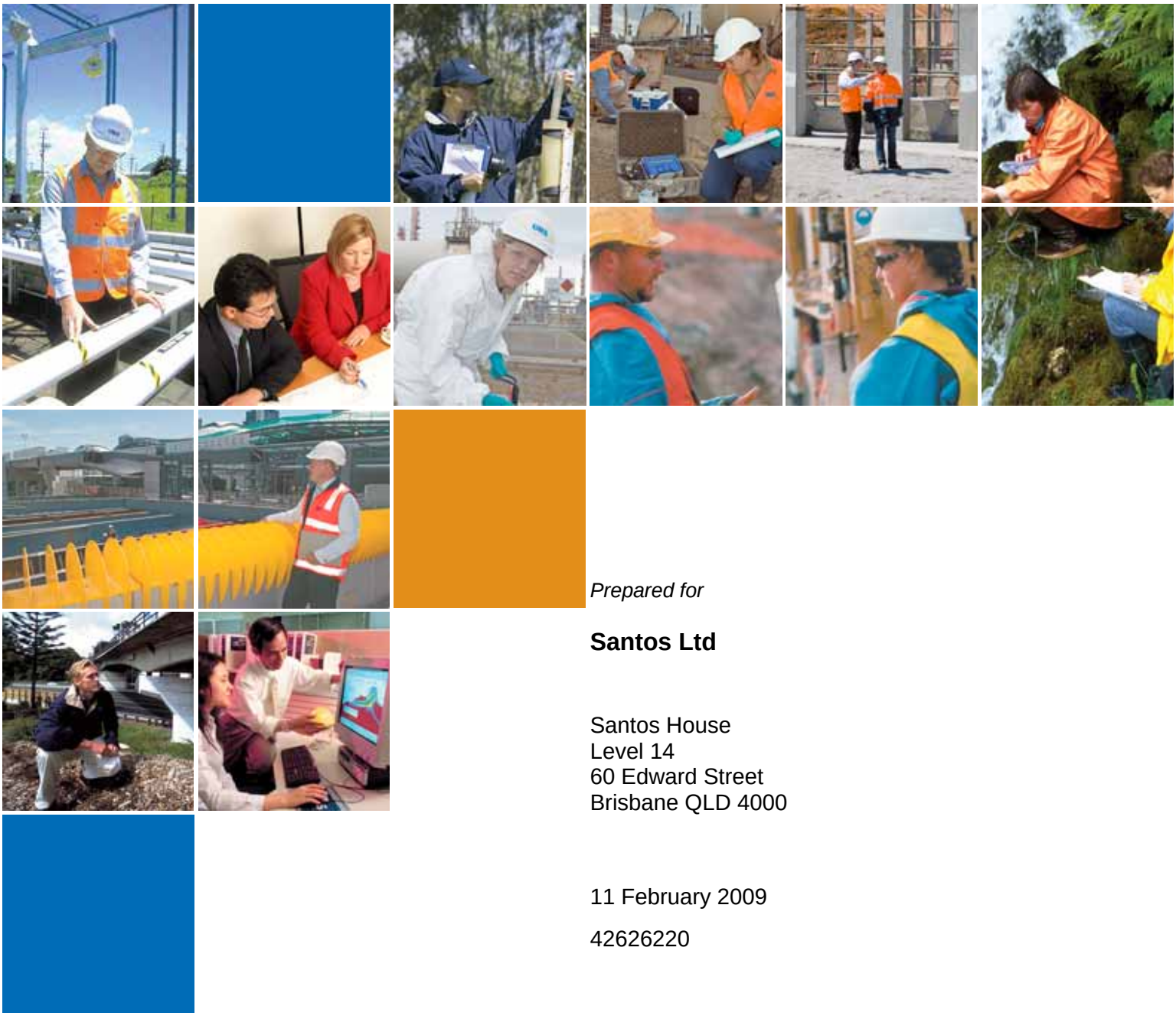
FINAL REPORT

GLNG - Visual Assessment for the LNG Facility



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11 February 2009

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Executive Summary

This section presents the visual assessment carried out by URS on behalf of Santos in relation to the proposed Liquefied Natural Gas (LNG) facility near China Bay on the south side of Curtis Island, Gladstone, a new bridge between Friend Point on Kangaroo Island and Laird Point on Curtis Island, together with the associated access road.

The Coal Seam Gas (CSG) fields and gas transmission pipeline are not included in this section as they are the subject to a separate assessment.

The visual assessment involved a field inspection to analyse and describe the existing landscape character of the area in which the LNG facility, bridge and access road are proposed to be constructed. Results of this assessment provided the baseline against which the potential incremental impact of the proposed development has been assessed.

The extent to which the LNG facility would potentially be visible was assessed with particular attention given to the key viewing situations in and around the City of Gladstone, Gladstone Harbour and The Narrows. Results of the visibility assessment were used to determine the likely level of significance of the visual impact of key components of the LNG facility, bridge and access road. A range of mitigation measures are identified that would minimise the level of potential visual impact of the proposed development.

