPBC status	Species profile notes and regional context
Yellow Chat (*Epthianura crocea macgregori*)	CE	Endemic to area and known from Curtis Island, the Torilla Plain and Fitzroy River delta, though seasonally mobile and possibly also occurs in other localities (Jaensch *et al.* 2004, Houston *et al.* 2004a). Known from freshwater and saline wetlands on marine plains including swampy grassland, saline herbland, saltmarshes, *Cyperus* sedgelands (Houston *et al.* 2004b). All sites where the Yellow Chat has are known to persist year-round are associated with drainage channels on coastal marine plains connected to tidally influenced wetlands (Houston *et al.* 2004a, Houston 2004). Typical breeding habitat is a network of braided channels flanked by rank vegetation (rushes, sedges or grass) that provides shelter adjacent to muddy substrates for foraging (Houston *et al.* 2004b). Dry season habitat requirements are under investigation and may be critical to the Chat's conservation (Houston *et al.* 2004b, QEPA 2005).
Black-throated Finch (sth. subsp.) (*Poephila cincta cincta*)	E	Currently only considered to be locally common near Townsville and Charters Towers (DEC and QWPS 2004). A seedeater known from a variety of grassy savannah woodland habitats dominated by *Eucalyptus* and/or *Corymbia*, though also woodlands dominated by *Melaleuca* and/or *Acacia* tree species (DEC and QWPS 2004, Higgins *et al.* 2006). On the coastal plains, grassy *Pandanus* savannah is also used (Pizzey 1991 in TSSC 2005). An open understorey of seeding perennial and annual grasses and available surface water are essential resources (Zann 1976, Higgins *et al.* 2006). Riparian woodland habitat is thought to be of particular importance (DEC and QWPS 2004, TSSC 2005). Nests in trees, sometimes in hollows (Zann 1976).

Species	EPBC status	Species profile notes and regional context
Star Finch (sth. subsp.) (*Neochmia ruficauda ruficauda*)	E	A seedeater of grassy woodlands and grasslands close to fresh water, though also recorded in cleared or suburban areas such as along roadsides and in towns (Holmes 1996 and 1998). Sites where recent records have been obtained have been dominated by grasses or have been in areas where the native vegetation has been partially cleared (DEWHA 2007a). Studies at nine former sites found that the habitat consisted mainly of woodland and dominated by trees that are typically associated with permanent water or areas that are regularly inundated; the most common species being *Eucalyptus coolabah, E. tereticornis, E. tessellaris, Melaleuca leucadendra, E. camaldulensis* and *Casuarina cunninghamii* (Holmes 1996). Population estimates of about 50 mature individuals in four confirmed sub-populations scattered across central Queensland (e.g. Wowan and Aramac districts) (Garnett and Crowley 2000, DEWHA 2007a).
Aquatic Species		
Fitzroy River Turtle (*Rheodytes leukops*)	V	Restricted to Fitzroy River catchment. Prefers combination of deep pools connected by shallow riffles, high water quality and extensive beds of Ribbon Weed (*Vallisneria* sp.) on which it feeds (Legler and Cann 1980, Cogger *et al.* 1993). Most of this section of the project area represents marginal habitat for the vulnerable Fitzroy River Turtle as this species prefers permanent freshwater riverine reaches and large, isolated permanent waterholes. Within the Fitzroy to Bajool project area, the Fitzroy River at the extraction point, and possibly Gavial Creek and the two off-stream lagoons (Lagoons 1 and 2), represent potential but low quality (i.e. not typically fast-flowing or clear waters) habitat for this species. Within the Bajool to Gladstone project area, the larger freshwater waterbodies (Twelve Mile Creek and Larcom Creek) represent only marginal habitat for this species as their waters are typically not clear or fast-flowing.

Species	EPBC status	Species profile notes and regional context
Mary River Cod (*Maccullochella peelii*)	E	This species has been translocated into the Fitzroy River catchment, although it is thought that the translocation attempt failed (Pusey *et al.* 2004). Note that the Wildlife Online (QEPA, 2007) database and the *EPBC Act* Protected Matters Report (DEWHA, 2007) did not identify any listed fish species within the project area.
Green Turtle (*Chelonia mydas*)	V	The most common species in the coastal region is the Green Turtle. Green Turtles are known to feed directly on seagrasses and algae (Kuiper-Linley *et al.* 2007), while Loggerhead Turtles are known to feed on bivalve molluscs from seagrasses and hard bottom areas (Limpus *et al.* 1994). Changes to seagrass and/or reef communities for some turtles) can therefore impact on turtles. No seagrass or major reef communities exist within the estuary reaches of the project area. While their distribution is not physically limited to areas where, for example, seagrasses grow, marine turtles are likely to be only transient visitors (if at all) to these creeks. The project area does not contain suitable nesting sites for marine turtles. The project area contains mangrove-lined creeks, whereas turtles typically nest in sandy beach/dune environments, where they can excavate a nest for their eggs. No particular sites are known as major nesting areas, since nesting intensity is highly variable between years.
Flatback Turtle (*Natator depressa*)	V	
Loggerhead Turtle (*Caretta caretta*)	E	
Hawksbill Turtle (*Eretmochylus imbricata*)	V	

G.6.1.2 Field Survey Results

G.6.1.3 Fitzroy to Bajool

The Aquatic Fauna Survey did not directly sample for fauna species listed in Table 3 (see section G.5.4); however the terrestrial field investigation program provided records for 185

vertebrate fauna species (both listed as threatened under the *EPBC Act* and not listed) either recorded within the mapped corridor and/or recorded from similar habitats within approximately one kilometre either side of the project area corridor. The recorded assemblage comprised two *EPBC Act* listed threatened fauna species:

- The Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*), which is listed as Vulnerable; and
- The Ornamental Snake (*Denisonia maculata*), which is also listed as Vulnerable.

A summary of these recorded *EPBC Act* listed threatened species is provided in Table 4 and the locations are identified in Figure 7.3 of the EIS. The location of each fauna survey site is provided in Figure 7.1 of the EIS. In regards to such data, it should be noted that the data represents records over a wide survey period (April to December) and may include records of the same individuals, though recorded during two separate sampling periods (especially Squatter Pigeon records). Table 4 does not represent a list of individuals, rather a list of sightings.

Habitats (which exhibit lower levels of disturbance and/or support higher values to the widest cross-section of the fauna assemblage of this section of the project area) are primarily associated riparian vegetation along the Fitzroy River and smaller waterways, small and scattered patches of native remnant and regrowth vegetation, and wetlands (including variety of large swales and depressions). Key habitat resources and areas of ecological sensitivity are listed in Table 5 and depicted in Figure 7.4 of the EIS.

Table 4 *EPBC Act* listed Threatened fauna survey records for Fitzroy to Bajool section

Status:	CE = Critically Endangered; E = Endangered; V = Vulnerable

Species	EPBC status	GPS location	Number of individuals	Month	Comments
Ornamental Snake (*Daenisonia maculata*)	V	253155E 7397039S	1	November	Sub-adult located under large ground log. Large ground logs common in area; large hollow-bearing *E. coolabah* trees common; cracking clays; adjoining

Species	EPBC status	GPS location	Number of individuals	Month	Comments
					seasonal wetland (southern side of Casuarina Road).
Ornamental Snake	V	252815E 7397005S	1	November	Adult foraging within large hollow ground log. Large ground logs common in area; large hollow-bearing *E. coolabah* trees common; cracking clays; adjoining seasonal wetland (southern side of Casuarina Road).
Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*)	V	255069E 7397139S	2	April	*Eucalyptus coolibah* grassy open woodland.
Squatter Pigeon	V	255737E 7388795S	2	April	Open grassland.
Squatter Pigeon	V	261132E 7384477S	3	June	Railway through grazing country with scattered forest red gums and poplar box.
Squatter Pigeon	V	253184E 7396940S	16	June	Seasonal wetland to south of Casuarina Road, fringed with mature hollow-bearing eucalypts. Dry when pigeons sighted. Ground cover sparse, predominantly *Salsola*.
Squatter Pigeon	V	243424E 7408131S	2	September	Pasture to south of Capricorn Highway.
Squatter Pigeon	V	249529E 7399792S	2	November	Alongside bush track in dry swale in open grassland (east of Kime Road).

Species	EPBC status	GPS location	Number of individuals	Month	Comments
Squatter Pigeon	V	249137E 7401882S	2	November	*E. coolabah* remnant within road reserve; sparse understorey and grass cover (east of Kime Road).
Squatter Pigeon	V	251647E 7397168S	4	December	Along side dirt Casuarina Road; open paddock adjoins, near homestead.
Squatter Pigeon	V	252947E 7396951S	1	December	Poplar Box remnant fringe along Casuarina Road.
Squatter Pigeon	V	249529E 7399792S	3	November	Alongside bush track; scattered trees along track; open grassland adjoining (east of Kime Road).

Table 5 Areas of fauna habitat sensitivity associated with the Fitzroy to Bajool section

Area #	GPS reference	Comments	Primary values
1	237768E 7421569S	Fitzroy River riparian habitats.	Fauna movement; habitat for forest birds and microbats; and hollow-bearing trees.
2	235180E 7415401S	Northwestern extension of a series of semi-permanent vegetated billabongs to north of Nine Mile Road.	Habitat for waterbirds and waders, including rare and migratory species.
3	234490E 7413765S	Western end of a series of semi-permanent vegetated billabongs. Extends south to Nine Mile Road.	Habitat for waterbirds and waders, including rare and migratory species.
4	234227E 7411350S	Western end of a large semi-permanent constructed wetland.	Habitat for waterbirds and waders, including rare and migratory species.

Area #	GPS reference	Comments	Primary values
5	235178E 7410276 S	Corridor traverses centre of semi-permanent wetland. Largely natural form though surrounds cleared of remnant vegetation. North of Malchi Nine Mile Road.	Habitat for waterbirds and waders, including rare and migratory species.
6	238744E 7409836 S	Billabong of natural form though surrounds cleared of remnant vegetation.	Habitat for waterbirds and waders, including rare and migratory species.
7	239640E 7409567 S	Billabong of largely natural form though surrounds cleared of remnant vegetation. North of Titman Road.	Habitat for waterbirds and waders, including rare and migratory species.
8	247726E 7405458 S	Adjacent to Gavial Creek wetlands.	Habitat for waterbirds and waders, including rare and migratory species.
9	250022E 7400559 S	Small open seasonal wetland – part of Serpentine Creek wetland system.	Habitat for waterbirds and waders, including rare and migratory species.
10	251112E 7398611 S	Shallow seasonal wetland and part of the Serpentine Creek wetland system – north of Georges Road.	Habitat for waterbirds and waders, including rare and migratory species.
11	251788E 7397765 S	Shallow seasonal wetland and part of the Serpentine Creek wetland system – south of Georges Road.	Habitat for waterbirds and waders, including rare and migratory species.
12	252472E 7396841 S	Seasonal wetland and part of the Serpentine Creek wetland system – south of Casuarina Road.	Habitat for waterbirds and waders, including rare and migratory species.
13	253143E 7394318 S	Dingo Creek riparian vegetation.	Fauna movement; locally significant habitat corridor.
14	255015E 7389095 S	Station Creek riparian vegetation.	Fauna movement; locally significant habitat corridor.
15	255346E 7388666 S	Oakey Creek riparian vegetation.	Fauna movement; locally significant habitat corridor.
16	261106E	Seasonal wetland system comprising of	Habitat for waterbirds and

Area #	GPS reference	Comments	Primary values
	7384693 S	natural form broad swales. Part of Inkerman Creek wetland system.	waders, including rare and migratory species; potential Yellow Chat habitat.

G.6.1.4 Bajool to Gladstone

The field investigation program provided records for 245 terrestrial vertebrate fauna species (both listed as threatened under the *EPBC Act* and not listed) either recorded within the mapped corridor and/or recorded from similar habitats within approximately one kilometre either side of the project area corridor. The recorded assemblage comprised two *EPBC Act* listed threatened fauna species:

- The Yellow Chat (*Epthianura crocea macgregori*), which is Critically Endangered; and
- The Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*), which is Vulnerable.

A summary of each recorded *EPBC Act* listed threatened species is provided in Table 6 and locations identified in Figure 7.5 of the EIS. The location of each fauna survey site is provided in Figure 7.2 of the EIS.

Habitats (which exhibit lower levels of disturbance and/or support higher values to the widest cross-section of the fauna assemblage of this section of the project area) are primarily associated with riparian vegetation (e.g. Raglan Creek), areas of native remnant and regrowth vegetation, and wetlands including variety of freshwater, brackish, saline habitats. Key habitat resources and areas of ecological sensitivity are listed in Table 7 and shown in Figure 7.6 of the EIS.

Table 6 *EPBC Act* listed Threatened survey records for Bajool to Gladstone section

Status:	CE = Critically Endangered; E = Endangered; V = Vulnerable

Species	EPBC Status	GPS location	Number of individuals	Month	Comments

Species	EPBC Status	GPS location	Number of individuals	Month	Comments
Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*)	V	271008E 7379403S	5	April	*Eucalyptus tessellaris* grassy woodland.
Squatter Pigeon	V	275732E 7377015S	2	April	Open grassland.
Squatter Pigeon	V	269852E 7378839S	2	April	Open grassland.
Squatter Pigeon	V	284971E 7373708S	6	April	*Eucalyptus coolibah* grassy open woodland.
Squatter Pigeon	V	288112E 7369756S	2	April	*Eucalyptus mollucana* grassy woodland.
Squatter Pigeon	V	291210E 7367065S	4	April	*Eucalyptus tereticornis*/*E. mollucana* grassy open woodland.
Squatter Pigeon	V	284994E 7373613S	4	April	*Eucalyptus coolibah* grassy open woodland adjacent to Reedy Creek Road.
Squatter Pigeon	V	273188E 7378272S	4	June	Grazing land (cleared poplar box woodland) with narrow linear remnant adjoining dirt road.
Squatter Pigeon	V	270947E 7379412S	2	July	Woodland patch adjacent to Twelve Mile Creek Road.
Squatter Pigeon	V	291210E 7367065S	2	September	Large billabong with aquatic vegetation (Horseshoe Lagoon wetland complex) on Darts Creek.
Squatter Pigeon	V	267674E 7381179S	1	September	Grassy verge of Toonda Port Alma Road. Narrow linear woodland remnant adjoining.

