

GLADSTONE–FITZROY  
**PIPELINE PROJECT**  
Environmental Impact Statement

Climate



Gladstone Area  
Water Board



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This information has been prepared by, or on behalf of, the Gladstone Area Water Board (GAWB) regarding the Gladstone-Fitzroy Pipeline project. Care has been taken to ensure that the information is accurate and up to date at the time of publishing.





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## 3. Climate

### 3.1 Introduction

This chapter discusses local climate characteristics, seasonal conditions (for consideration, particularly at the construction phase), extreme climatic events and climate change as it relates to the Gladstone-Fitzroy Pipeline project (the project).

This chapter does not include a description and assessment of the natural hazards relevant to the project area as defined in *State Planning Policy 1/03 Mitigating the Adverse Effects of Flood, Bushfire and Landslide* as these are described in Chapter 16, Hazard and Risk.

The greenhouse gas assessment for the construction and operation of the project is included in Chapter 10, Air Environment.

### 3.2 Methodology

The methodology for the review of climatic conditions and extreme climatic conditions in the study area included a review of available information relating to the climate and seasonal conditions in the study area. The sources of this information include the following:

- Local Government websites
- State Government websites
- Relevant legislation and policy (see Section 3.4)
- Other publications regarding local climate conditions (see Section 3.10).

The description of impacts relating to local climate, seasonal conditions and extreme climatic events was undertaken through the consideration of the possible effects that these issues may have on the project and the environment of the project area.

Table 3.1 Impact Significance Criteria for Climate

Significance	Climatic Effects
Major Adverse	The impacts of local climate, extreme climatic events or climate change to the project area cause destruction of project infrastructure, widespread environmental damage or death of personnel.
Moderate Adverse	Climatic conditions or extreme climatic events in the project area result in damage to infrastructure, long delays to construction, environmental damage and/or severe injury to personnel.
Minor Adverse	Climatic conditions or extreme climatic events cause localised impacts to the project including delays to construction, increased erosion or minor health impacts to project personnel.
Negligible	Climatic conditions or extreme events do not cause any discernable impacts to the project infrastructure, personnel or surrounding environment.

The assessment of impacts as a result of local climate, seasonal events, extreme climatic events and climate change has been undertaken with reference to the significance criteria in Table 3.1.

### 3.3 Assumptions and Limitations

The description of local climate and seasonal conditions is based on the most relevant and up to date information available for the project area. Microclimatic variations may mean that there are localised variations to climate that are not described here. In addition the effects of climate change are likely to alter climatic conditions in ways that are not currently known.

### 3.4 Relevant Legislation and Policy

#### 3.4.1 Disaster Management Act 2003

This Act calls for Local Disaster Management Plans to include mitigation options to help manage risks associated with disasters and promote community involvement in the process.

#### 3.4.2 Rockhampton City/Fitzroy Shire Natural Hazards Guide 2006

This guide was prepared by Rockhampton City Council/Fitzroy Disaster Management Group (now part of Rockhampton Regional Council) as a requirement of the *Disaster Management Act 2003*.

The guide was produced to provide information to residents, businesses and visitors on the natural disasters that could be experienced in the area. It describes precautions people should take to prepare for and respond to these natural disasters. This includes cyclones, heat waves and severe storms.

### 3.4.3 Gladstone City Council/Calliope Shire Council Joint Local Disaster Management Plan 2005

This management plan was prepared to ensure compliance with the *Disaster Management Act 2003*. The plan aims to decrease community vulnerability to the impact of hazard events by planning for and mitigating against the potential adverse effects of a significant emergency or disaster event; to effectively prepare for managing the effects of such an event; and to effectively respond to and recover from an event.

## 3.5 Baseline

### 3.5.1 Local Climate and Seasonal Conditions

The study area is classified as a subtropical climate zone, characterised by a hot, humid summer and low winter rainfall (Bureau of Meteorology 2008). Median annual rainfall is in the range 650 to 1,200 mm (Bureau of Meteorology 2008).

Rockhampton City lies on the Tropic of Capricorn and the southeast trade wind belt. As a result the area does not tend to experience regular northwest monsoonal activity nor does it experience higher latitude cold fronts (Bureau of Meteorology 2008).

Average annual rainfall experienced for Rockhampton City is around 532 mm and around 529 mm for Gladstone City. There are two distinct seasons - wet and dry. The wet season is predominant from December to March and the dry season from June to September. Average daily temperatures for Rockhampton City average around 20 to 34°C and 21 to 32°C for Gladstone City. Winter temperatures vary from around 10-25°C for Rockhampton City and 7-24°C for Gladstone City (Rockhampton and Gladstone City Councils 2008).