The visual assessment concludes that construction of the proposed LNG facility would result in a fundamental change to the existing landscape character of the site on Curtis Island. This change would result from the removal of existing woodland vegetation, implementation of earthworks and construction of the LNG facility structures. However, the Visual Impact Assessment concludes that most components of the proposed LNG facility would only be visible from a limited number of view situations that are accessible to the general public. Potential views of the LNG train, storage tanks and other structures would generally be blocked by the system of hills and ridges that define the valley in which the LNG facility is to be located. The result would be a low to moderate visual impact for most view situations, with the exception of The Narrows waterway, where the visual impact is predicted to be high due to availability of direct views into the proposed LNG facility site.

The level of visual impact that would result from the vertical flare stack would be significantly greater than other components of the LNG facility, which are substantially lower and generally visually screened by the natural landforms of the valley in which it is proposed to be located. The vertical flare option would result in an approximate 80 metre high structure with a flame up to approximately 80 metre high above the stack during the periods when flaring occurs. While the flame is predicted to occur irregularly and for limited periods of time, it would be highly visible due to its height and the visual contrast with the natural landscape setting of Curtis Island against which it would be seen. The visual impact would be greatly increased when flaring occurs at night, which is illustrated by the visual simulations presented in Section 3.7. A ground level flare would be a mitigation option to the vertical flare stack as it would eliminate the potential visual impact of flaring. However, the practicality of the ground flare option would need to be determined by Santos.

The proposed mitigation measures presented with this visual assessment take account of the classification of Curtis Island as an ‘Area of State Significance (Scenic Coastal Landscapes)’ within the Curtis Coast Regional Management Plan. The mitigation measures aim to ensure that the high landscape values of the site and adjoining areas of Curtis Island are maintained to the maximum extent possible.

While the proposed bridge between Friend Point and Laird Point, which would provide access to the LNG facility site on Curtis Island, will be highly visible from vessels moving along The Narrows waterway and adjoining foreshore areas, it will not be visible from many of the other view situations that were identified in this visual assessment process. High quality design and careful management of the bridge construction process would

Executive Summary

result in the creation of a visually distinctive new structure that would form a visual marker along The Narrows waterway separating Gladstone Harbour from the natural landscape character associated with the Mackay/Capricorn Marine Park north of the bridge.

Introduction Section 1

This section presents the visual assessment carried out by URS on behalf of Santos in relation to the proposed Liquefied Natural Gas (LNG) facility near China Bay on the south side of Curtis Island at Gladstone, a new bridge across The Narrows to Curtis Island together with the associated access road. It does not include the Coal Seam Gas (CSG) fields and gas transmission pipeline, which are the subject to a separate assessment.

The visual assessment was carried out by Noel Corkery, a Senior Landscape Architect Consultant to URS. It involved an analysis of the existing landscape character of the study area to provide the baseline against which the potential incremental impact of the proposed development has been assessed. The extent of the study area was determined by an initial analysis of the likely view shed or area from which the LNG facility is likely to be visible. The landscape character is described by identifying, describing and illustrating a series of Landscape Character Zones throughout the study area. The landscape quality of the study area was then assessed and the local, regional, state, national and international significance of the proposed LNG facility site was then reviewed together with the potential for the site to absorb change.

Assessment of the potential significance of visual impact associated with the LNG facility, bridge and access road involved a process that included:

- Plotting separate view sheds or area of visibility of the LNG facility structures (excluding the flare stack), the flare stack and the bridge across The Narrows to Cutis Island;
- Identifying a series of view situations throughout the study area and analysing the level of visibility of the LNG facility, flare stack, bridge and access road;
- Illustrating views from each of the view situations;
- Preparing a set of visual simulations of future views of the LNG facilities from key view situations, including day and night views both with and without flaring;
- Assessment of the magnitude of visibility resulting from the combination of view distance, period of view, approximate number of viewers;
- Prediction of sensitivity to change of the various categories of viewer; and
- Evaluation of the likely level of visual impact taking account of the combination of magnitude of visibility and viewer sensitivity.

Results of the predicted visual impact are presented separately for the LNG facilities (excluding the flare stack), the flare stack, bridge and access road.

A series of mitigation measures are presented which aim to minimise the potential visual impact of the LNG facilities, bridge and access road.

Section 2 Existing Landscape Character

2.1 Introduction

The regional landscape setting of Gladstone is strongly defined by mountain ranges that form the skyline to views to the west from the city and by the tree-covered central ridge of Curtis Island to the north. These visually prominent natural landforms are often seen in the context of the water surface of Gladstone Harbour and The Narrows, which contributes to visual quality of many views.