Species	EPBC Status	GPS location	Number of individuals	Month	Comments
Squatter Pigeon	V	268408E 7380069S	1	September	Grassy verge of Toonda Port Alma Road. Narrow linear woodland remnant adjoining.
Squatter Pigeon	V	272750E 7378616S	2	September	Grassy verge of Twelve Mile Creek Road. Narrow linear woodland remnant adjoining.
Squatter Pigeon	V	273527E 7377745S	2	September	Open grassland adjoining constructed wetland – west of Twelve Mile Road.
Squatter Pigeon	V	273558E 7377878S	1	October	Mixed *Eucalyptus* woodland with grassy/shrubby understorey.
Squatter Pigeon	V	271964E 7379217S	2	October	Poplar box remnant woodland with grassy understorey.
Squatter Pigeon	V	268523E 7379656S	4	October	On unsealed road through mixed *Eucalyptus* woodland with grassy/ shrubby understorey.
Squatter Pigeon	V	267395E 7381524S	1	October	Open grassland alongside unsealed road.
Squatter Pigeon	V	252558E 7397024S	2	October	In dry swale with mid-dense to sparse cover of *Salsola* spp.
Squatter Pigeon	V	267360E 7381568S	2	November	Grassy open drain alongside Marmoor/Toonda Port Alma Road intersection.

Species	EPBC Status	GPS location	Number of individuals	Month	Comments
Squatter Pigeon	V	271356E 7379366S	2	November	Poplar box woodland remnant with grassy understorey alongside Twelve Mile Road.
Squatter Pigeon	V	270363E 7378971S	2	December	Dirt track through grazed open grassland.
Squatter Pigeon	V	266045E 7381959S	1	December	Road fringed with *Eucalyptus camabageana* and; understorey grassy.
Yellow Chat (*Epthianura crocea macgregori*)	CE	271121E 7380255S	2	July	Saline wetlands at Twelve Mile Creek. Birds seen in close proximity to one another, out on saline flats; amidst saltwater couch and saltbush fringing inundated clay pan.
Yellow Chat	CE	270842E 7381180S	2	September	Twelve Mile Creek Reserve. Saltmarsh adjoining inundated clay pan.

Table 7 Areas of fauna habitat sensitivity associated with the Bajool to Gladstone section

Area #	GPS reference	Comments	Primary values
17	262098E 7384738S	Seasonal wetland system comprising of natural form broad swales – south of Port Alma railway. Part of Inkerman Creek wetland system.	Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat.

Area #	GPS reference	Comments	Primary values
18	263729E 7383889 S	Inkerman Creek and associated wetlands.	Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat.
19	267056E 7382452 S	Node of *Eucalyptus moluccana* woodland.	Habitat node in largely cleared landscape
20	269977E 7379303 S	Southern extent of saline wetlands of Twelve Mile Creek Reserve.	Adjacent to potential Yellow Chat habitat.
21	270526E 7379266 S	Freshwater section of Twelve Mile Creek – adjacent and upstream of Twelve Mile Creek Reserve.	Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat..
22	271347E 7379141 S	Twelve Mile Creek tributary – riparian vegetation.	Wildlife movement corridor.
23	273562E 7377895 S	Broad seasonal wetland – part of Pelican Creek.	Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat..
24	276522E 7376943 S	Southern extent of the Horrigan Creek wetland complex.	Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat
25	276750E 7376802 S	Horrigan Creek riparian vegetation.	Wildlife movement corridor.
26	276882E 7376737	Horrigan Creek riparian vegetation.	Wildlife movement corridor.
27	277447E 7376420 S	Raglan Creek riparian vegetation (western extent).	Wildlife movement corridor.
28	277783E 7376382 S	Raglan Creek riparian vegetation (eastern extent).	Wildlife movement corridor.

Area #	GPS reference	Comments	Primary values
29	278466E 7376245 S	Remnant vegetation. Also large wetland approximately 100 m to south.	Habitat node in largely cleared landscape.
30	2900029 E 7369279 S	Darts Creek riparian vegetation – north of Darts Creek Road.	Wildlife movement corridor.
31	292431E 7367021 S	Darts Creek riparian vegetation – north of Popenia Road.	Wildlife movement corridor.
32	299229E 7360674 S	Larcom Creek tributary riparian vegetation.	Wildlife movement corridor.
33	299783E 7359955 S	Larcom Creek riparian vegetation.	Wildlife movement corridor.
34	307772E 7362081 S	Boat Landing Creek riparian vegetation.	Wildlife movement corridor.
35	310784E 7362439 S	Remnant vegetation to near north of railway line.	Large bushland node.

G.6.1.5 Aquatic Fauna Habitat Values for EPBC Act Listed Species

A review of the EPBC Protected Matters Report (DEWHA 2007) and the Wildlife Online (QEPA 2007) database for aquatic macrophyte species of conservation significance identified no *EPBC Act* listed Threatened Species occurring, or likely to occur within the project area.

G.1.1.1.1 Fitzroy to Bajool

The Fitzroy River at the intake point is located within the weir pool formed by the Fitzroy River barrage. This site represents the largest waterbody within the project area, and has a number of inherent functional ecological values, including:

- Permanent refugia for aquatic fauna that are intolerant of pool drying;
- A movement corridor for aquatic fauna, linking the high value estuarine and freshwater reaches;
- An important habitat for freshwater fish species of fisheries significance (recreational and commercial), and a locally important recreational fishing area (note that commercial fishing is prohibited at this site); and
- Potential habitat for the Fitzroy River Turtle.

Several off-stream lagoons (oxbow lakes) also occur within the project area. These environments can represent important aquatic habitats for many aquatic fauna species, and can have higher biodiversity values than other meso-habitat types. It is unlikely that the lagoons within the project area support habitat for *EPBC Act* listed threatened aquatic fauna species due to their small size, absence of optimal habitat for these species, and historical (clearing) and ongoing pressures from adjacent catchment land uses.

Most other natural waterways and drainages within the project area are ephemeral streams. Some of the more permanent waterbodies (e.g. creeks) could support seasonal refugia for aquatic fauna species. During and shortly after flow, these drainages can also support relatively rich and abundant macroinvertebrate and fish communities. It is unlikely that the ephemeral streams within this section of the project area support important habitat for *EPBC Act* listed threatened aquatic fauna species due to their small size, absence of optimal habitat for these species, and historical (clearing) and ongoing pressures from adjacent catchment land uses.

G.1.1.1.2 Bajool to Gladstone

The most significant aquatic habitat within this section of the project area is Raglan Creek. This waterway contains well developed mangrove areas that are likely to represent locally important habitat for species of direct economic (fisheries) significance (e.g. Mud Crabs, Banana Prawns, juvenile life-stages of many fish species). This site is also a locally important recreational fishing area apparent through evident fishing and boat ramps. The only listed marine fauna species that could potentially occur within the project area is the Saltwater Crocodile (*Crocodylus porosus*), however this is listed as Migratory and not as threatened under the *EPBC Act* (therefore impacts upon this species is outside of the scope of this report; however, an impact assessment concerning the species is provided in Chapter 8 of the EIS).

Inkerman Creek is also an estuarine creek system containing mangroves and saltmarsh vegetation. This creek system would have similar functional properties to Raglan Creek, albeit perhaps to a lesser degree given the smaller size of the waterway.

Most other natural waterways and drainages within the project area are ephemeral streams. These would have similar aquatic habitat values as those described for the Fitzroy to Bajool section of the project area, and are unlikely to represent important habitat for *EPBC Act* listed threatened aquatic fauna species.

G.6.2 Threatened Terrestrial Flora and Threatened Ecological Communities

G.6.2.1 Review of Existing Information Sources

Results of the searches of Wildlife Online (EPA 2007a) and the *EPBC Act* Protected Matters Report (DEW, 2007) for the project area are shown below in Table 8.

A search of the Wildlife Online database (EPA 2007a) for species that are simultaneously listed under the *EPBC Act* returned a list of 13 plant species (Table 8). The original extract is shown in Appendix E2 of the EIS, and is represented in two halves (west and east) due to limitations in longitudinal range of the database search. It should be noted that the search area specified needs to be a rectangle, and the number of different species is highly likely to be over-represented (i.e. some are not likely to be present in the study area).

An *EPBC Act* Protected Matters Report (DEWHA 2007) was generated from a similar search, but with a more narrowly defined search area (search area and results from original extract are shown in Appendix E2 of the EIS) and returned a list of 11 plant species and their conservation status (nine Vulnerable and two Endangered, as shown in Table 8). Five species were reported that did not occur on the Wildlife Online list, indicating that these species are expected to occur, but have not been recorded in the search area. For these species, refer to the last four entries in Table 8.

Table 8 Wildlife Online and *EPBC Act* Protected Matters Report

Species records within the Wildlife Online Database, with unrecorded species from EPBC Protected Matters Report at bottom of list	**Wildlife Online Records***	***EPBC Act****	***EPBC Act* Protected Matters Report (smaller defined area)*****
Asplenium pellucidum	2	V	
Atalaya collina	3	E	Reported
Cossinia australiana	4	E	
Cupaniopsis shirleyana	10	V	Reported
Cycas megacarpa	25	E	
Cycas ophiolitica	14	E	Reported
Denhamia parvifolia	1	V	
Eucalyptus raveretiana	2	V	Reported
Hakea trineura	1	V	
Marsdenia brevifolia	1	V	
Parsonsia larcomensis	4	V	Reported
Philotheca acrolopha	1	V	
Quassia bidwillii	2	V	Reported

Unrecorded species:			
Bosistoa selwynii	0	V	Reported
Bosistoa transversa	0	V	Reported
Bulbophyllum globuliforme	0	V	Reported
Corymbia xanthope	0	V	Reported
Leucopogon cuspidatus	0	V	Reported
*Records *indicates the number of records of the species contained within the database for the area searched.*			
***EPBC Act indicates the conservation status of each taxon under the Environment Protection and Biodiversity Conservation Act 1999. The codes are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct In The Wild (XW) And Vulnerable (V).*			
***Reported by *EPBC Act* Protected Matters Report means that this particular species is mapped as occurring within the smaller defined area of the *EPBC Act* Protected Matters Report search area, in addition to Wildlife Online records.			

There are seven species listed in Wildlife Online that are simultaneously listed as threatened under the *EPBC Act* that are known to occur in the project area or surrounds and were not reported in the *EPBC Act* Protected Matters Search. These include a variety of species that occur in a variety of habitats. These species are listed in the following Table 10, with their likely habitat or area, and likelihood of occurrence within the corridor.

Table 9 *EPBC Act* listed Threatened species and likelihood of occurrence

Wildlife Online species records that were not identified in the EPBC Protected Matters search	**Likely habitat or area** **(rows in this table with scrub species are shaded)**	**Likelihood of occurrence of habitat**
Asplenium pellucidum	rainforest	low
Cossinia australiana	scrub	fair*
Cycas megacarpa	coastal ranges	fair
Denhamia parvifolia	scrub	fair*
Hakea trineura	well-drained soils	low
Marsdenia brevifolia	scrub	fair*
Philotheca acrolopha	heath	low

Likelihood of occurrence of habitat **only within remaining scrub remnants.*

G.6.2.2 Field Survey Results

No targeted *EPBC Act* listed threatened plant species were observed during survey in either section of the corridor. However, one non-target species was observed, although it was a sterile specimen and absolute confirmation of identification was not possible. This was a Vulnerable species (listed under the *EPBC Act*), and was one individual of (probably) ooline (*Cadellia pentastylis*) found at Detailed Site 14 (Marble Creek) (see Figure 6.1 of the EIS).

Almost all of the species listed as threatened under the *EPBC Act* are scrub species (i.e. species typically found in scrub). These species were assumed to be most likely to occur within remnant patches of softwood scrub or vine thicket, so targeted survey for these species was restricted to these remnant patches. Partially cleared, or regrowth, areas of scrub were also surveyed as part of the vegetation survey. None of the listed scrub species were found during the surveys. If they were present, they are nevertheless protected by virtue of their habitat (*viz*. scrub), which is protected under the *EPBC Act*.

Black Ironbox (*Eucalyptus raveretiana*) is listed under the *EPBC Act* as Vulnerable (see Table 8) and is known to occur in riverine areas that are likely to be intersected by the corridor. It was not found during the survey, despite being specifically searched for at each of the creek crossings.

Corymbia xanthope is listed under the *EPBC Act* as Vulnerable (see Table 8) and is known to occur north of Rockhampton. It is considered unlikely that this species occurs in the study area, based on collection label details of this species (Botanic Gardens Trust 2004), which indicate it occurs on skeletal soils in association with *Hakea* sp. and *Triodia* sp.. This type of habitat was not observed in the study area.

The two cycads *Cycas megacarpa* and *Cycas ophiolitica* are listed under the *EPBC Act* as Endangered, but are not reported in the *EPBC Act* Protected Matters Search for the study area. They are known to occur in the study area (see Table 8, and Appendix E2 of the EIS for original Wildlife Online extract) and are likely to be in forested areas intersected by the corridor. However, neither of these species were observed during field assessments. It is possible that a young *Cycas* sp. without a trunk may be confused with *Macrozamia sp*., but nothing that looked like either genus was observed within the corridor (except, at a distance, for the marginally similar *Xanthorrhoea johnsonii*).

The overall findings of survey were also generally in accordance with those of previous survey work in the same general area by HLA Envirosciences (2006). A notable difference is that the two *EPBC Act* listed threatened species found by HLA Envirosciences survey

(*Macrozamia serpentina* and *Eucalyptus raveretiana*) were not found in the corridor, but occur in the broader study area used in the HLA survey.