There is a high incidence of winter and early spring fogs. Maximum temperatures in the low-to-mid 40°C have been recorded in October to March. Minimum temperatures as low as 0°C have been recorded during winter.

The predominant wind directions in Rockhampton are from the southeast and east, at a frequency of around 35 to 40 percent of the time. Wind speeds are primarily in the 10 to 20 km/hr range.

The predominant wind directions in Gladstone, as with Rockhampton, are also from the southeast (am) and east (pm), at a frequency of around 30 to 40 percent of the time. Wind speeds are slightly higher than those recorded in Rockhampton, being primarily in the 20 to 30 km/hr range (Bureau of Meteorology 2008).

See Chapter 10, Air Environment, for Rockhampton and Gladstone wind rose diagrams illustrating wind direction and speed.

### 3.5.2 Extreme Climatic Events

This section discusses possible extreme climatic events that may occur in the project area. This does not include flood, bushfire or landslides which are discussed in Chapter 16, Hazard and Risk. Reference has been made to the Disaster Management Plans for Fitzroy/Rockhampton and Calliope/Gladstone Shires (Rockhampton City Council 2005, Gladstone City Council and Calliope Shire Council 2005). The local government areas relevant to the study area are now Rockhampton Regional Council and Gladstone Regional Council.

It is possible for extreme climatic events, influenced by season or time of year, to occur in the project area and which need to be considered for the project. These include:

- **Severe Storms** - Severe thunderstorms pose a threat of economic loss and fatalities from hail, lightning and wind. The study of community risk in Gladstone undertaken by the Australian Geological Survey Organisation (AGSO) and Bureau of Meteorology (AGSO, Bureau of Meteorology 2001) indicates that there is not enough information on severe storms in the area to quantify the level of risk from severe thunderstorms. However the impact from any one storm will be more localised than that of a tropical cyclone and is more likely to occur in the summer months. The effects may include damage from torrential rain, high wind, hail and lightning.
- **Tropical Cyclones** - Rockhampton lies within a "cyclone risk zone" and can be affected by cyclones at least once a year, roughly around November through to April, resulting in heavy rain and storm surges. Cyclones tend to originate in the warm waters of the Coral Sea northeast of Australia (Fitzroy Shire Council 2007). Tropical cyclones pose a serious threat to Queensland communities and industry. Often the most significant impact from tropical cyclones, or tropical lows, is flooding (Bureau of Meteorology 2008).

Although the considerable majority of cyclone impacts are located in north Queensland, occasionally a cyclone affects areas further south down the east coast. Even cyclones that are located off the north or central Queensland coast can affect areas well to the south. Heavy rain can occur well to the south of the cyclone and the strong easterly winds between the cyclone and a high to the south may cause large waves over the east coast.

According to the former Fitzroy Shire Council, since 1883 there have been 37 recorded cyclones that have impacted the Rockhampton area between St. Lawrence and Gladstone. The monthly distribution of these cyclones is provided below (Fitzroy Shire Council 2007).

– January	9
– February	14
– March	12
– April	2

- **Heatwaves** - In the period between 1803 and 1992 at least 4,287 people died in Australia as a direct result of heat waves. The elderly, especially those living alone, are a particularly susceptible group (AGSO, Bureau of Meteorology 2001).

### 3.5.3 Climate Change

#### 3.5.3.1 General Overview

There is a significant body of evidence that suggests the increase of 'greenhouse' (heat-trapping) gases in the atmosphere has resulted in a warming of the global climate during the previous century. Predictive work indicates that this warming will accelerate in the future due to continued anthropogenic (i.e. caused by humans) greenhouse gas (GHG) emissions. In the 20<sup>th</sup> Century, global average sea level has risen by 10 to 20 cm, primarily due to global warming. This sea level rise will continue, and possibly accelerate, over the next century and beyond, through a combination of mechanisms, including:

- Thermal expansion of the oceans
- Melting of glaciers and ice caps
- Melting of the Greenland and Antarctic ice sheets
- Changes in terrestrial storage.