The original landscape character in the area south of The Narrows has been significantly changed by development of a number of industrial plants that are accessed from the Port Curtis Way. Structures within these industrial plants are generally geometric in form and include colours that visually contrast with the surrounding remnant woodland vegetation. The industrial plants generally appear as islands of structure set within a tree-covered natural landscape. Views of these plants from public roads are generally limited to the upper portions of structures due to the visual screening effect of vegetation at ground level. Visible emissions from a number of the industrial plant stacks create a dynamic but visually prominent element in the landscape. Views from elevated locations within Gladstone urban areas include the industrial plants, Gladstone Power Station and high voltage powerlines, which are seen against a backdrop of the visually prominent forest-covered mountains to the west of the city. Lighting on the existing industrial plants creates a strong contrast at night with the dark outline of the forest-covered mountains to the west.

The proposed LNG facility is to be located at China Bay on the southern edge of Curtis Island at the eastern portion of 'The Narrows' waterway. While the hills and ridges that define the valley in which the proposed LNG facility site is located are visible from surrounding areas, the centre of the valley itself is generally screened from most surrounding areas. Consequently the base on the valley in which the LNG facility would be located is only directly visible from boats travelling along 'The Narrows' waterway and from locations along the southern foreshore of The Narrows. The extent to which structures within the LNG facility would be visible from surrounding areas will depend on the height and size of individual structures. The visual assessment carried out for this EIS has involved individual consideration of the major structures within the proposed LNG facility site.

2.2 Landscape Character Zones (LCZ's)

In order to understand the landscape context in which the proposed LNG facility site is located, an analysis of the landscape character of Gladstone was carried out. The landscape analysis involved identification of a series of Landscape Character Zones (LCZ's) that are shown on Figure 2-1 and described in the following table. The LCZ's are areas that are relatively consistent in terms of their combination of landform, vegetation, land use and development. While individual LCZ's may incorporate substantial visual variation, they provide a broad baseline landscape context in which the proposed LNG facility, new bridge and access road will be located.

Each LCZ is described and illustrated by photographs in Table 2-1, which follows Figure 2-1.

Client

Project

GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
LNG FACILITY

Drawn: CA | Approved: JB | Date: 11-02-2009

Job No: 4262 6220 | File No: 42626220-g-712.wor

Title

LANDSCAPE CHARACTER ZONES

Figure: 2.1

A4 | Rev: A

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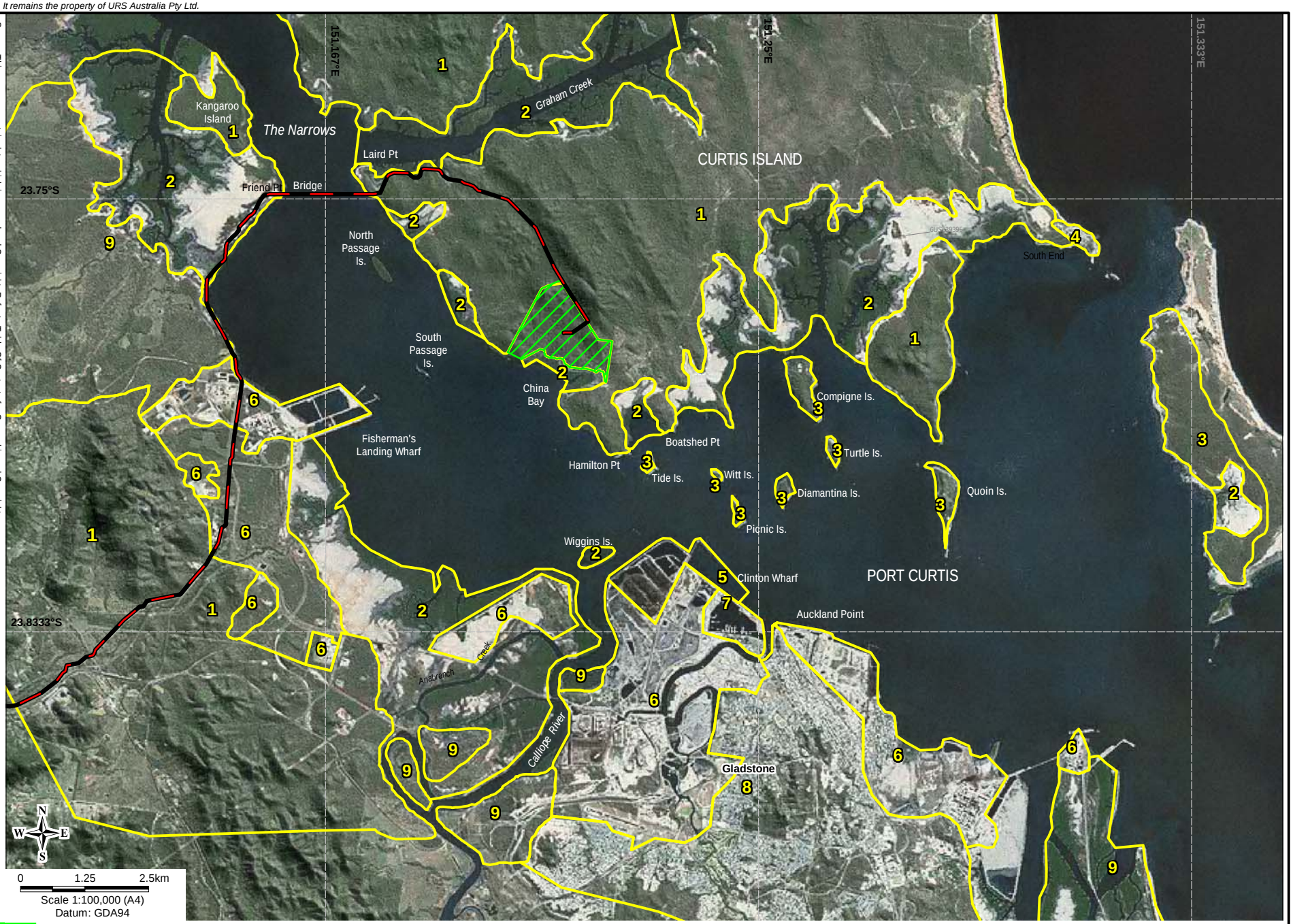