G.6.2.3 EPBC Act Referral Triggers identified from existing information

Several *EPBC Act* referral triggers were identified from preliminary data. Those triggers, based on likelihood of occurrence from habitat and distribution data, were:

- The presence of "semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions" (referred to as *scrub*), as defined in the *EPBC Act* Protected Matters Report as threatened Ecological Communities. A small unmapped patch of this scrub was observed on the Malchi Nine Mile Road at Brief site 177 (see *Map 6.1*, Short site 4), and is an *EPBC Act* referral trigger. Also, there is the possible presence of *Atalaya collina* (endangered under the *EPBC Act*) in this scrub. This scrub remnant may also contain the *EPBC Act*-listed scrub species *Quassia bidwillii, Cossinia australiana, Cupaniopsis shirleyana* and *Denhamia parvifolia*.
- *Atalaya collina* (endangered under the *EPBC Act*) could occur in the patch of scrub at Brief site 30 on the Twelve Mile Creek Road, which is closer to Yarwun. Brief site 30 is approximately 200 m to the northeast of the corridor (see Map 6.1), so a search for this species was made for at least two kilometres either side of that patch along the corridor in likely areas of habitat. A simultaneous search was made for the *EPBC Act*-listed scrub species *Quassia bidwillii, Cossinia australiana, Cupaniopsis shirleyana* and *Denhamia parvifolia*.
- The forest communities east of Yarwun, (sampled by Detailed site 39a, Short site 39b, and Brief sites 133 to 136 [see Map 6.1]] dominated by *Corymbia citriodora and Eucalyptus crebra*, had *Macrozamia* sp. in the understorey in places. As mentioned previously, young endangered cycads *Cycas megacarpa* or *C. ophiolitica* (i.e. without trunks) could appear to be *Macrozamia* spp. *Cycas megacarpa* or *C. ophiolitica* are endangered under the *EPBC Act*.
- Riverine crossings along the corridor may possibly have *Eucalyptus raveretiana* in places, which is listed as vulnerable under the *EPBC Act*. All river crossings within the right-of-way (approximately 12 crossings from the extraction point to Yarwun) were inspected for this species where access was granted. This species was not observed in the right-of-way, but could possibly occur within the corridor.
- A 200 m stretch of low-growing Brigalow (*Acacia harpophylla*) with extensive gilgai (a high density of small waterholes or pools, each ranging from about five to ten metres in diameter) was observed on the south side of Inkerman Creek on Lot 68 DS141. This patch of vegetation occurred between the tidal interface of Inkerman Creek, and the taller Brigalow further east towards the Toonda Port Alma Road. Brigalow (*Acacia harpophylla*) is a threatened Ecological Community under the *EPBC Act*. However, the height of the community on-site averaged approximately three metres, which does not meet the

structural requirements for the definition of remnant Brigalow (11–15 m) under the *VM Act*, and the *EPBC Act* uses the structural classification of the *VM Act* (in this case Regional Ecosystem 11.3.1 or 11.4.3). If the Land Zone in this area was interpreted as Land Zone 4 (clay plains rather than the alluvials of Land Zone 3), then the Regional Ecosystem for this Brigalow would become RE 11.4.3 (which has a defined height of 10–16 m under the *VM Act*). The vegetation at Site 9c rarely exceeded three metres in height and its remnant status was uncertain. Site 9c was typical of the whole patch. Regrowth can be considered as remnant if it reaches 70% of the height of its remnant height defined under the *VM Act*, but the three metre height of this Brigalow at Site 9c was too short for this.

G.7 Assessment of Impacts on NES Matters and Mitigation Measures

G.7.1 Terrestrial Threatened Fauna

The alignment of the Gladstone–Fitzroy pipeline was selected to minimise impact to native fauna habitats. In particular, alignment has been strongly influenced by the requirement to avoid traversal of as many wetland habitats (albeit seasonal or semi-permanent) and large and connected areas of native vegetation habitat as possible. This has largely been achieved, though given the length of the pipeline and topographic constraints, it is not possible to avoid all areas that may support fauna habitat.

With successful implementation of appropriate environmental management controls as recommended in Section G.7.1.3, Mitigation any potential impacts on *EPBC Act* listed threatened fauna species are likely to be limited to direct impacts associated with construction of the proposed pipeline. Potential impacts include:

- Vegetation clearing and habitat disturbance;
- Habitat fragmentation and disturbance to wildlife movement corridors;
- Disturbance to wetlands and waterways;
- Trench fall (entrapment of fauna within open trenches during construction);
- Creation of environments favourable to the colonisation and expansion of environmental weeds and pest animals.

The following provides a summary of each of these potential impacts.

G.7.1.1 Potential Impact Processes

G.1.1.1.3 Vegetation Clearing and Habitat Disturbance

Structural habitat heterogeneity is an important determinant of terrestrial fauna diversity (e.g. Beattie 1995, Agnew *et al.* 2003). Features that enhance habitat heterogeneity include hollow-bearing trees, a shrubby understorey, ground logs and fallen timber (Gilmore 1985, Bennett *et al.* 1994, Barrett 2000). Generally, greater structural and floristic diversity is associated with areas of remnant native vegetation. The removal of remnant vegetation cover results in the loss of feeding resources and shelter/breeding sites for native fauna and reduced faunal diversity.

The pipeline alignment has been selected to avoid or, where this has not been practicable (e.g. due to topographic constraints), minimise impacts to areas of remnant vegetation. Therefore, the vast majority of the construction footprint traverses cleared and highly disturbed environments and avoids as many areas of regrowth native vegetation as possible.

As a result, impacts to areas of remnant vegetation would not be substantial and the proposed loss of remnant vegetation will be minimal. It is recommended that management practices be implemented that further reduce the loss of vegetation and habitat disturbance associated with the proposed pipeline and disturbance to native fauna (see Section G.7.1.3 and G.7.2.5 for details).

A large proportion of the project area and surrounding land is subject to grazing and agricultural activities. Within this production landscape, native fauna habitat values have been greatly reduced through either complete clearing of native vegetation cover (and replacement with exotic pasture grasses) or through associated disturbances to remaining patches of native vegetation. Disturbance through simplification of habitat structure (selective clearing, grazing and inappropriate fire regimes) reduces suitable resources and conditions for native fauna and ultimately results in significant reduction in faunal diversity. Often, these simplified habitats support environments more favourable to aggressive, opportunistic native species and introduced predators and/or competitors (e.g. feral cat and cane toad) to the disadvantage of native fauna species that prefer more structurally complex habitats.

A significant threat to a variety of fauna is the potential loss of hollow-bearing trees (Bennett *et al.* 1994). A wide range of vertebrate fauna species are dependent on tree hollows for shelter and breeding, including gliders, possums, microbats, owls, parrots, ducks, and reptiles (Bennett *et al.* 1994, Phillips 2001, Gibbons and Lindenmayer 2002).

Throughout the region, the removal of mature remnant vegetation cover for the development of a production landscape has resulted in a significant reduction in the abundance of hollow-bearing trees. Throughout the project area, mature trees with either limb or trunk hollows were found to be uncommon to rare. Such trees are generally associated with patches of remnant vegetation, though also as isolated individuals within pastoral land. Those specimens within strips of riparian vegetation (surrounded by cleared lands) are considered to be particularly important in regards to their potential contribution to both habitat values and support for fauna dispersal. Even single or widely scattered mature hollow-bearing trees within a largely cleared landscape can be important habitat (Lumsden and Bennet 2003).

Although native regrowth vegetation occurs within and adjacent to the project area, most trees are too young to form hollows. The majority of this tree cover would require many decades of further growth to reach suitable maturity for hollow formation (e.g. >120 years old to form hollows suitable for occupancy of vertebrate fauna; see data in Gibbons and Lindenmayer (2002)).

All mature hollow-bearing trees will be considered a priority for retention and it is not expected that the construction of the pipeline will require removal of any individuals. A variety of the management strategies are recommended specifically to minimise any potential impacts to

hollow-bearing trees within the vicinity of the construction zone (see Section G.7.1.3 for details).

As identified previously, ground logs and fallen timber contribute to habitat heterogeneity and species diversity. Ground debris such as fallen logs and timber provide shelter and habitat for a wide range of taxa including native rodents, dasyurid marsupials, bandicoots, snakes, lizards, frogs, and birds (Barrett 2000, Nichols and Reynolds 2000, Grant *et al.* 2001, MacNally and Horrocks 2002, Michael *et al.* 2004). These resources also support suitable habitat for colonising plants and animals (e.g. insects and fungi) which are a source of food for many of these vertebrate species (e.g. Greenslade and Majer 1993, Majer and Nichols 1998).

Impacts to fauna from removal of dead timber will generally diminish over time with natural re-accumulation. Where the pipeline route transects areas of remnant or remnant regrowth vegetation, post-construction management practices will be implemented to minimise impact to ground fauna (e.g. collecting dead timber and redistribution over the alignment after construction) (see Section G.7.1.3 for details).

Clearing for infrastructure within areas of remnant vegetation will increase the boundary to area ratio of these communities and therefore increase the potential for edge effects. Edge effects can significantly influence the characteristics of a fauna assemblage. Processes associated with habitat edges may extend well into a habitat area, thus allowing impacts to reach deep into a habitat area (e.g. displacement of small-sized avifauna resulting from the presence of aggressive/competitive birds (Catterall *et al.* 1991)). Edge effects can include the establishment of weeds and alteration to micro-climatic conditions (e.g. greater light intensity, more wind penetration, lower humidity). A variety of the management strategies are recommended specifically to minimise edge effects on areas of remnant vegetation (see Section G.7.1.3 for details).

G.1.1.1.4 Habitat Fragmentation and Disturbance to Wildlife Movement Corridors

Habitat fragmentation is a reduction in the continuity of a habitat through disturbance or loss. Isolation of fauna populations in small remnants increases their vulnerability to local extinction as a result of stochastic events (e.g. fire, drought and disease) and can decrease their genetic viability in the long-term (Soule *et al.* 1988, Laurence 1990). The capacity of a habitat area to support a range of fauna is also influenced by its extent. Very small habitat areas may be unable to sustain animals with large territories/home ranges, whilst fauna restricted to these and relatively narrow/linear habitats, which support high edge to area relationship, may be exposed to increased predation and competition from species in adjoining areas (Brooker *et al*. 1999).

Throughout the region, habitat areas have been fragmented by vegetation clearing in support of pastoral and agricultural activities. The alignment of the corridor has been selected to avoid large and connected habitat areas and where this has not been possible, to minimise the impact of fragmenting habitat areas.

The survival of species within habitat patches (whether small, large and/or isolated) depends, in part, on their ability to disperse and the capacity to disperse is not equal among species. Discontinuity of suitable habitat linkages may present physical and psychological barriers that can impede or even prevent movement between habitats (Andrews 1990, Catterall *et al*. 1991, Burnett 1992, Brooker *et al*. 1999). The most important and strategically effective initiative in regards to the maintenance of habitat connectivity will be the protection and rehabilitation of native vegetation cover associated with waterways (seasonal or otherwise). Riparian vegetation generally provides a higher diversity of plant species (and therefore feeding resources for fauna) and often denser cover which encourages fauna movement.

Whilst waterway crossings are unavoidable, the pipeline alignment avoids higher quality areas of riparian vegetation. It is recommended that management practices be implemented that further reduce the loss of vegetation and habitat disturbance at these crossing points (see Section G.7.1.3 for details). Where it has not been practicable to avoid higher quality riparian vegetation and/or where other habitat sensitivities exist, direct drilling of pipeline crossings will be implemented to avoid impacts to fauna habitats.

G.1.1.1.5 Disturbance to Wetlands and Waterways

With the exception of habitats associated with Eight Mile/ Inkerman Creek and Twelve Mile Creek Reserve, natural wetlands throughout the project area have been highly modified by a combination of earth works and/or native vegetation clearing. Bunding works to enhance their capacity to act as ponded pastures under wet summer conditions have significantly altered many of these formerly natural systems. The majority of these wetlands are subject to ongoing disturbance by cattle. Other wetlands have been constructed and are typically small dams.

Despite these disturbances, a variety of these wetlands support habitat values for a wide variety waterbirds and waders, including rare and migratory species. South of Midgee, a number of these sites have been monitored monthly over a seven month period in respect to their potential to serve as seasonal refuges for the critically endangered Yellow Chat (*Epthianura crocea macgregori*).

As a result of the findings of the field survey program, wetland habitats were identified and the pipeline route adjusted to avoid these whenever possible. In several instances where this was not possible, trenchless crossing methods will be used to reduce the impact to flora and fauna

habitat values. Where complete avoidance or trenchless construction methods were not possible, mitigation measures will be adopted that will aim to minimise disturbance to these areas (see Section G.7.1.4 or details). It should be noted that, a distinctly precautionary approach has been adopted in relation to considerations of the pipeline alignment and potential Yellow Chat habitat.

Riparian vegetation generally provides a higher diversity of plant species and often supports mature vegetation and important resources including hollow-bearing trees. Consequently, these areas typically support habitat for a diversity of species and facilitate fauna movement. A characteristic of production landscapes, as is the case within the project area and surrounds, riparian vegetation remains as relatively linear habitats within an otherwise cleared landscape.

Clearing of riparian vegetation will be kept to the minimum required to safely construct the pipeline and meet other environmental requirements (e.g. erosion control, spoil storage). Where possible, construction of waterway crossings will only take place during the dry season (June – September). To avoid impacts to riparian communities, trenchless methods are preferred to cutting an open trench and filling as this reduces the amount of clearing of riparian vegetation. Where trenchless methods are not possible, a variety of other impact mitigation strategies will be implemented, e.g. minimising clearing widths for construction and post-construction rehabilitation (see Section G.7.1.3 for details).

G.1.1.1.6 Trench Fall

The pipeline will be located underground and trenching is required to accommodate the pipeline. Whilst the pipeline instatement will be progressive (in order to minimise the length of open trenching at any one time), sections of open trench will be present and unavoidable. Open trenching has the potential to form a temporary barrier to fauna movement. In addition, there is the potential for small ground dwelling fauna to fall into the open trench and become trapped and exposed to overheating, dehydration, predation and/or drowning. Relevant EPBC listed species are the Ornamental Snake, Collared Delma, Brigalow Scaly-foot, and Yakka Skink. A detailed list of impact mitigation measures relevant to these taxa are provided in Section G.7.1.3.5.

Research associated with a variety of major Australian pipeline projects has demonstrated that pipeline trenches can entrap significant numbers of a diverse range of native fauna (including species of conservation significance), particularly reptiles, frogs and small mammals, with the potential for high levels of mortality (Ayers and Wallace 1997, Woinarski *et al*. 2000, Doody *et al*. 2003, Wilson and Swan 2004, and Wilson 2005b). The potential for fauna entrapment and mortality is significant and has been acknowledged as a key

environmental issue by the *Australian Pipeline Industry Association Code of Environmental Practice* (APIA 2005).

To help reduce potential impacts from trench fall, the length of open trench will be the minimum practicable at any one time. It is recommended that management practices be implemented that reduce the potential for fauna to enter open trenches and prevent mortality of any individuals which may become entrapped (see Section G.7.1.3 for details).