#### 3.5.3.2 Potential Implications of Sea Level Rise

Mean sea level rise is expected to increase with local and regional variations due to land-sea movements and changes to ocean currents. Global sea level rise is projected by the Intergovernmental Panel on Climate Change to be 18 to 59 cm by 2100 relative to 1990 levels, with a possible additional contribution from ice sheets of 10 to 20 cm (IPCC 2007). There are a number of uncertainties with these figures, and they could be subject to variation from a variety of factors including ice melting rates, erosion, coastal subsidence, increased snowfall and regional variations.

Potential impacts of sea level rise in Australia's coastal areas include:

- Damage to buildings and infrastructure from the depth of floodwaters and the force of the water flow
- Increased intensity of storm surges and increased wave heights that can contribute to coastal flooding
- Increased salinity of rivers, bays and coastal aquifers resulting from saline intrusion
- Increased coastal erosion
- Loss of important mangroves and other wetlands
- Impact on Marine ecosystems.

## 3.6 Assessment of Impacts

This section describes the likely impacts arising from the project as a result of local climate, extreme climatic events, and climate change.

### 3.6.1 Local Climate, Seasonal Changes and Extreme Climatic Events

The likely impacts of local climate and seasonal changes during the construction of the project include:

- Dry conditions are likely to increase the amount of dust generated from construction activities
- Increased wind speeds during a storm are likely to increase the impact of dust-generating activities
- Erosion is likely to increase following a severe storm or flood event
- Wet weather can hamper construction activities and vehicle access to construction sites
- High temperatures and humidity can potentially affect construction workers, resulting in sunburn and/or sunstroke
- A cyclonic event or severe storm has the potential to cause flooding of construction areas and halt works for periods of time.

## 3.6.2 Climate Change

### 3.6.2.1 Sea level rise and Highest Astronomical Tide (HAT) changes

River flooding can occur when the amount of water in them exceeds the capacity of the channel; this usually develops during periods of heavy rainfall. This can be exacerbated by tidal flooding caused by storm surges and high tide levels, which may be more likely with climate change. The flood risk for the project and the outcomes of the *State Planning Policy Guideline – Mitigating the Adverse Impacts of Flood, Bushfire and Landslide (2003)* are discussed in Chapter 16, Hazard and Risk.

In the case of the Fitzroy River intake and Alton Downs Water Treatment Plant (WTP), an assessment has been undertaken of the possible effects of predicted sea level rise and Highest Astronomical Tide (HAT) changes.

The existing HAT for Gladstone in 2008 is estimated to be 2.35 m above the Australian Height Datum (AHD). The WTP is located upstream of the Fitzroy River barrage, which has been constructed to provide fresh water supply storage and to prevent the intrusion of salt water further upstream. The level of the flood barrier at full supply level is 3.8 m AHD. Current projections estimate the level of sea water rise would be up to 79 cm by 2100 (IPCC 2007). If this occurred the HAT level would be 3.14 m, well below the existing barrier level (3.8 m), providing protection for the WTP and intake from inundation caused by rising sea levels due to climate change. The pipeline itself and associated pump stations are designed to continue operation when inundated, and would not be affected by temporary flooding or storm surges. It is therefore considered that there is a low risk to the project from predicted sea level or tidal HAT rise caused by climate change in the next 100 years.

## 3.7 Mitigation Measures

This section describes the mitigation measures to be implemented to minimise the impacts arising from or to the project during construction and operation as a result of local climate, extreme climatic events and climate change.

### 3.7.1 Local Climate and Seasonal Changes

Mitigation measures that will be considered in the mitigation of the possible impacts from local climate and seasonal changes include the following. These and other measures are included in Chapter 20, Planning Environmental Management Plan.

- Taking into account seasonal conditions when scheduling work
- Construction at sensitive sites during dry periods wherever possible
- Control of dust at all times
- The use of erosion and sediment control measures during construction to prevent increased erosion and sedimentation during rainfall events (see Chapter 5, Soils and Contaminated Land)
- Implementation of health and safety procedures to reduce the risk of dehydration, heat stroke or sunburn that may affect project personnel during construction, particularly during heatwaves (see Chapter 16, Hazard and Risk).

### 3.7.2 Extreme Climatic Events

Extreme climatic events cannot be prevented however the effects from these events can be minimised through the following:

- Monitoring both long and short-term weather forecasts during the construction period
- Modify work hours during heatwaves so as to limit the number of hours construction personnel are exposed to high temperatures
- Postpone construction work during periods of cyclones, severe storms and other extreme climatic events
- Health and Safety Management Systems to ensure appropriate procedures are in place to prevent health and safety incidents arising as a result of extreme climatic events
- A Disaster Management Plan/Emergency Management Plan for the project during construction and operation.