Section 2 Existing Landscape Character

Table 2-1 Landscape Character Zones

Landscape Character Zones	
LCZ1 - Forest-covered Hills & Ridges • Steep slopes and high elevation landforms include Curtis Island & hills to west of Gladstone • Natural forest cover, predominantly eucalypt species • Absence of buildings and structures contributes to natural landscape character • Visually prominent landscape features of regional significance that strongly influence the visual character of Gladstone	
LCZ 2 - Mangroves & Tidal Mud-flats • Flat landform in tidal zone • Visually distinctive landscape character created by tidal fluctuation covering the lowest elevation areas with water during high tide • Open views across mud-flats & salt marsh areas • Mangrove stands visually enclosed & provide limited visual screening to views from surrounding areas • Contiguous stands of Mangroves create distinctive natural landscape character along shoreline visible from waterways & adjoining sections of foreshore	
LCZ 3 - Tree-covered Islands • Strongly undulating tree-covered landforms are visually prominent against the flat water surface of Gladstone Harbour & The Narrows • Elevated views across Gladstone Harbour are available from locations on the Islands where vegetation has been cleared • Limited number of residential buildings are located on the islands and they are generally oriented to the east; jetties & buildings on some islands diminish the generally natural landscape character	

Existing Landscape Character

LCZ 4 - South End Township & Jetty

- Flat to gently undulating landform sloping down to sandy beach & tidal flats
- Remnant coastal woodland creates natural setting for beach
- Residential development in South End Township contrasts with the surrounding natural landscape
- Jetty structure & solar panels are visually prominent and contrast with the natural character of adjoining landscape & waterways

LCZ 5 - Coal Loading Port Facilities

- Jetty structures, coal facilities & moored ships form a visually prominent industrial element along the foreshore of Gladstone Harbour
- Movement of ships creates a visually dynamic element in the Harbour setting
- Lighting for night loading is highly visible from the foreshore & locations throughout Gladstone urban areas
- Shore-based coal handling facilities include coal stockpiles & conveyors that form a visually distinctive element in the landscape

LCZ 6 - Industrial Development Sites

- Earthworks have created extensive areas of exposed red-coloured soil that visually contrast with contrasts with adjoining Mangroves & water surface
- Vegetation cover is generally grassland with few scattered trees & shrubs
- Perimeter security fence precludes public access to foreshore

LCZ 7 - Gladstone Marina

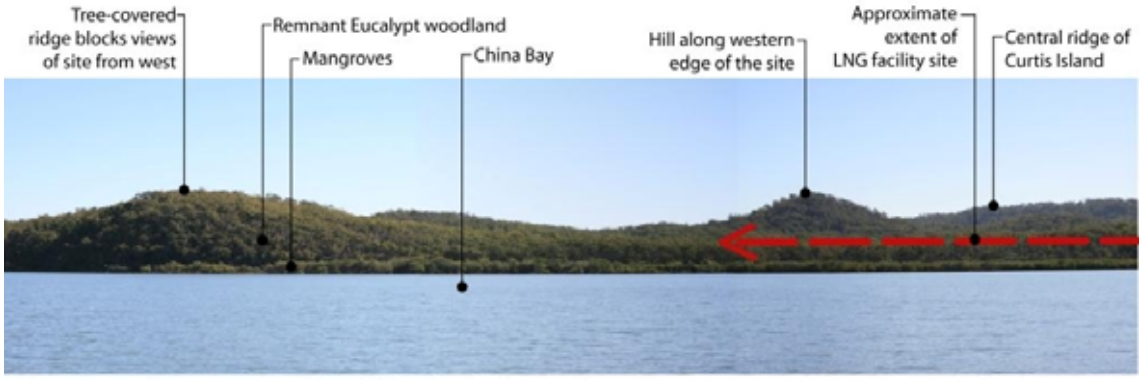
- Jetty structures & moored boats/yachts contrast with foreshore vegetation & water surface
- Yacht masts form a distinctive visual vertical element
- Boat movement creates visual interest within the well defined space of the marina
- Visually enclosed by vegetation located in Spinnaker Park to the north & by buildings along the southern & western foreshore