G.1.1.1.7 Introduced Fauna and Flora

Vertebrate Fauna:

The review of existing information and the findings of field surveys has identified a suite of introduced fauna species which are know or likely to occur within the project area and surrounds. The majority of these species have been widely acknowledged as implicit in the degradation of habitat values for both native fauna biodiversity and species of conservation significance. Threats include predation of native taxa, competition with native fauna, physical degradation of native fauna habitat, and transmission of pathogens to native fauna.

Evidence drawn from field surveys indicates that the occurrence of a variety of pest species was widespread throughout the project area and most are assumed to have resident populations, though their abundance is likely to vary throughout the project area.

As part of the operation of the project, no pest species will be deliberately introduced to the project area and measures will be implemented to reduce accidental introduction.

Invertebrate Fauna:

The invertebrate pests of most concern are introduced ants. Red Imported Fire Ants (*Solenopsis invicta*) were first recorded from Australia in 2001 when colonies were found in Brisbane. In 2006, fire ant colonies were found at Yarwun, just west of Gladstone. By September 2006, the Yarwun ants had been eradicated, but the possibility remains that other fire ant colonies may exist around Gladstone or elsewhere in central Queensland.

CSIRO climate model analysis shows that fire ants have the potential to inhabit vast areas of coastal Australia, including natural areas such as world heritage areas and national parks (DPI&F 2007). Fire ants are very aggressive and are voracious feeders and these attributes indicate that fire ants have the potential to impact on native fauna biodiversity, particularly native ground fauna, including invertebrates, skinks, frogs, birds and mammals (DPI&F 2007). There is evidence of these impacts in some fire ant infested bushland in Brisbane's southwest (DPI&F 2007). Fire ants also have the potential effect long-term changes to vegetation communities in natural areas as a result of their habit of eating or damaging native plant

seeds and predating/disturbing insects and animals which pollinate native plants (DPI&F 2007).

Red Imported Fire Ants have been declared a notifiable pest under the *Plant Protection Act 1989* (Qld). Landholders are legally obliged to inform the DPI&F if they suspect they have fire ants, and the withholding of this information can result in fines.

The National Fire Ant Eradication Program commenced in 2002 to eradicate the red imported fire ant from Queensland and is part of a nationally coordinated program involving a cooperative approach between the Commonweath and Queensland Governments (DAFF 2007). Part of the National Fire Ant Eradication Program strategy aims to reduce the spread of fire ants through movement controls, i.e. restrictions on the disturbance or movement of high-risk materials. High-risk materials include soil, mulch, hay, turf and earth-moving machinery/vehicles/equipment.

The extreme southern extent of the project area is included within the area declared as the Yarwun Fire Ant Restricted Area (DPI&F 2007). Regulations apply to commercial activities which involve moving high-risk materials within and out of a fire ant restricted area (e.g. movement of high risk materials must be accompanied by a movement certificate or fire ant declaration form).

Red Imported Fire Ants are very small, only 2–6mm long, coppery brown in colour like beer bottles. They live mainly in dome-shaped nests with no visible entry holes. The nests can be up to 40cm tall (see illustrations at http://www.dpi.qld.gov.au/cps/rde/xchg/dpi/hs.xsl/4790_4549_ENA_HTML.htm), although new nests are often concealed underground or beneath debris with no mound present. Fire ants readily nest in industrial sites such as outdoor depots, where they can easily be transported along with containers or pipes that have been stored on the ground, especially if soil adheres to the base. They are easily overlooked because they often remain concealed within their nests for long periods, but will storm out when disturbed and sting fiercely. The worker ants vary greatly in size, and this characteristic, plus the lack of visible entry holes in nests, and the stinging behaviour, provides good indications that ants are fire ants. Illustrations can be found on the Department of Primary Industries and Fisheries (DPI&F) website (http://www2.dpi.qld.gov.au/fireants/8294.html). Construction personnel; should not try to identify ants themselves, but should mail samples of any suspicious ants to the Queensland Fire Ant Control Centre. The ants should be killed with insect spray or frozen in a fridge, then sent in a dry condition.

Another invasive ant of concern is the Yellow Crazy Ant *Anoplolepis gracilipes*. Crazy ants have been recorded at various sites along the Queensland coast, including Cairns, Hervey Bay, Brisbane and Logan City. Although crazy ants are not known from the region between

Cairns and Hervey Bay, it is considered likely by experts at Biosecurity Queensland that undetected infestations exist (*pers comm.* T. Low, 2007).

Where high populations or super-colonies form, crazy ants can directly impact on a range of native vertebrate and invertebrate fauna and flora (including *EPBC Act* listed threatened taxa), resulting in considerable losses of biodiversity, changes in habitat structure and alterations to the ecosystem processes (DECC 2005, TSSC 2005).

The Yellow Crazy Ant is declared a Class 1 pest under the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld). A class 1 pest is one that is not commonly present in Queensland, and if introduced would cause an adverse economic, environmental or social impact. Class 1 pests established in Queensland are subject to eradication from the state. Landowners must take reasonable steps to keep their land free of class 1 pests. Declaration under state legislation imposes a legal responsibility for control by all landowners on land under their management and without a permit, it is an offence under the *Land Protection Act* to:

- introduce a pest animal to the state;
- feed a declared pest animal;
- keep a declared pest animal; or
- release a declared pest animal.

The declaration establishes responsibility with landholders, and gives QNR&M power to take emergency control action, including issuing emergency quarantine notices.

As with fire ants, crazy ants can be transported on vehicles, especially among soil or green waste. A lump of earth attached to a grader, truck or section of pipe could carry a queen ant and enough workers to found a new colony. Vehicle hygiene is thus important. Construction personnel will be trained to report any unusual ants detected around depots or camps.

Yellow imported crazy ants are yellowish tan, about 5 mm long, with long antennae and long legs (see DPI&F website at http://www.nrw.qld.gov.au/pests/pest_animals/declared/crazy_ant.html). Crazy ants do not sting but will spray irritating formic acid from their abdomens when disturbed. This is unlikely to have serious medical consequences. Crazy ants can be spread through transportation with timber and other products, and they have been found inside kitchens on industrial premises in Queensland.

Environmental Weeds:

As identified in Chapter 6 of the EIS, Terrestrial Flora, there are a variety of exotic weed taxa within the project area and surrounds. Many of are either known to, or have the potential to

pose a significant threat to the maintenance of terrestrial biodiversity values. Weed hygiene and control protocols will be developed and implemented through a construction weed management plan (see Section G.7.1.3 for details and Chapter 6, Terrestrial Flora).

G.7.1.2 Potential Impacts

As a result of the review of existing information sources, a wide variety of *EPBC Act* listed Threatened Species were initially considered in regards to potential occurrence within the project area (see Table 3). Habitat suitability assessments and a series of targeted field surveys undertaken for this chapter have provided further assistance to refining the list of taxa to include those known to occur within the project area and close surrounds or those, which have a potential to occur within the project area, and close surrounds.

The findings of that work also indicate that that the project area does not support high quality preferred habitat for the any of those species, though the project area does support areas of comparatively lower quality habitat in which *EPBC Act* listed threatened species have been recorded and/or could potentially occur.

In consideration of these issues, it is concluded that generally there is minimal prospect that the development and operation of the project will result in a significant impact to local populations if appropriate impact mitigation measures are implemented (see Section G.7.1.3 for details).

The following sections identify those *EPBC Act* listed threatened fauna species considered in the final analysis and a summary of the potential impact on these species.

G.1.1.1.8 *EPBC Act* listed Threatened Fauna

The field survey program has detected *EPBC Act* listed threatened taxa which have been recorded within the project area or on adjacent land. They are:

- *Critically endangered*: Yellow Chat (*Epthianura crocea macgregori*);
- *Vulnerable*: Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*); and
- *Vulnerable*: Ornamental Snake (*Denisonia maculata*).

The review of fauna databases and local studies identified a variety of *EPBC Act* listed threatened species that have been recorded in, or have the potential to occur in, the broader area encompassing the project area. As determined through field surveys, habitat suitability assessments, and knowledge of habitat requirements, the project area does not support examples of quality preferred habitat for many of these species. Whilst the likelihood of occurrence within the project area for many of these taxa was determined to possible, though

highly unlikely, a conservative precautionary approach has been adopted and those species have been included in the assessment of potential impacts.

The primary potential impacts to *EPBC Act* listed threatened taxa include loss of shelter and food resources, loss of breeding sites, trench fall (primarily herpetofauna) and possibly increased predation (primarily small ground mammals and birds) resulting from:

- Clearing of remnant vegetation and riparian communities;
- Removal of habitat trees, especially mature hollow-bearing trees;
- Removal of ground debris in the construction of the pipeline;
- Trenching operations;
- Increased ease of access for introduced predators.

Table 10 provides a summary of occurrence status and potential impacts and mitigation responses for *EPBC Act* listed threatened fauna that are known to occur, or have the potential to occur, within habitats of the project area and/or land immediately adjacent.

Table 10 Summary of occurrence status and mitigation responses for *EPBC Act* listed Threatened fauna

Status:	CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory
Legislation:	*EPBC Act = Environment Protection and Biodiversity Conservation Act 1999* (Cth)

Species	EPBC status	Occurrence status and summary of key impact mitigation strategies
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	**No record, possible.** Northern extent of distribution around Gladstone, though may occur in southern parts of project area. Minimise tree clearing and impacts to remnant woodlands and forest.
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V	**No record, possible.** Northern extent of distribution around Gladstone/Mt. Larcom. Minimise impacts to remnant vegetation communities (especially those with a shrubby understorey), microtunneling or restricted clearing widths through riparian communities, protection of hollow-bearing trees, and post-construction habitat rehabilitation.

Species	EPBC status	Occurrence status and summary of key impact mitigation strategies
Collared Delma (*Delma torquata*)	V	**No record, possible.** Minimise impacts to remnant woodland and open forest communities (especially those associated with cracking clays), open trench exclusion fencing, and trench fall rescue protocols.
Brigalow Scaly-foot (*Paradelma orientalis*)	V	**No record, possible.** Minimise impacts to remnant vegetation communities (especially those with rocky outcrops at the southern end of the project area), open trench exclusion fencing and trench fall rescue protocols.
Yakka Skink (*Egernia rugosa*)	V	**No record, possible.** Minimise impacts to remnant woodland and open forest communities (especially those with rocky outcrops at the southern end of the project area), trench fall rescue protocols, and post-construction habitat rehabilitation.
Ornamental Snake (*Denisonia maculata*)	V	**Known.** Recorded from woodland adjacent to wetland (near south of Midgee). May occur in similar habitats to north and south, especially patches on heavier, cracking clay soils, in association with waterbodies. Minimise impacts to wetland areas through microtunneling, minimal clearing paths, post-construction habitat rehabilitation, open trench exclusion fencing, trench fall rescue protocols, and trench fall rescue protocols, and post-construction habitat rehabilitation.
Red Goshawk (*Erythrotriorchis radiatus*)	V/M	**No record, possible.** Minimise impacts to remnant woodland and forest (particularly larger patches in southern sector of project area), and post-construction habitat rehabilitation. Distribution uncertain in region and these raptors require a very large home range.
Painted Snipe (*Rostratula benghalensis*)	V,M	**No record, possible.** Occurrence erratic and unpredictable, seldom remaining long in wetlands at any locality. Minimise impacts to wetland areas through microtunneling, minimal clearing paths, and post-construction habitat rehabilitation.
Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*)	V	**Known.** Recorded from a variety of locations**,** though mainly within the central sector of the project area. Known to occur in highly disturbed cleared landscapes. Minimise impacts to drier eucalypt woodland and areas where native grasses predominate, and post-construction habitat rehabilitation.

Species	EPBC status	Occurrence status and summary of key impact mitigation strategies
Yellow Chat (*Epthianura crocea macgregori*)	CE	**Known.** Recorded within one kilometre of project area though not recorded within adjacent areas along ROW (despite a seven-month monitoring program). Five areas of potentially suitable Yellow Chat habitat are traversed by the ROW (see figure 7.4 and 7.6). These include potential Yellow Chat habitat at: • Fauna Habitat Sensitivity Site 16 (see Table 12), north of Inkerman Creek • Fauna Habitat Sensitivity Site 17 (see Table 13), at the Inkerman Creek crossing • Fauna Habitat Sensitivity Site 21 (see Table 13) at the 12 Mile Creek crossing • Fauna Habitat Sensitivity Site 23 (see Table 13), at the Pelican Creek crossing • Fauna Habitat Sensitivity Site 24 (see Table 13), to the west of Raglan Creek Minimise impacts to wetland areas through microtunneling (see for all monitoring sites), minimal clearing paths, sediment and pollutant controls, rehabilitation of pre-construction drainage patterns, dry season construction scheduling, post-construction habitat rehabilitation, and feral animal weed control strategies.

Table 11 lists those relevant taxa which are classified as threatened (i.e. endangered or vulnerable) under the *EPBC Act* and responses to the significant impact criteria as described within the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines – Matters of National Environmental Significance* (May 2006). As a result of the analysis summarised in the following table, it is considered that the proposed action will not have a real chance or possibility of occurring as per the Guidelines noted above.

Table 11 Summary of significant impact criteria for *EPBC Act* listed Threatened fauna

Significant impact criteria
Criteria 1: Lead to a long-term decrease in the size of the population.
Criteria 2: Reduce the area of occupancy of the species.
Criteria 3: Fragment an existing population into two or more populations.
Criteria 4: Adversely affect habitat critical to the survival of the species.
Criteria 5: Disrupt the breeding cycle of a population.
Criteria 6: Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Criteria 7: Result in invasive species that are harmful to an endangered species becoming established in the species' habitat.
Criteria 8: Introduce disease that may cause the species to decline

Threatened species	Status	Response to significant impact criteria								
		#1	#2	#3	#4	#5	#6	#7	#8	#9
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	No	No	No	No	No	No	No	No	No
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V	No	No	No	No	No	No	No	No	No
Ornamental Snake (*Denisonia maculata*)	V	No	No	No	No	No	No	No	No	No
Collared Delma (*Delma torquata*)	V	No	No	No	No	No	No	No	No	No
Brigalow Scaly Foot (*Paradelma orientalis)*	V	No	No	No	No	No	No	No	No	No
Yakka Skink (*Egernia rugosa*)	V	No	No	No	No	No	No	No	No	No
Red Goshawk (*Erythrotriorchis radiatus*)	V	No	No	No	No	No	No	No	No	No
Painted Snipe (*Rostratula benghalensis*)	V	No	No	No	No	No	No	No	No	No
Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*)	V	No	No	No	No	No	No	No	No	No
Yellow Chat (*Epthianura crocea macgregori*)	CE	No	No	No	No	No	No	No	No	No

Alignment with the Yellow Chat Recovery Plan

In August 2008, a recovery plan for the Yellow Chat (*Epthianura crocea macgregori*) was released by the Commonwealth and Queensland governments (Houston and Melzer 2008). The recovery plan lists the following as threats to Yellow Chats:

1 Lack of knowledge regarding key aspects of Capricorn yellow chat ecology and habitat requirements.
2 Construction of barriers such as extensive levee banks for ponded pasture development or road works within tidal areas.
3 Construction of impoundments (weirs and dams or ponded pastures) upstream of areas supporting yellow chats.
4 Spread of exotic pasture grasses, particularly aleman grass and Olive hymenachne.
5 Increase in cattle stocking densities where chats currently occur.
6 Uncontrolled fire.