### 3.7.3 Climate Change

The assessment considers that the risk of inundation from tidal flooding caused by climate change is low and as such existing mitigation measures (e.g. the siting of the WTP above the mapped flood level) are considered adequate.

### 3.8 Residual Impact

The residual impact after the implementation of mitigation measures has been assessed using the significance criteria in Section 3.2.

#### 3.8.1 Local Climate and Seasonal Changes

The mitigation measures proposed are expected to reduce the impacts resulting from local climate and seasonal changes to **negligible**.

#### 3.8.2 Extreme Climatic Events

The mitigation measures proposed are expected to reduce the impacts resulting from extreme climatic events to **minor adverse** as these events cannot be prevented, but the mitigation measures proposed will reduce the severity of the impact to the environment, personnel or property.

#### 3.8.3 Climate Change

The WTP has been sited above the Q100 flood level and due to the Fitzroy Barrage downstream, the risk of tidal flooding as a result of sea level rise has been assessed as **negligible**.

### 3.9 Summary and Conclusions

Local climate, extreme climatic events and climate change have the potential to have an influence on the environment in the project area during construction or operation of the project. Mitigation measures that have been proposed are considered adequate to reduce the impact of these conditions or events to **negligible** or **minor adverse**.

Table 3.2 Summary of impacts

EIS Area: Climate Feature/ Activity	Current Value + Substitutable Y:N	Description of Impact		
		Description in Words	Mitigation Inherent in Design/ Standard Practice Mitigation	Residual Impact Using Significance Criteria
Local Climate and Seasonal Changes	Local climatic conditions Not substitutable	Localised environmental effects during project construction	<ul style="list-style-type: none"> <li>Construction at sensitive sites during dry periods where possible</li> <li>Erosion control measures</li> <li>Dust control</li> <li>Health and safety procedures.</li> </ul>	Negligible
Extreme Climatic Events	N/A	Damage to property, environment or personnel and construction delays	<ul style="list-style-type: none"> <li>Monitoring of forecasts</li> <li>Changes to work practices if required</li> <li>Disaster and emergency management planning.</li> </ul>	Minor adverse
Climate Change and Sea Level Rise	N/A	Potential increases in sea level affecting project infrastructure	<ul style="list-style-type: none"> <li>Siting of key infrastructure above flood levels.</li> </ul>	Negligible
<b>KEY:</b> Significance Criteria: Major, High, Moderate, Minor, Negligible +ve = positive impacts; -ve = negative impacts D = direct; I = indirect C = cumulative; P = permanent; T = temporary ST = short-term; MT = medium-term; LT = long-term			<b>Relative Duration of Environmental Effects</b> 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	

### 3.10 References

AGSO and Bureau of Meteorology (2001)

BOM (Bureau of Meteorology) (2008), Climate of Rockhampton, viewed online February 2008, available at <http://www.bom.gov.au/weather/qld/rockhampton/climate.shtml>

CSIRO 2006 *Climate Change and Australia's Coastal Communities* (8 page brochure)

CSIRO 2007 *Climate Change in Australia*, Technical Report

Fitzroy Shire Council (2007) accessed online February 2008, available at [www.fitzroyshire.qld.gov.au](http://www.fitzroyshire.qld.gov.au)

Geoscience Australia AGSO (2001), *Community Risk in Gladstone - a multi-hazards risk assessment* accessed online February 2008 [Online], available at [www.ga.gov.au/hazards/reports/gladstone](http://www.ga.gov.au/hazards/reports/gladstone)

Gladstone City Council (2008) access online February 2008, available at [www.gladstone.qld.gov.au](http://www.gladstone.qld.gov.au)

Gladstone City Council and Calliope Shire Council (2005) *Joint Local Disaster Management Plan*, accessed online on February 21, 2008 available at [www.calliope.qld.gov.au/Community/docs](http://www.calliope.qld.gov.au/Community/docs)

Intergovernmental Panel on Climate Change (2007) *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group 1 to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom

Rockhampton City Council (2006), *Rockhampton, Fitzroy Natural Hazards Guide* accessed online on February 2008 [Online], available at <http://www.rockhampton.qld.gov.au/doccache/uploadfiles/11569-DisasterManagementKit.pdf>

Rockhampton City Council (2008) accessed online February 2008, available at [www.rockhampton.qld.gov.au](http://www.rockhampton.qld.gov.au)



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