Section 2 Existing Landscape Character

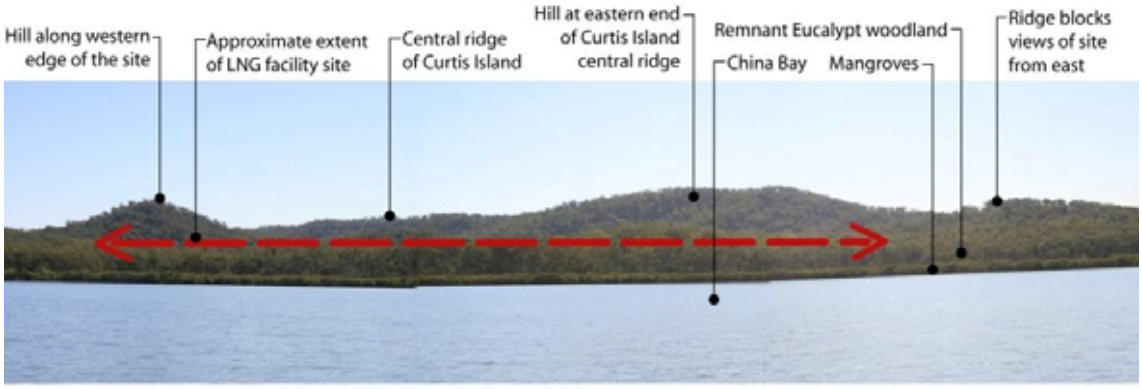
LCZ 8 - Gladstone Urban Development • Visual character dominated by mixed residential, commercial & public buildings • Diverse visual character with long distance views generally blocked by buildings but glimpses between buildings are available from some elevated areas & streets • Some views extend to Gladstone Harbour, the coal loader & Curtis Island ridgeline on the skyline • The central commercial area is located along a ridge that provides a limited number of elevated views to the north, east & west	
LCZ 9 - Remnant Woodland Areas • Gently undulating landform with some areas of flat low elevation land adjoining the waterfront • Predominantly vegetation is eucalypt woodland that generally blocks views from roads	

2.3 Landscape Character of Proposed LNG Facility Site

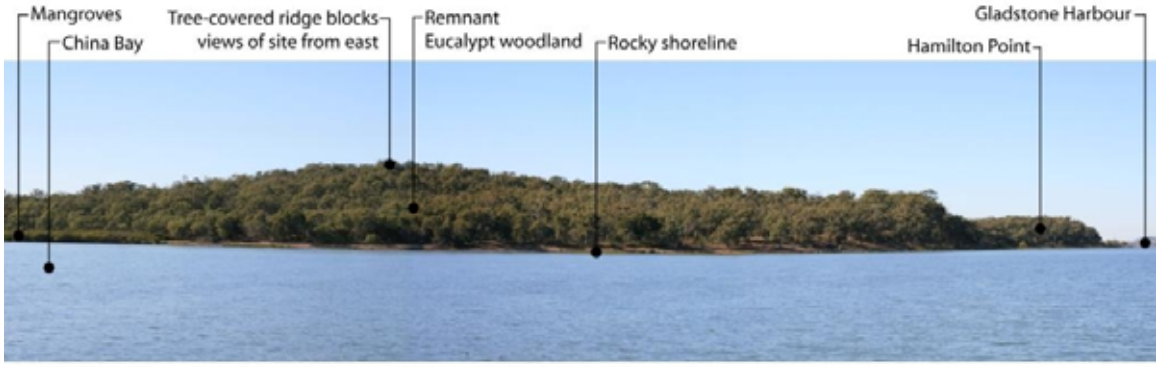
The visual character of the proposed LNG facility site reflects a particular combination of landform and natural vegetation. The valley landform of the site adjoining China Bay is strongly defined by a major ridgeline to the north and secondary ridges and a series of lower hills that extend south to the shoreline, which form the eastern and western sides of the valley. The major ridge to the north of the site forms part of the visually prominent tree-covered central ridgeline of Curtis Island. The extensive tree cover on the site and surrounding ridges and foreshore mangroves of China Bay together with the absence of structures or buildings, result in the site having a very natural landscape character. The photographs presented below, which were taken from a boat in China Bay, illustrate the natural landscape character and indicate the approximate location of the proposed LNG facility development.



1. View to north - western portion of the LNG facility site from China Bay



2. View to central portion of the LNG facility site from China Bay



3. View to north - eastern portion of the LNG facility site from China Bay

2.4 Landscape Quality of the LNG Facility Site

In order to provide a baseline against which to evaluate changes that would result from the proposed LNG facility development, as assessment was carried out of the existing landscape quality of the site. The Landscape Quality was evaluated by applying a methodology that has been adapted from a methodology developed by the US Bureau of Land Management (BLM, 1984). The factors taken into account in determining an overall rating for the site are defined in Table 2-2, which also includes a numeric rating against each factor.