Field survey work undertaken to investigate potential Yellow Chat habitat within the project area will contribute to the understanding of Yellow Chat occurrence and habitat usage (thus support resolution of threat #1). In relation to threats 2 and 3, the project does not involve

development of levee banks or impoundments and is supported by a extensive range of impact avoidance and mitigation strategies in relation to construction works within or near wetlands, thus the project will not exacerbate the effects of threats 2 and 3. In relation to threat #4, a comprehensive suite of measures are to be implemented (and continually monitored) in relation to preventing the introduction of environmental weeds within the project area (see Chapter 20). Likewise, there are a suite of project controls designed to eradicate and environmental weeds which may establish within the project area and adjoining land. In relation to threat #5, the project does not involve the introduction of cattle and a comprehensive suite of measures are to be implemented (and continually monitored) in relation to preventing the introduction of introduced fauna within the project area (see Chapter 20). In relation to threat #6, protocols have been prepared to ensure minimal risk of fire emanating from the project area (See Chapter 16 and 20).

G.1.1.1.9 Fitzroy to Bajool

During the field survey program, habitats of comparatively higher value were identified and the pipeline route adjusted to avoid these whenever possible. However, where impacts are unavoidable, mitigation measures will be adopted that will aim to minimise disturbance to these areas (see Section G.7.1.3, Mitigation) as these areas represent indirect impacts on *EPBC Act* listed threatened fauna. Table 12 lists and describes the areas of fauna habitat sensitivity (see also Figure 7.4 of the EIS) and for each area, a summary of the key impact mitigation strategies which should be implemented.

Table 12 Potential impacts and primary mitigation strategies for key locations within the Fitzroy to Bajool section

Area #	Habitat and comments	Potential impacts and primary mitigation strategies
1	Fitzroy River riparian habitats. Fauna movement; habitat for forest birds and microbats; and hollow-bearing trees.	Removal of mature hollow-bearing trees; disruption to wildlife movement corridor. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; trench fall management protocols.

2	Northwestern extension of a series of semi-permanent vegetated billabongs to north of Nine Mile Road. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; feral animal weed control strategies.
3	Western end of a series of semi-permanent vegetated billabongs. Extends south to Nine Mile Road. Habitat for waterbirds and waders, including rare and migratory species	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; feral animal weed control strategies.
4	Western end of a large semi-permanent constructed wetland. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; feral animal weed control strategies.
5	Corridor traverses centre of semi-permanent wetland. Largely natural form though surrounds cleared of remnant vegetation. North of Malchi Nine Mile Road. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling.

6	Billabong of natural form though surrounds cleared of remnant vegetation. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling.
7	Billabong of largely natural form though surrounds cleared of remnant vegetation. North of Titman Road. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling.
8	Adjacent to Gavial Creek wetlands. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage; introduction of exotic flora. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; weed control protocols; rehabilitation of pre-construction drainage patterns; dry season construction scheduling.
9	Small open seasonal wetland – part of Serpentine Creek wetland system. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage; introduction of exotic flora. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; weed control protocols; rehabilitation of pre-construction drainage patterns; dry season construction scheduling.

10	Shallow seasonal wetland and part of the Serpentine Creek wetland system – north of Georges Road. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling.
11	Shallow seasonal wetland and part of the Serpentine Creek wetland system – south of Georges Road. Habitat for waterbirds and waders, including rare and migratory species.	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage; introduction of exotic flora. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; weed control protocols; rehabilitation of pre-construction drainage patterns; dry season construction scheduling.
12	Seasonal wetland and part of the Serpentine Creek wetland system – south of Casuarina Road. Habitat for waterbirds and waders, including rare and migratory species	Alteration to surface hydrology; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling.
13	Dingo Creek riparian vegetation. Fauna movement; locally significant habitat corridor.	Removal of remnant vegetation; disruption to wildlife movement corridor; alteration to surface hydrology. Strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns.

14	Station Creek riparian vegetation. Fauna movement; locally significant habitat corridor.	Removal of remnant vegetation; disruption to wildlife movement corridor; alteration to surface hydrology. Strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns.
15	Oakey Creek riparian vegetation. Fauna movement; locally significant habitat corridor.	Removal of remnant vegetation; disruption to wildlife movement corridor; alteration to surface hydrology. Strict vegetation clearance protocols; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns.
16	Seasonal wetland system comprising of natural form broad swales. Part of Inkerman Creek wetland system. Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat.	Removal of mature hollow-bearing trees; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.

G.1.1.1.10 Bajool to Gladstone

During the field survey program, habitats of comparatively higher value were identified and the pipeline route adjusted to avoid these whenever possible. However, where impacts are unavoidable, mitigation measures will be adopted that will aim to minimise disturbance to these areas (see Section G.7.1.3) as these areas represent indirect impacts on *EPBC Act* listed threatened fauna. Table 13 lists and describes the areas of fauna habitat sensitivity and for each area, a summary of the key impact mitigation strategies which will be implemented.

These mitigation measures will include minimising disturbance widths, microtunnelling, and adopting practices for restoring areas of high habitat values.

Table 13 Potential impacts and primary mitigation strategies for key locations within the Bajool to Gladstone section

Area #	Habitat and comments	Potential impacts and primary mitigation strategies
17	Seasonal wetland system comprising of natural form broad swales – south of Port Alma railway. Part of Inkerman Creek wetland system. Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat.	Alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
18	Inkerman Creek and associated wetlands. Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat.	Removal of remnant vegetation; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; post-construction area-specific restoration; microtunneling; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
19	Node of *Eucalyptus moluccana* woodland. Habitat node in largely cleared landscape.	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; introduction of exotic flora and fauna. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; feral animal weed control strategies; trench fall management protocols.

20	Southern extent of saline wetlands of Twelve Mile Creek Reserve. Adjacent to potential Yellow Chat habitat.	Alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; minimal construction clearing path; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
21	Freshwater section of Twelve Mile Creek – adjacent and upstream of Twelve Mile Creek Reserve. Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat.	Alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; microtunneling; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies.
22	Twelve Mile Creek tributary – riparian vegetation. Wildlife movement corridor.	Removal of remnant vegetation; removal of mature hollow-bearing trees; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
23	Broad seasonal wetland – part of Pelican Creek. Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat.	Alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.

24	Southern extent of the Horrigan Creek wetland complex. Habitat for waterbirds and waders, including rare and migratory species; potential Yellow Chat habitat.	Alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
25	Horrigan Creek riparian vegetation. Wildlife movement corridor.	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; microtunnelling; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
26	Horrigan Creek riparian vegetation. Wildlife movement corridor.	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; microtunnelling; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.

27	Raglan Creek riparian vegetation (western extent). Wildlife movement corridor.	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restorationl; microtunnelling; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
28	Raglan Creek riparian vegetation (eastern extent). Wildlife movement corridor.	Removal of remnant vegetation; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; post-construction area-specific restoration; microtunnelling; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
29	Remnant vegetation. Also large wetland approximately 100m to south. Habitat node in largely cleared landscape.	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; introduction of exotic flora and fauna. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; feral animal weed control strategies; trench fall management protocols.

30	Darts Creek riparian vegetation – north of Darts Creek Road. Wildlife movement corridor.	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
31	Darts Creek riparian vegetation – north of Popenia Road.	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.

32	Larcom Creek tributary riparian vegetation	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
33	Larcom Creek riparian vegetation	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.

34	Boat Landing Creek riparian vegetation	Removal of remnant vegetation; removal of mature hollow-bearing trees; habitat fragmentation; disruption to wildlife movement corridor; alteration to surface hydrology; introduction of exotic flora; disturbance to wildlife during key seasonal habitat usage. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; dry season construction scheduling; weed control strategies; trench fall management protocols.
35	Remnant vegetation to near north of railway line	Removal of remnant vegetation; introduction of exotic flora. Refine the ultimate pipeline alignment during final surveying; strict vegetation clearance protocols; respreading of logs, fallen and cleared vegetation; protection protocols for hollow-bearing trees; reuse of trimmed limb hollows; post-construction area-specific restoration; minimal construction clearing path; sediment and pollutant controls; rehabilitation of pre-construction drainage patterns; weed control strategies; trench fall management protocols.

G.7.1.3 Mitigation

General Requirements

All personnel shall attend environmental training prior to entering the work site. As part of this training, all personnel will be briefed about their obligations to protect fauna.

- Fauna shall not be fed and direct contact with fauna is to be avoided. This includes both native and introduced species.

Vegetation Clearing and Habitat Disturbance

- Minor alignment refinements that reduce impacts to areas of remnant vegetation and waterway crossings are to be investigated and adopted where possible during final surveying. An experienced botanist/ecologist is to assist.
- Refine the ultimate pipeline alignment during final surveying to avoid or minimise the clearing of mature hollow-bearing trees. An experienced botanist/ecologist is to assist.

- No vegetation removal shall occur until relevant approvals have been obtained. All permit approval conditions will be followed.
- Clearing boundaries will be delineated on all drawings and in the field to define the extent of authorised clearing.
- Installation of vegetation clearance markers (e.g. high visibility poly-web fencing) prior to the commencement of vegetation clearance. No flagged vegetation shall be removed.
- Identify and peg out intended vehicle access tracks to and along the right of way (ROW) at the commencement of the construction phase, to prevent the development of multiple access tracks.
- Vegetation clearing will be limited to within the construction footprint. Construction equipment and personnel will not be permitted outside the surveyed areas. Impact to vegetation outside the ROW will be avoided.
- Cleared vegetation is to be stockpiled so as not to impede wildlife, surface drainage and avoid damage to adjacent live vegetation.
- Locating features such as fill stockpiles, access tracks, site facilities, etc. in areas of existing disturbances.
- Within areas of remnant vegetation, limiting clearing along access tracks within the ROW to slashing to a minimum height of 200mm, to allow for the retention of ground layer and understorey vegetation elements in all areas not directly utilised for infrastructure construction or access track purposes.
- Where possible, lopping of trees within the clearing zone, in preference to completely removing them.
- If required, trimming of branches overhanging the easement will be undertaken using a chainsaw, following the 'three-cut' method.
- All mature hollow-bearing trees are to be retained and protected wherever practicable. Where this cannot be achieved, hollow limbs and/or trunks should be left on the ground adjacent to the ROW (or relocated to within areas of remnant vegetation) to provide habitat for ground-dwelling fauna.
- Clearance of ground cover vegetation shall be restricted to the construction easement. Cleared or trimmed vegetation shall be stockpiled separately from topsoil.
- No large scale burning of vegetative wastes is to be undertaken. Timber is to be chipped or stick raked into stock piles for use in revegetation and erosion control.
- Prescribed burning will only be undertaken with fire authority approval and only when it is not possible to respread the cleared vegetation (e.g. where material includes a major component of woody weed infestation).
- Construction activities shall be scheduled to minimise the time between clearing and rehabilitating the ROW.
- Topsoil and vegetation will be respread as soon as practicable after the completion of construction works.
- The surface profile shall be reinstated to ensure maintenance of local surface conditions.

- The topsoil shall be stockpiled in a manner so that it can be easily returned during reinstatement (i.e. not placed on uncleared vegetation or against tree trunks). Soil and vegetation stripped from the ROW will be stored immediately adjacent to the site where it originated. No soil or vegetation material is to be transported along the corridor.
- Trench spoil is to be stockpiled separately from topsoil. Where practicable, deep top soil from the trench will be stockpiled separately from the subsoil.
- A reseeding plan based on soil type and existing local ground layer vegetation characteristics (i.e. native or improved pastures) along the alignment will be implemented.
- Local provenance native plant seed is to be used for rehabilitation within any areas of remnant or remnant regrowth vegetation that supports a ground cover of native grasses. Where this is not possible, seed from other parts of central Queensland would be acceptable.
- Monitoring of vegetation reestablishment is to be conducted by a suitably experienced ecologist.

Habitat Fragmentation and Disturbance to Wildlife Movement Corridors

- Constraining corridor clearing widths to the minimum necessary to allow construction of infrastructure (i.e. the minimum required to safely construct the infrastructure and fulfil environmental management requirements, e.g. erosion control).
- Avoiding additional clearing of remnant vegetation for construction vehicle access tracks, truck turning areas and extra workspaces, etc.
- Logs and fallen vegetation will be pulled back over the alignment to provide habitat for native fauna.
- Where required, trees adjacent to working areas are to be lopped, with complete-to-ground clearing being avoided.
- Avoid construction of separate crossings for access tracks, as access would be able to be gained to the crossing area from both sides of all creeks.
- Any fencing necessary along the outer ROW boundary should allow passage of fauna from either side of such fencing. For new fencing, the design should incorporate a 30 cm gap between ground level and the first rail or wire strand. A chain-wire fence should also incorporate a 30 cm gap between the bottom of the chain-wire and ground level and the overall height of a chain-wire fence should be limited to maximum of 1.5 m or less. The use of barbed wire should be avoided and used only where essential to exclude stock from adjoining pastoral activities. Where the use of barbed wire can not be avoided, the fence design should incorporate alternate strands of plain wire and barbed wire, e.g. top strand plain wire, middle strand barbed wire and bottom strand plain wire. Existing boundary fences should be retrofitted to meet the above recommendations.

Disturbance to Wetlands and Waterways

- Refine the ultimate pipeline alignment during final surveying to further minimise impacts to wetland and riparian habitats.
- An experienced botanist/ecologist is to assist where any alignment refinements are proposed during final surveying of wetland or riparian crossings.
- Construction should be undertaken during the dry season (i.e. June to September) wherever possible.
- Water quality protection measures (e.g. sediment and pollutant controls) are to be installed prior to the main construction works (i.e. trenching and pipeline instatement).
- Disturbance to habitat values have been minimised where possible through trenchless construction methods.
- The construction corridor and the clearing of wetland vegetation cover (native or introduced) is to be kept to the minimum required to safely construct the pipeline and comply with other environmental management safeguards (e.g. erosion control, pollutant controls, spoil storage, etc.).
- Surface drainage is to be returned to pre-construction patterns.
- Areas disturbed by constructing activities are to be rehabilitated to closely reflect pre-construction vegetation floristics and structure.
- Monitoring of vegetation reestablishment is to be conducted by a suitably experienced ecologist.

Trench Fall

- Construction should be timed to take place in the coolest and driest months (i.e. June to September), when activity levels of reptiles and amphibians are lowest and when conditions are most favourable for minimising fauna mortality in open trenching.
- Construction activities will be planned so that the excavated trench will be open for the minimum practicable amount of time to install pipe sections. Trenching should occur progressively to minimise the period of time the trench is open and the length of open trench.
- Specific requirements to minimise fauna entrapment and mortality include:
    - Minimising the length of trench open at any one time.
    - The majority of the trench is to be backfilled prior to cessation of construction each day.
    - Minimising length of trench to be left open over night.
    - The ends of an open trench will ramped to a gentle incline (< 50%) so as to allow any fauna to escape.
    - Escape ramps and trench plugs (with slopes < 50%) are to be established for every 500 m of open trench. Additional methods may be adopted to create ‘ladders’ at

regular intervals to assist small fauna to exit the trench (e.g. branches, ramped gangplanks, etc.; see APIA (2005)).

- In addition, two damp, sawdust filled hessian bags (shelter sites) are to placed intermediate to the escape ramps (i.e. for every 250 m of open trench). Provision of fauna refuge areas should be guided by methods successfully employed during construction of the North Queensland Gas Pipeline (NQGP) (see Wilson and Swan (2004)),

- Construction personnel will inspect the entire open length of the trench daily from sunrise. If required, wildlife handlers (spotter catchers) will be called to site to attend to fauna issues.
- Wildlife handlers will remove wildlife from the trenches, identify, record data and release the captures into nearby vegetated areas. Personnel will be legally permitted, trained in appropriate handling protocols, and will possess the necessary Personal Protection Equipment (PPE) for the handling of animals.
- Wildlife handlers must be licensed to euthanase badly injured fauna that are found within the trench. The *Australian National Health and Medical Research Council's Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (2004)* are to be followed when dealing with injured fauna.
- A permit to interfere with wildlife from the Queensland Environment Protection Agency will be required for the wildlife handling activities as will the appropriate Animal Ethics Permit fro the Department of Primary Industries.
- Protocols for extracting fauna with minimal harm from open trenches should follow guidelines provided in Woinarski *et al.* (2000).

Introduced Flora and Fauna

Vertebrate Fauna

- The proposed development will not deliberately introduce any invasive species. Companion animals are to be banned from all pipeline construction activities to ensure that no pest species are introduced.
- Feral animal control strategies will be developed and implemented under a feral animal control plan. This will include:
- Design and implementation of an ongoing eradication program which targets pest animals.
- Design and implementation of an ongoing systematic monitoring program to detect the occurrence of feral animals and to assess the success of the eradication program.
- Implementation of a program to ensure strict litter control throughout the construction site. This is to be supported by: site-wide signage; an adequate number of litter bins (which by design exclude birds and vermin); bin clearance on a regular basis; daily maintenance of crib rooms to ensure cleanliness; educational signage within crib rooms on the linkage

between poor waste management practices, increases in pest animal populations and subsequent impacts to native fauna.

- Implementation of design features for permanent structures (e.g. pump stations. water treatment plant, etc.) and temporary site facilities (e.g. construction site offices. etc.) which minimise harbourage or roost opportunities for vermin and animal pests.

Invertebrate Fauna

The extreme southern extent of the project area is included within the area declared as the Yarwun Fire Ant Restricted Area (DPI&F 2007). Regulations apply to commercial activities which involve moving high risk materials within and out of a fire ant restricted area (e.g. movement of high risk materials must be accompanied by a movement certificate or fire ant declaration form).

To comply with these regulations, an Approved Risk Management Plan (ARMP) will be developed in consultation with DPI&F. The ARMP will set out strategies to be implemented to reduce the risk of spreading fire ants, including measures to reduce the potential facilities and/or equipment becoming infested with fire ants. The ARMP will include, but not be limited to, the following strategies (after DPI&F 2007):

- A site inspection must be conducted by a DPI&F inspector or approved person prior to moving or disturbing any soil.
- Vehicles, equipment and pipes will be inspected at depots before they are taken into the field to ensure they are not carrying live ants, and not carrying clods of earth that could conceivably contain ants.
- Construction activities will not move fire ant infested material outside the restricted area without the approval of a DPI&F inspector and only to approved disposal sites within a restricted area. Infested soil may only be moved to a DPI&F approved disposal site.
- All high risk materials will be treated before being moved out of the restricted area.
- Materials not infested with fire ants may be disposed within the restricted area using approved disposal sites only.
- Where the ARMP is not applicable to sub-contractor activities, a Fire Ant Declaration (FAD) form to move high risk materials will be required.
- All materials moved from within the restricted area will be accompanied by a movement certificate or Fire Ant Declaration Form.

Whilst there are no known populations of crazy ants within the region, the suite of mitigation measures to address the potential for the introduction of these pests forms a sub-set of those to be applied in respect to fire ants. As such, prevention and control strategies for crazy ants will be incorporated within the Approved Risk Management Plan outlined above, and applied throughout the project area.

Flora

- Weed eradication programs will be implemented as required, and a weed management plan will be implemented during construction.
- Equipment and material introduced to the region, especially those from interstate, will be screened for pest species.
- Workers undertaking the following tasks will be required to fulfil all washdown requirements: surveying; fencing / gating; clearing and grading; and reinstating. The remainder of the workforce will be required to stay on project approved roads or on the construction corridor, where they will not come into contact with weeds.
- Ensure all vehicles and machinery that will access the ROW are free from soil/organic matter prior arrival on site.
- Identify on drawings and to personnel, entry and exit points to the ROW at which hygiene protocols become effective.
- Establish and maintain weed wash down bays at designated entry and exit points.
- Clean down of machinery when moving from disturbed areas to undisturbed areas during clear, grade and rehabilitation.
- No soil or vegetation material is to be taken beyond one kilometre from the point of original clearing or extraction.

Animal Welfare

- Wildlife assessment/rescue services are to be engaged prior to vegetation clearing, to assess appropriate site clearing approaches to minimise deleterious impacts to fauna. Spotter/catcher services (wildlife handlers) are to be employed until all clearing has ceased.
- Wildlife handlers will follow the *Australian National Health and Medical Council's Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (2004)* when dealing with injured fauna.
- A permit to interfere with wildlife from the Queensland Environment Protection Agency will be required for the wildlife handling activities as will the appropriate Animal Ethics Permit fro the Department of Primary Industries.
- Development and implementation of protocols for any displaced fauna to be relocated to more suitable similar habitat within the surrounding area.
- Establishment of fauna exclusion fences to prevent fauna inadvertently re-entering the construction areas.
- Where possible, the timing of vegetation clearance (particularly areas of remnant vegetation) will be selected in order to minimise impacts (direct and indirect disturbances) to affected fauna habitats during optimum breeding periods (e.g. May to September is the breeding season for Yellow Chat as per the Development Scheme for the Stanwell – Gladstone Infrastructure Corridor State Development Area).

- Establishment of habitat enhancements to retained remnant habitat within the project area (e.g. artificial roost boxes for microbats).

G.7.1.4 Residual Impacts

As previously described, the majority of the project area is highly disturbed. For these largely cleared and grazed lands, the implementation of the mitigation strategies outlined above will result in the project creating a **negligible** residual impact on *EPBC Act* listed threatened fauna species (see Table 14). However, due to the impact upon the key locations (see Section G.7.1.2), the residual impact upon *EPBC Act* listed threatened fauna species is considered **minor adverse**.

Table 14 Project impact significance criteria for *EPBC Act* listed Threatened fauna

Significance	Impact significance criteria for terrestrial fauna
Major adverse	Extensive or acute disturbance (major impact) upon a matter of national importance. These effects are generally, but not exclusively, associated with sites, species and/or communities described as matters of national significance under the *EPBC Act*. The effects, whether direct or indirect, have the potential to result in the designation of a matter of national significance being permanently compromised. Mitigation measures and detailed design work are unlikely to remove all of the impacts upon the affected communities or interests. Significant residual impacts would predominate.
High adverse	These effects (major impact) are likely to be important considerations at a state or bioregional scale but, if adverse, are potential concerns to the project, depending upon the relative importance attached to the issue during the decision making process. Effects are likely to manifest as irreversible loss or damage to a substantial part of the state or bioregional distribution, or the majority of the local distribution of a threatened habitat type, community or population of flora or fauna as listed under the *EPBC* A*ct*. Mitigation measures and detailed design work are unlikely to remove all of the effects upon the affected communities or interests. Residual impacts would predominate.
Moderate adverse	These effects (major impact) are likely to be important at a sub-regional or local scale, resulting in an extensive or acute disturbance resulting in the loss or the permanent lowering of the area's biodiversity values. In some situations, the impact will result in limited disturbance (moderate impact) to a feature or site of regional importance where recovery is anticipated following completion of the works concerned. The cumulative effects of such issues may lead to an increase in the overall effects upon a particular area or species population. They represent issues where effects will be experienced but mitigation measures and detailed design work may ameliorate/enhance some of the consequences upon affected communities or interests. Some residual effects will still arise.

Significance	Impact significance criteria for terrestrial fauna
Minor adverse	These effects (moderate impact) are likely to be important at a local scale. Lesser loss or disturbance than moderate adverse (major impact) to a locally important site or local biodiversity values. Limited or temporary effects (minor impact) on national, bioregional or regional values. Relatively minor impacts to protected species and/or biodiversity generally, where mitigation measures are anticipated to alleviate short-term adverse impacts. Mitigation and compensation measures are generally effective in ameliorating the consequences upon affected communities or interests.
Negligible	Any impacts on resources considered to be of negligible ecological value, or effects on species, habitats or resources of value are likely to be imperceptible. Effects that result in minimal change or that which is beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.
Beneficial	Any effects that are expected to result in an improvement of the quality of ecological resources following completion of works. These can, for example, include creation of new or additional habitat features which are beneficial to native fauna, or introduction of measures that would achieve improvements in quality of existing habitat. Design features or management activities, which would make a long-term contribution to ecological objectives, or measures to ensure the long-term protection of species under threat which may not be adversely affected by the project per se (e.g. feral animal controls and weed eradication).

G.7.1.5 Cumulative and Interactive Impacts

The concept of cumulative impacts acknowledges that a development and associated activities can combine and interact with others to cause collective effects and that the resultant effect may be different in nature or extent from the effects of the individual activities alone. Cumulative impacts can result from a number of different elements within a project as well as from a number of different projects with interacting impacts in the same area. Cumulative impacts can be viewed in terms of the relationship between introducing a new development with existing land uses and the further interaction with other developments being planned.

Fauna habitat values within the project area have been strongly influenced by a history of cattle grazing and agriculture. This has resulted in extensive areas where native vegetation has been cleared. Those areas of native vegetation which remain, though often small and isolated or poorly connected, are of significance in maintaining local biodiversity values, and in some cases, supporting the only remaining habitat for species of conservation significance.

Although, the project has the potential to generate impacts to *EPBC Act* listed threatened native fauna habitat, it is considered that the successful implementation of the recommended mitigation measures has the potential to reduce any cumulative and interactive effects to a

level of relatively low significance. Whilst the cumulative and interactive effects of the addition of the project to the suite of existing land uses is considered to be of a relatively low significance, this result must be considered in the context of other potential projects which may be implemented within the SGIC. Other infrastructure projects include gas pipelines, water pipelines, and fibre optic cabling.

Further infrastructure within in the SGIC is likely to result in the following:

- Vegetation clearance, including removal of native and remnant vegetation which may lead to further reduction in *EPBC Act* listed threatened fauna habitat areas, habitat fragmentation, and the potential for introduction of feral animals and plants.
- Widening of previous waterway crossings or establishment of new crossings with the potential to generate disruption to wildlife movement opportunities and alterations to surface hydrology.
- Additional disturbance to seasonal wetlands with the potential to generate disruption to surface hydrology, disturbance to wildlife during key seasonal habitat usage, and the introduction of exotic flora and fauna.

Concomitant with the implementation and operation of each further project, there is the potential for cumulative and interactive impacts on local *EPBC Act* listed threatened fauna to reach a higher level of significance that that which can be attributed to the current project alone. These effects may result in diminishing the capacity of the local area to support current levels of native faunal diversity and the viability of local populations of some *EPBC Act* listed threatened taxa.

Many of habitat features within the SGIC (or transected by the SGIC), because of their size and/or context, may be approaching potential thresholds where repeated disturbances to them could result in significant deterioration of values. Any future proposed developments, will be required to address the cumulative impacts of their developments with the impacts of the other existing and the currently proposed developments in the area, and would be considered by the relevant approval authorities.

G.7.2 Threatened Terrestrial Flora and Threatened Ecological Communities

G.7.2.1 Main Potential Impact Processes

The main potential impacting processes to *EPBC Act* listed threatened flora and Threatened Ecological Communities associated with the clearing of the 30 m right-of-way and construction of the pipeline are:

- Clearing of vegetation remnants;
- Reduction of flora species habitat;
- Removal of individual species of significance;
- Reduction of wildlife corridor functionality;
- Remnant vegetation edge effects;
- Riparian vegetation disturbance; and
- Weed introduction.

G.7.2.2 Activities Causing Impacts

The activities which may cause the impacts listed in Section G.7.2.1 are:

- Felling of individual trees;
- Clear-felling of stands of trees, and increasing edge effects such as wind and weed penetration;
- Bulldozing of shrubby areas;
- Trenching across ephemeral wetlands and creeks, specifically including clearing either side of the trench;
- Digging pits on either side of wet creeks for entry and exit of underground boring; and
- Possible, accidental introduction of weeds to a site.