Section 2 Existing Landscape Character

Table 2-2 Scenic Quality Ratings Table (Source: BLM)

Key	Rating Criteria and Scores		
Landform	High vertical relief as expressed in prominent cliffs, spires or massive rock outcrops or severe surface variation or highly eroded formations or detailed features, dominant and exceptionally striking and intriguing. **5**	Steep valleys, volcanic cones, hills or ridges; or interesting erosion patterns or variety in size and shape of landforms; or detailed features which are interesting though not dominant or exceptional. **3**	Low rolling hills, foothills or flat valley bottoms or few or no interesting landscape features **1**
Vegetation	A variety of vegetative types has expressed in interesting forms, textures and patterns **5**	Some variety of vegetation, but only one or two major types **3**	Little or no variety or contrast to vegetation **1**
Water	Clear & clean appearing, still or cascading white water & any of which are a dominant factor in the landscape **5**	Flowing or still, but not dominant in the landscape **3**	Absent or present, but not noticeable **0**
Colour	Rich colour combinations, variety or vivid colour or pleasing contrast in the soil, rock, vegetation, water or snowfields **5**	Some intensity of variety in colours & contrast of soil, rock & vegetation, but not a dominant scenic element **3**	Subtle colour variations, contrast or interest; generally muted tones **1**
Influence of adjacent scenery	Adjacent scenery, greatly enhances visual quality **5**	Adjacent scenery moderately enhances overall visual quality **3**	Adjacent scenery has little or no influence on overall visual quality **0**
Scarcity	One-of-a-kind or unusually memorable or very rare within the region. **5**	Distinctive, though somewhat similar to others within the region **3**	Interesting within its setting, but fairly common within the region **1**
Cultural modifications	Modifications add favourably to visual variety while promoting visual harmony **2**	Modifications add little or no visual variety to the area and introduce no discordant elements **0**	Modifications add variety, but are very discordant and promote strong disharmony **- 4**

The maximum potential rating that could be achieved is 32, which would apply to a landscape that was assessed as meeting all of the criteria in the left hand column.

The Scenic Quality Rating Categories defined in the BLM system are:

19 - 32 = **High**

12 - 18 = **Medium**

11 or less = **Low**

An assessment of scenic quality of the proposed LNG facility site was carried out and the results are presented in Table 2-3.

Table 2-3 Scenic Quality Rating of Proposed LNG Site

Key Factors	Rating Applied
Landform	3
Vegetation	3
Water	3
Colour	3
Influence of adjacent scenery	5
Scarcity	3
Cultural modifications	0
Total	**20**

The rating of 20 out of a possible maximum of 32 indicates that the Scenic Quality of the proposed LNG facility site is considered to be high.

2.5 Landscape Significance of LNG Facility Site.

The landscape significance of the LNG facility site varies depending on whether it is considered in the local, regional, state, national or international context. At a local level the site is highly significant as it forms part of the northern shore of 'The Narrows', which is visually dominated by the natural landscape character of Curtis Island. Local fisherman and pleasure boat operators use China Bay as well as 'The Narrows' waterway. In addition, views to the north from a number of locations along the Mount Larcom – Gladstone Road on the southern side of 'The Narrows' between Caliope River and the Reid Road intersection include the proposed LNG facility site at China Bay.

The proposed LNG facility site is significant in a regional context due to its location on a visible portion of Curtis Island, which is a very significant natural feature of the Gladstone regional landscape. This regional significance is increased by the relationship of the site to 'The Narrows' as vessels travelling along this section of waterway pass close to the site. 'The Narrows' is used by pleasure and commercial craft travelling to and from Rockhampton as well as ships berthing at the Fisherman's Landing wharf. The site is visible from a number of locations along Port Curtis Way, which carries significant volumes of regional traffic between Gladstone and Rockhampton. However, these views are at a distance of 7-8 kilometres, which is relatively long. The views extend across tidal mud flats and mangroves in the foreground to the visually prominent central ridge of Curtis Island, which forms a backdrop to the proposed LNG facility site.

The Curtis Coast Regional Management Plan, which was prepared by the EPA in conjunction with the Queensland Parks and Wildlife Service (Queensland Government, 2003), identifies the whole of Curtis Island as an 'Area of State Significance'. The Management Plan includes a statement that Queensland State Policy is to identify areas of state significance (scenic coastal landscape) and to recognise and protect their diversity, quality and extent of scenic landscape values. The policy requires that regional planning strategies and local government planning schemes, which cover 'areas of state significance' (scenic coastal landscapes), are to include measures that protect areas with coastal values from incompatible land uses.