G.7.2.3 Impacts upon Ecological Communities

Table 15 lists those relevant Ecological Communities which are classified as Endangered under the *EPBC Act* and responses to the Significant Impact Criteria as described within the

EPBC Act Policy Statement 1.1 Significant Impact Guidelines – Matters of National Environmental Significance (May 2006). None of the Significant Impact Criteria will be met as a result of the project, but the reduction in area of a low-growing patch of Brigalow may occur (at Site 9c). The structural form of this patch of Brigalow does not meet the requirements for classification as remnant under the *VM Act*, nor the *EPBC Act*, which uses the structural classification of the *VM Act*.

Partial clearing of the semi-evergreen vine thickets of the Brigalow Belth (North and South) and Nandewar bioregions at Short Site 4 (see Figure 6.1 of the EIS) would only occur if the right-of-way were extended across existing road. If the corridor is located on the other side of the road, and this is the current intention, then no scrub will need to be cleared.

Table 15 Summary of Significant Impact Criteria for *EPBC Act* Endangered Ecological Communities

Endangered Ecological Communities	**Response to Significant Impact Criteria**						
	#1	#2	#3	#4	#5	#6	#7
Brigalow (*Acacia harpophylla* dominant and co-dominant)*	no*	no	no	no	no	no	no
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions	no	no	no	no	no	no	no

Significant Impact Criteria	
Criterion 1 -	reduce the extent of an ecological community
Criterion 2 -	fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
Criterion 3 -	adversely affect habitat critical to the survival of an ecological community
Criterion 4 -	modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
Criterion 5 -	cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
Criterion 6 -	cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established; or

	– causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community
Criterion 7 -	interfere with the recovery of an ecological community
**refer to discussion on the classification of Brigalow structure for Site 9c in section G.6.2.3*	

G.7.2.4 Direct Impacts upon EPBC Act listed Threatened Terrestrial Flora Species

Whole Right of Way

Endangered (under *NC Act* and *EPBC Act*) scrub species are of greatest concern in regard to the impact of the corridor. These scrub species are most likely to occur in Regional Ecosystem 11.11.18, as this defines lowland scrub on metamorphic sediments. Scrub in the project area is not necessarily restricted to this RE, depending on geological substrate and species assemblage. Table 9 shows the likelihood of occurrence of **targeted** *EPBC Act* listed Threatened Species along the corridor, of which the most likely species are scrub species. Due to the species diversity within scrub remnants, it is not possible to assess the relative likelihood of impact to specific scrub species, without exact knowledge of the proposed location of the pipeline (i.e. within a few metres)[3], and extensive survey of all scrub species along that line. It is considered unlikely that adult (mature) scrub species will be disturbed in the right-of-way. Scrub on Marble Creek had the greatest likelihood of impact, but the crossing point was surveyed and no *EPBC Act* listed Threatened Species were observed at that point. There are areas of scrub regrowth within the right-of-way that will be cleared, but these species are not advanced in growth (i.e. usually less than one metre high), and it is unlikely that these will be of sufficient growth form to warrant avoiding.

Black Ironbox (*Eucalyptus raveretiana*) is considered unlikely to occur in riverine locations along the corridor, but it is still possible that individuals may be encountered. These individuals are therefore at risk of removal or damage if not identified before trenching, boring or clearing operations take place.

[3] Note that Table 6-4 identifies the likelihood of occurrence of habitat for specific scrub species as fair, but **only** within remaining scrub remnants.

Fitzroy to Bajool

Wetlands are the ecosystems which will be most impacted along this section of the corridor. All wetlands in this area are to be trenched through, rather than bored under, because of their ephemeral nature (and size, in some cases). The wetlands impacted are identified in Table 6.7 of EIS Chapter 6. No threatened wetland species were identified for the project area from the *EPBC Act* Protected Matters Report, nor from Wildlife Online (see Table 8 Wildlife Online and *EPBC Act* Protected Matters Report).

Scrub species could potentially be impacted along this section of the corridor. Refer to the previous section above (Section 0) for impacts to these species.

Bajool to Gladstone

Although Brigalow (*Acacia harpophylla*) regrowth may occur immediately south of Inkerman Creek, it constitutes a Threatened Ecological Community under the *EPBC Act* (if of sufficient structure), but the species as an individual is not listed as threatened under the act.

Two species of tree cycads (*Cycas megacarpa* and *C. ophiolitica*) are known to occur in areas that may be intersected by the proposed corridor. They are Endangered under the *EPBC Act,* and could be impacted through removal and/or disturbance of vegetation.

Scrub species could potentially be impacted along this section of the corridor, through removal and/or disturbance of vegetation. Refer to the section above regarding 'Whole Right of Way' under this section for impacts to these species.

Summary of Significant Impact Criteria for EPBC Act Threatened Terrestrial Flora Species

Table 16 lists those relevant flora species which are listed as Threatened under the *EPBC Act* and responses to the Significant Impact Criteria as described within the *EPBC Act Policy Statement 1.1 Significant Impact Guidelines – Matters of National Environmental Significance* (May 2006). None of the Significant Impact Criteria will be met as a result of the project.

Table 16 Summary of Significant Impact Criteria for reported *EPBC Act* listed Threatened flora species

Threatened Species	Status	Response to Significant Impact Criteria								
		# 1	# 2	# 3	# 4	# 5	# 6	# 7	# 8	# 9
Atalaya collina	E	no	no	no	no	no	no	no	no	no
Bosistoa selwynii	V	no	no	no	no	no	no	no	no	no

Bosistoa transversa	V	no	no	no	no	no	no	no	no	no
Bulbophyllum globuliforme	V	no	no	no	no	no	no	no	no	no
Corymbia xanthope	V	no	no	no	no	no	no	no	no	no
Cupaniopsis shirleyana	V	no	no	no	no	no	no	no	no	no
Eucalyptus raveretiana	V	no	no	no	no	no	no	no	no	no
Leucopogon cuspidatus	V	no	no	no	no	no	no	no	no	no
Parsonsia larcomensis	V	no	no	no	no	no	no	no	no	no
Quassia bidwillii	V	no	no	no	no	no	no	no	no	no
*Cadellia pentastylis**	V	no	no	no	no	no	no	no	no	no

Significant Impact Criteria	
Criterion 1	lead to a long-term decrease in the size of an important population of a species
Criterion 2	reduce the area of occupancy of an important population
Criterion 3	fragment an existing important population into two or more populations
Criterion 4	adversely affect habitat critical to the survival of a species
Criterion 5	disrupt the breeding cycle of an important population
Criterion 6	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
Criterion 7	result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species' habitat
Criterion 8	introduce disease that may cause the species to decline
Criterion 9	interfere substantially with the recovery of the species

* This species was not originally targeted, but was observed (identified as probably ooline) during the survey

Summary of EPBC Act listed Threatened Terrestrial Flora Species Impacts

It is unlikely that *EPBC Act* listed Threatened species will be encountered along the corridor, during removal and/or disturbance of vegetation with the possible exception of ooline (*Cadellia pentastylis*). Table 16 shows that none of the Significant Impact Criteria (under the *EPBC Act*) will be met as a result of the project.

G.7.2.5 Mitigation and Residual Impacts

This section discusses the mitigation measures that will be implemented to minimise the potential impacts identified in Section G.7.2.1 to G.7.2.4, including aspects such as design (e.g. pipeline alignment), construction supervision by an environmental advisor, and the use of offsets. Further mitigation measures are identified in the Planning EMP in Chapter 20. Residual impacts and the severity of impacts are also identified.

Assessment of Impact Severity

Table 17 defines the significance criteria used for assessing impacts and is specifically adapted here to assess impacts on *EPBC Act* listed flora and ecological communities.

Table 17 Significance criteria for residual flora impacts

Significance	Criteria
Major adverse	Extensive or acute disturbance (major impact) occurring at a site of national importance, which results in the lowering of its ecological value. Also, direct or indirect adverse impact on an Threatened Ecological Community under the *EPBC Act* to the extent that its designation is potentially compromised, or the populations it supports or represents are materially reduced. Adverse effects on nationally or internationally protected species endangering their conservation status (Threatened species under the *EPBC Act)*.
High adverse	Irreversible loss or damage to a substantial part of the regional distribution, or the majority of the local distribution of a habitat type, community or population of flora (Threatened Ecological Community under the *EPBC Act*). Long-term disturbance effects to populations or plant species protected by the *EPBC Act.*
Moderate adverse	Limited disturbance (moderate impact) to a Threatened Ecological Community under the *EPBC Act* where recovery is anticipated following completion of the works concerned. Lesser effects than major adverse on nationally protected species where mitigation measures are anticipated to alleviate adverse impacts.
Minor adverse	Limited or temporary effects (minor impact) on Threatened Ecological Communities. Minor impacts on *EPBC Act* listed Threatened species where mitigation measures are anticipated to alleviate adverse impacts.
Negligible	Any impacts on resources considered to be of negligible ecological value, or effects on *EPBC Act* listed Threatened Species or Threatened Ecological Communities - the effects of which, when they occur, are likely to be imperceptible.
Beneficial	Any measures that are expected to result in an improvement of the quality of *EPBC Act* listed Threatened Species or Threatened Ecological Communities following their completion. These can, for example, include creation of new habitat features or introduction of measures that would achieve improvements in quality at an existing ecological site. Design features or management activities, which would

Significance	Criteria
	make a long-term contribution to ecological objectives, or measures to ensure the long-term protection of *EPBC Act* listed Threatened species, which may not be adversely affected by the project, are also included in this category.

EPBC Act listed Threatened Terrestrial Flora Species and Threatened Ecological Communities Mitigation

As discussed in Section G.7.2.4, construction (and operation) of the pipeline may impact on threatened (under *EPBC Act*) scrub species that may occur within the proposed corridor, but it is not possible to assess the relative likelihood of impact to specific scrub species without exact knowledge of the pipeline location (i.e. within a few metres during construction)[4]. Mitigation measures that will be implemented to minimise the potential impact to *EPBC Act* listed threatened scrub species include:

- A pre-construction survey of all scrub communities at the time the ROW is surveyed, focusing on the identification of *EPBC Act* listed Threatened Species along the proposed right-of-way (see Chapter 20 Planning EMP for proposed vegetation clearing practices);
- Areas of remnant vegetation along the alignment will be highlighted on all drawings and clearly marked in the field
- Potential minor realignment of the right-of way where possible (i.e. a few metres to go around trees or shrubs);
- Clearing boundaries will be clearly delineated on all drawings and in the field to define the extent of authorised clearing, which will not exceed the construction area.

Where these mitigation measures are implemented, along with the requirements in Chapter 20 of the EIS, there is likely to be a **negligible** impact to scrub species along the corridor.

Black Ironbox (*Eucalyptus raveretiana*) is considered unlikely to occur in riverine locations along the corridor, but it is still possible that individuals may be encountered. Mitigation measures to minimise the impact will include a pre-construction survey for Black Ironbox individuals, and potential minor realignment of the right-of way (i.e. a few metres to go around individual). There is likely to be a **negligible** impact to this species with the implementation of the above mitigation measures.

[4] Note that Table Table 9 identifies the likelihood of occurrence of habitat for specific scrub species as fair, but **only** within remaining scrub remnants.

Fitzroy to Bajool

Wetlands that potentially provide habitat for *EPBC Act* listed threatened wetland species and are likely to be impacted by the construction of the proposed pipeline are identified in Table 6.7 of EIS Chapter 6. While trenching is proposed for wetlands in this area because of their ephemeral nature (and size, in some cases), the implementation of the following mitigation measures will minimise the potential impact:

- When trenching across part of the wetland, topsoil will be stockpiled, and replaced after works to enable ground layer species to re-establish; and
- Wetlands will be restored, particularly for site 2.

Where these mitigation measures are implemented, along with the requirements outlined in the Planning EMP (Chapter 20 of the EIS), there is likely to be a **negligible** impact to *EPBC Act* listed threatened wetland species.

As previously mentioned, the ecological community at Site 4 will not be impacted and therefore no mitigation is provided here.

Bajool to Gladstone

Section G.7.2.4 outlines the potential occurrence of, and impact to, Brigalow (*Acacia harpophylla*) regrowth (or possibly stunted remnant) immediately south of Inkerman Creek. While the species (as an individual) is not listed as threatened under the *EPBC Act*, the community may constitute a Threatened Ecological Community under the act (if of sufficient structure). Mitigation measures and residual impacts for this community (located at site 9c) are outlined in the Table 18.

Table 18 Mitigation Measures and Residual Impacts at Site 9c

Mitigation	Residual Impact
Minimise width of clearing of vegetation within area needed for pipeline and right-of-way. There is an existing old narrow vehicle track that will be used for the right-of-way if possible. Total length of clearing is approximately 200 m, so it will be possible to reduce the clearing width so that two vehicles can pass during construction. Clearing to be strictly kept to a maximum of 15 m, with boundaries clearly marked with 2 m lengths of high-visibility poly-web fencing, with 10 m gaps permitted. If EPA determines that this community is of remnant status, hence Endangered, then all Brigalow plants that are removed will be partially buried in an adjacent waterlogged area to allow suckering and consequent regrowth.	**Minor adverse**, but could be **moderate adverse** if EPA determines that this community is of remnant status, hence Endangered.

If EPA determines that this community is of remnant status, hence Endangered, then all Brigalow plants that are removed will be partially buried in an adjacent waterlogged area to allow suckering and consequent regrowth.

Two species of tree cycads (*Cycas megacarpa* and *C. ophiolitica*, Endangered under *EPBC Act*), known to occur within the proposed corridor, may be impacted through removal and/or disturbance of vegetation in the right-of-way. Mitigation measures to minimise the potential impact on these species includes the avoidance of clearing in remnant vegetation, or where this is not possible, translocation of impacted individuals (as per Forster (2007)). Requirements outlined in the Environmental Management Plan (Chapter 20 of the EIS) will also be implemented. There is likely to be a **negligible** impact to *EPBC Act* listed threatened cycad species through implementation of these measures.

Summary of Mitigation

While it is considered unlikely that *EPBC Act* listed Threatened Species along the corridor will be impacted by the proposed project, pre-construction surveys will be conducted. When any *EPBC Act* listed threatened individuals remain within the construction footprint, these can be translocated (or replacements planted, depending on species) resulting in a **negligible** residual impact.