Section 2 Existing Landscape Character

Schedule 1 titled 'Areas of state significance (scenic coastal landscapes) described in Policy 2.7.1', lists Curtis Island in the category of 'Islands and offshore features'. The Policy states that the desired coastal outcomes for this category are that:

- *The landscape values of islands and their contribution to the landscape values of the Curtis Coast region are protected and maintained*
- *Views from the mainland and viewpoints to the islands are maintained and enhanced.*

Specific measures are listed in Schedule 1 to achieve these outcomes, which include:

- *Ensure that development remains unobtrusive and compatible with landscape values. For example, buildings should not be higher than mature tree height and not on the shorelines or ridgelines or visible from view points*
- *Screen access points and other development from viewpoints*

The proposed LNG facility site is also located within the Gladstone State Development Area (GSDA) which was established by the Queensland Government in 1993. Details of the GSDA are available on the web site http://www.gladstoneindustry.org.au/home/. In July 2008 the west coast of southern Curtis Island was added as an Industry Precinct to provide for the establishment of liquefied natural gas (LNG) facilities. The facilities include processing operations (including liquefaction and storage) of national, state or regional significance that require access to export wharf facilities. To the east of this precinct an Environmental Management Precinct was designated and Kangaroo Island was added as a Restricted Development Precinct to link the Gladstone State Development Areas.

One of the objectives of the Gladstone State Development Area is to ensure development recognises and protects environmental, cultural heritage and community values of area.

The proposed LNG facility site is not located within a landscape that has been identified as significant at a national or international level.

2.6 Capacity of Site to Visually Absorb Change

The natural landscape character of the proposed LNG facility site limits the capacity for it to visually absorb significant change. Introduction of structures higher than the existing tree layer would introduce man-made elements that contrast with the surrounding tree covered slopes. However, the ridges and spurs, which define the eastern, northern and western edges of the valley adjoining China Bay, generally block views from most directions, except from the south. As a result the site has significant capacity to visually absorb change in relation to views from the east, north and west, provided structures do not extend above the level of the adjoining landforms. In relation to views from the south that extend into the valley, the site has limited capacity to visually absorb change. This capacity could be significantly increased by careful selection of colours on visible structural components of the facility to minimise the visual contrast between them and the tree-covered slopes that form the background against which they would be viewed. Mitigation measures aimed at minimising the level of the potential visual impact are addressed in more detail in Section 4.

3.1 Introduction

A key factor that will influence the potential visual impact of the proposed LNG facility, bridge and access road developments will be the level of visibility from a series of key locations surrounding the facility. Visibility is a measure of the extent to which particular components of the proposed facility may be visible from surrounding areas, the relative number of viewers, the period of the view, view distance and context of the view.

The potential visual impact of the proposed LNG facility will primarily be influenced by the following two factors:

- The level of visibility or extent to which the proposed LNG facility, bridge and access road would be visible from surrounding areas; and
- The degree of visual contrast between those visible portions of the LNG facility, bridge and access road, and the landscape against which they would be viewed.

Distance imposes a strong influence on potential visibility because the proportion of the total view occupied by the LNG facility, bridge or road will decrease with distance. In addition, the visual contrast between the major components of the facility, as well as the bridge and road, and the surrounding landscape, will also decrease with distance due to atmospheric effects of dust and water vapour.

The methodology adopted and the results of the visual assessment process carried out by URS are described in detail in the following sections.

3.2 Description of Proposed LNG Facility Development

Details of the various components of the proposed LNG facility area are described in detail in other sections of the EIS. However, key aspects of the proposed development that are most relevant to the visual assessment include:

- progressive clearing of existing woodland/open forest vegetation and the site re-graded to allow construction of the proposed LNG facility;
- major elements of the LNG facility would include three gas ‘train’ structures (20-25m high), storage tanks (approx. 40m high) and flare stacks (approx. 80m high);
- the flare stacks will require obstacle lighting in accordance with Civil Aviation Safety Authority (CASA) requirements;
- the LNG facility would be located within a small valley adjoining China Bay on the eastern shore of The Narrows;
- off-shore facilities will include an LNG material off loading facility (MOF)and jetty connected to the LNG facility site;
- construction of a bridge across ‘The Narrows’ between Friend Point on Kangaroo Island and Laird Point on Curtis Island, which will require lighting;
- construction of the section of access road from the northern end of Landing Road to the western end of the new bridge at Friend Point, which will involve clearing vegetation and earthworks along the road alignment; and

Section 3 Visual Assessment

- construction of the section of access road from the eastern end of the new bridge at Laird Point to the LNG facility on Curtis Island, which will also involve clearing of woodland vegetation and earthworks along the road alignment.

Natural gas will be delivered to the LNG facility via a gas transmission pipeline following the alignment of the new bridge and associated access road. The pipeline will be installed in a sea bed trench to cross The Narrows.

The LNG facility will consist of parallel processing units, called trains, to treat and liquefy natural gas and send it to two storage tanks. A number of flare structures will also be constructed as part the LNG facility.

The LNG will be loaded to ships that will moor at a jetty to be constructed in China Bay, adjoining the site. The jetty structure will be a combination of rock filled groyne abutting the shoreline and an open piled trestle structure about 1.3 km long, that will lead to a pile-supported ship loading dock in China Bay.