G.7.2.6 Cumulative and Interactive Impacts

The right-of-way is part of a larger corridor which will accommodate more services in the form of pipelines or cables. The Gladstone Area Water Board does not have control over these future additional services, and their potential impacts. The most significant issue associated with these additional services is the need for further clearing of vegetation, and the results of this study will be available to future proponents to assist with determining impacts, and devising mitigation measures.

It is considered unlikely that impacts on *EPBC Act* listed threatened flora species will accumulate over time due to additional services being installed. The corridor has been investigated as part of this assessment, and significant new findings are unlikely.

The key problems introduced by the installation of additional services are likely to be:

- Clearing of more vegetation in the form of another right-of-way, effectively widening the cleared part of the corridor. This will reduce remnant sizes and increase remnant fragmentation; and
- Introduction of more weeds, either in terms of quantity, or diversity, because of increased activity from construction, and subsequent maintenance.

Many of the environmental pressures generated by subsequent services may be greater than the current proposed project because they may occur during the rehabilitation period of this project, when damage could occur more easily to replanted areas. It is beyond the scope of this report to assess the cumulative impacts of these subsequent rights-of-way, but it is recommended that this report be used as a key source of baseline information, and as a guide to further impacts. Environmental management plans developed by other parties for additional services should be aware of the existing EMP (Chapter 20 of the EIS), so that management practices are coordinated between service operators. For example, weed management programs should be coordinated to increase effectiveness, particularly in areas infested by Parthenium and Giant Rats-tail Grass.

G.7.3 *EPBC Act* listed Threatened Aquatic Fauna and Flora

G.7.3.1 Impacts

Potential impacts to *EPBC Act* listed threatened aquatic flora, fauna and their habitat resulting from the construction and operation phases of the Gladstone–Fitzroy Pipeline project are:

Construction phase:

- Vegetation clearing and channel disturbance
- Water quality modifications (due to changes in turbidity and the mobilisation of organic sediments, Acid Sulfate Soils and other toxicants)
- Creation of in-stream barriers (i.e. culverts)

Operational phase:

- Alterations to habitat, both surrounding the intake pipe and within the Fitzroy River weir pool
- Translocation of exotic species, especially the noxious Water Hyacinth* (*Eichhornia crassipes*) from the Fitzroy River
- Water treatment plant (WTP) operational impacts.

Chapter 8 of the EIS describes these impacts in detail for aquatic flora and fauna.

Due to the low probability of occurrence of *EPBC Act* listed threatened aquatic flora and fauna species within the project area, significant impacts to listed Threatened Species are considered unlikely. Despite this, mitigation measures will still be implemented for non-*EPBC Act* listed species. These mitigation measures cover impacts on all aquatic flora and fauna (not only *EPBC Act* species which are listed as threatened) and hence these can be found in Chapter 8 of the EIS.

G.7.3.2 Residual Impacts

The levels of residual impact described in Table 19 were considered in assigning significance to the environmental impacts identified.

After mitigation, impacts upon aquatic flora and fauna that are listed under the *EPBC Act* as threatened are considered negligible.

Table 19 Impact Significance Criteria for Aquatic Flora and Fauna

Impact level	Scale of impact	Assessment criteria (must meet the criteria of one or more impact categories)		
		Habitat impact	**Species impacts**	**Ecosystem impacts**
Major adverse	Moderate (or greater) impacts at a national or state scale	> 60% of habitat removed	Mortality of a protected species, likely to cause local extinction	Total ecosystem collapse
High adverse	Minor impact at national or state scale, moderate (or greater) impact at a regional scale	30–60 % of habitat removed	Mortality of a protected species affects recruitment and the capacity to increase in numbers	Measurable impact to ecosystem function: some functions are lost, declining or increasing outside an historical range, or facilitate new species to appear
Moderate adverse	Major or high (medium- to long-term) impact at a local scale	5–30% of habitat removed	Mortality within some species causes impacts at the maximum acceptable level.	Measurable change to ecosystem components but no loss of functions (no loss of components)
Minor adverse	Moderate or high (short-term) impact at a site-specific scale, or minor impact at a local	< 5% of habitat removed	Protected species affected but no impact on population status (e.g. stress or behavioural change to individuals)	Keystone species not affected and minor changes in relative abundance of other species
Negligible	Negligible impact at local, regional, state and national scales, or minor impact at (or below) a site-specific scale	< 1% of habitat removed	No impact to protected species	Possible changes but within the range of natural variation
Beneficial	Any scale	Habitat creation	Improvement in population status of protected species	Ecosystem improvements (e.g. rehabilitation)

G.8 Conclusion

G.8.1 *EPBC Act* listed Threatened Fauna

The terrestrial and aquatic fauna and habitat values of the project area have been assessed through a comprehensive review of existing information and a field program, which has been implemented over a seven month period.

The assessment of potential impacts to these values has generated an extensive suite of mitigation measures for the project in keeping with best management practices (also, see EMP, Chapter 20 of the EIS). With the successful implementation of the recommended mitigation measures, it is considered that the impact of the project on *EPBC Act* listed threatened fauna will be relatively low in significance.

Although, the project has the potential to generate impacts to fauna habitat, it is considered that the successful implementation of the recommended mitigation measures has the potential to reduce any cumulative and interactive effects with existing land uses to a level of relatively low significance.

Many of habitat features within the Stanwell–Gladstone Infrastructure Corridor (or transected by the SGIC), because of their size and/or context, may be approaching potential thresholds where repeated disturbances to them could result in significant deterioration of values. Any future proposed developments, will be required to address the cumulative impacts of their developments with the impacts of the other existing and the currently proposed developments in the area, and would be considered by the relevant approval authorities.

Table 20 below summarises the residual impacts upon *EPBC Act* listed threatened terrestrial and aquatic fauna for the project. Although the impact upon *EPBC Act* listed threatened aquatic fauna is considered negligible due to the low probability of occurrence of *EPBC Act* listed species in the project area, the impact upon *EPBC Act* listed threatened fauna (both aquatic and terrestrial) is considered to be minor.

Table 20 Summary of residual impacts to *EPBC Act* listed Threatened fauna for the project area

Species	EPBC status	Occurrence status within Project Area	Potential impacts	Mitigation measures	Residual impact
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	**No record, possible.** Northern extent of distribution around Gladstone, though may occur in southern parts of project area.	Clearing of foraging habitat (open forest & woodland)	Avoiding potentially suitable habitat; minimal construction clearing path within remnant woodlands and forest; strict vegetation clearance protocols; and post-construction area-specific restoration.	**Negligible** to **minor**
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V	**No record, possible.** Northern extent of distribution around Gladstone/Mt. Larcom.	Clearing of foraging & roost habitat (open forest & woodland)	Avoiding potentially suitable habitat; minimal construction clearing path within remnant vegetation communities; strict vegetation clearance protocols; microtunneling or restricted clearing widths through riparian communities; protection of hollow-bearing trees; and post-construction habitat rehabilitation.	**Negligible** to **minor**
Collared Delma (*Delma torquata*)	V	**No record, possible.** Northern extent of distribution around Gladstone/Mt. Larcom.	Loss of foraging/breeding habitat (open forest & woodland); trench fall mortality; and degradation of habitat (weed invasion).	Avoiding potentially suitable habitat; minimal construction clearing path within remnant vegetation communities; strict vegetation clearance protocols; habitat pre-clearing surveys/rescue; open trench exclusion fencing; trench fall rescue protocols; weed control strategies; and post-construction habitat rehabilitation.	**Negligible** to **minor**

Species	EPBC status	Occurrence status within Project Area	Potential impacts	Mitigation measures	Residual impact
Brigalow Scaly-foot (*Paradelma orientalis*)	V	**No record, possible.** Remnant vegetation communities (especially those with rocky outcrops) at the southern end of the project area	Loss of foraging/breeding habitat (open forest & woodland); trench fall mortality; and degradation of habitat (weed invasion).	Avoiding potentially suitable habitat; minimal construction clearing path within remnant vegetation communities; strict vegetation clearance protocols; habitat pre-clearing surveys/rescue; open trench exclusion fencing; trench fall rescue protocols; weed control strategies; and post-construction habitat rehabilitation.	**Negligible** to **minor**
Yakka Skink (*Egernia rugosa*)	V	**No record, possible.** Remnant vegetation communities (especially those with rocky areas with shrubby understorey) at the southern end of the project area	Loss of foraging/breeding habitat (open forest & woodland); trench fall mortality; and degradation of habitat (weed invasion).	Avoiding potentially suitable habitat; minimal construction clearing path within remnant vegetation communities; strict vegetation clearance protocols; habitat pre-clearing surveys/rescue; open trench exclusion fencing; trench fall rescue protocols; weed control strategies; and post-construction habitat rehabilitation.	**Negligible** to **minor**

Species	EPBC status	Occurrence status within Project Area	Potential impacts	Mitigation measures	Residual impact
Ornamental Snake (*Denisonia maculata*)	V	**Known.** Recorded from woodland adjacent to wetland (near south of Midgee). May occur in similar habitats to north and south, especially patches on heavier, cracking clay soils, in association with waterbodies.	Loss of foraging habitat (seasonal wetlands) and refuge/breeding (adjacent woodland with abundant fallen timber); trench fall mortality; and degradation of habitat (changes to wetland hydrology; weed invasion).	Avoiding potentially suitable habitat; minimal construction clearing path within remnant vegetation communities; strict vegetation clearance protocols; dry season construction scheduling (wetlands); microtunneling (wetlands); habitat pre-clearing surveys/rescue; open trench exclusion fencing; trench fall rescue protocols; weed control strategies; and post-construction habitat rehabilitation; rehabilitation of pre-construction drainage patterns.	**Negligible** to **minor**
Red Goshawk (*Erythrotriorchis radiatus*)	V/M	**No record, possible.** Distribution uncertain in region and these requires a very large home range.	Clearing of foraging habitat (riparian & open forests)	Avoiding potentially suitable habitat; minimal construction clearing path within remnant & riparian vegetation communities; strict vegetation clearance protocols; microtunneling (waterway habitats); and post-construction habitat rehabilitation.	**Negligible** to **minor**

Species	EPBC status	Occurrence status within Project Area	Potential impacts	Mitigation measures	Residual impact
Painted Snipe (*Rostratula benghalensis*)	V,M	**No record, possible.** Occurrence erratic and unpredictable, seldom remaining long in densely vegetated wetlands at any locality.	Loss of foraging habitat (densely vegetated seasonal wetlands); degradation of habitat (changes to wetland hydrology; weed invasion).	Avoiding potentially suitable wetland habitat; dry season construction scheduling; minimal construction clearing path; strict vegetation clearance protocols; microtunneling; sediment and pollutant controls; weed control strategies; post-construction habitat rehabilitation; rehabilitation of pre-construction drainage patterns.	**Negligible** to **minor**
Squatter Pigeon (sth. subsp.) (*Geophaps scripta scripta*)	V	**Known**. Recorded from a variety of locations, though mainly within the central sector of the project area. Known to occur in highly disturbed, cleared landscapes.	Loss of foraging habitat; degradation of habitat (weed invasion); introduction of introduced predators.	Avoiding potentially suitable habitat; minimal construction clearing path within remnant woodlands and forest; strict vegetation clearance protocols; feral animal and weed control strategies and post-construction area-specific restoration.	**Negligible** to **minor**

Species	EPBC status	Occurrence status within Project Area	Potential impacts	Mitigation measures	Residual impact
Yellow Chat (*Epthianura crocea macgregori*)	CE	Known. Recorded within one kilometre of project area though not recorded within adjacent areas along ROW (despite a seven-month monitoring program).	Loss of foraging habitat; degradation of habitat (weed invasion); introduction of introduced predators.	Avoiding potentially suitable wetland habitat; dry season construction scheduling; minimal construction clearing path; strict vegetation clearance protocols; microtunneling; sediment and pollutant controls; weed control strategies; post-construction habitat rehabilitation; rehabilitation of pre-construction drainage patterns strategies.	**Negligible** to **minor**

G.8.2 *EPBC Act* listed Threatened Flora and Threatened Ecological Communities

The construction of the pipeline and clearing of the right-of-way is likely to have an overall **negligible** to **minor adverse** impact to (aquatic and terrestrial) *EPBC Act* listed threatened flora and ecological communities. Prior to construction, a trained ecologist will identify areas within the corridor where negative impacts on flora communities (in general) and *EPBC Act* listed Threatened Species are possible. This information will be documented in the Construction EMP.

Occasional traffic and other activity that could potentially disturb vegetation are likely to occur infrequently in the right-of-way during the operational phase of this project. The main ongoing concerns will be monitoring of vegetation rehabilitation, and weed control.

Environmental management plans have been proposed which address these issues. It is expected that the information from this report will be readily available to subsequent users of the corridor when additional services are installed to assist with minimisation of cumulative impacts. It is envisaged that many of the environmental pressures generated by subsequent pipelines or services may be increased and possibly greater than this project because they may occur during the rehabilitation period, and the clearing width within the corridor will be increased.

A summary of key impacts and mitigation measures are shown in Table 21.

Table 21 Summary of residual impacts to *EPBC Act* listed Threatened Flora for the project area

Feature Description	Current value Substitution (yes/no)	Description of potential impacts	Mitigation measures	Residual impact
Possibly an Endangered ecological community (*EPBC Act*) at Site 9c	Natural ecosystems; Wildlife habitat Not substitutable.	Clearing of 0.6 ha of *possibly* Endangered Ecological Community, depending on interpretation by EPA. Stunted Brigalow south of Inkerman Creek.	• Minimise clearing by adjusting location and width of right-of-way. • Provision of offset, or rehabilitation of adjacent area. • If EPA determines that this community is of remnant status, hence Endangered, then all Brigalow plants that are removed will be partially buried in an adjacent waterlogged area to allow suckering and consequent regrowth.	**Negligible** to **minor**
Impacts upon Flora species listed under the *EPBC Act*	*EPBC Act* listed Threatened Species	Removal of specimens	• Avoidance of clearing in remnant vegetation • Pre-construction Surveying • Clearly marked areas of significance • Potential minor realignment of the right-of way where possible	**Negligible**

Feature Description	Current value Substitution (yes/no)	Description of potential impacts	Mitigation measures	Residual impact
			• Clearing boundaries will be clearly delineated on all drawings and in the field to define the extent of authorised clearing, which will not exceed the construction area. • When trenching across part of the wetland, topsoil will be stockpiled, and replaced after works to enable ground layer species to re-establish • Restoration of wetlands • Translocation of impacted individuals	

G.9 References and Bibliography

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