LNG tankers will enter Gladstone Harbour and proceed along the main shipping channel to berth at the loading dock adjoining the LNG facility near China Bay. Turnaround time for vessels to enter and exit Gladstone Harbour will be about 22 hours, during which the loading time will be approximately 14 hours. Tugs will assist berthing and departure of ships and provide assistance where necessary to deal with the effects of wind and tide. At the initial production rate of 3 mtpa, it is expected that approximately 35-40 ships will be loaded with LNG each year. This rate is expected to increase to 105 - 120 ships when the production rate increases to 10 mtpa.

A dry gas flare will be used to burn emergency methane gas releases that result from interruptions to the process within the LNG facility or from the unlikely need to empty the gas transmission pipeline. The proposed flare design will be a vertical stack that would be designed to protect facility personnel from overexposure to radiant heat during flaring events. The LNG facility is being designed for negligible flaring during normal operations in order to minimise environmental impacts, reduce greenhouse gas emissions and minimise the loss of natural gas resources. Nevertheless, allowance has been made for unplanned events and experience from other LNG facilities indicates that flares could operate for up to 1.25% of the time, or approximately 108 hours per year.

Vapours generated during the LNG loading operations of ‘cold’ ships will be sent to a boil-off gas compressor. The marine flare will only be operated if the boil off gas compressor is not able to process the vapoures. Ships not normally used to transport LNG specifically from the GLNG facility (e.g. spot cargoes) will be initially flared during the cool down process to remove any possible impurities that may be present in the ship’s tanks before being diverted to the boil-off gas compressor.

Any ‘warm’ ships from dry dock will require a controlled cool-down before loading of LNG can commence. In such situations the excess vapours (above the capacity of the vapour recovery system) will be sent to the marine flare until the ship has been sufficiently cooled. The duration of flaring for this category of ship could last for up to 12 hours.

3.3 Visual Assessment Methodology

The visual assessment process carried out as part of this EIS has involved:

- A review of documents and aerial photos to identify issues relevant to the existing landscape character of the proposed LNG facility site, bridge and access road locations;
- A field inspection to identify key viewing situations to determine the extent to which the LNG facility site, bridge and access road locations are visible;

- Analysis of the various viewing situations, including the use of a helicopter, to determine the extent to which major structures in the facility would be visible from surrounding areas;
- Determination of the level of significance of potential visual impact that would result from the major components of the proposed LNG facility, bridge and access road;
- Identification of mitigation measures to minimise the potential visual impacts of the proposed LNG facility, bridge and access road.

Particular attention was given to potential views of the LNG facility site from public roads and residential areas. In addition, the visibility assessment included detailed consideration to views from public lookouts located within the Gladstone urban area as well as sections of Gladstone Harbour including The Narrows waterway.

Assessment of the potential significance of visual impact associated with the proposed LNG facility, bridge and access road developments involved identification of the extent to which they would be visible (Visibility) and the significance of the change to the visual character of the landscape that would result from the development.

The assessment of Visibility has been based on the principle of 'intervisibility', which means that if an area or location is visible from the site then the site would also be visible from that location. The precise level of visibility was confirmed by visiting the sections of public road, lookouts, open spaces and areas of waterway. This involved the use of a helicopter hovering at the height of major components of the LNG facility, including the flare stacks, storage tanks and LNG train, to determine those areas from which the components would be visible.

The levels of significance of potential visual impacts were assessed through consideration of the combination of **Magnitude** of visual change in the visual landscape character and the **Sensitivity of Viewers** who will see the change.

In summary the visual assessment involved:

- Analysis of the existing landscape character in which the LNG facility, bridge and access road would be located;
- A field inspection to determine the extent to which the site, bridge crossing point and access roads are generally visible;
- Use of a helicopter to determine the potential visibility of major components of the LNG facility; and
- Identification of the various viewing situations from which the LNG facility, bridge and access roads would potentially be visible from surrounding areas.

The various criteria used to determine the magnitude of potential visual impacts of the proposed LNG facility, bridge and access road development are listed in Table 3-1. The levels of Magnitude of Visibility resulting from combination of the various criteria are presented in Table 3-2.

Section 3 Visual Assessment

Table 3-1 View situation assessment criteria

Criteria	Definition
View Distance	
• Long	• >5km
• Medium	• 1-5km
• Short	• 200-1000m
• Very short	• <200m
Period of View	
• Long term	• >2 hrs
• Moderate term	• 1minute to 2 hrs
• Short term	• <1 minute
Number of Viewers	
• High	• >5,000 people per day
• Moderate	• 1,000-5,000 people per day
• Low	• 100-1,000 people per day
• Very low	• <100 people per day

Table 3-2 Magnitude of visibility matrix

	Long Distance			Medium Distance			Short Distance			Very Short Distance		
Period of View L=long, M=medium, S=short	**L**	**M**	**S**	**L**	**M**	**S**	**L**	**M**	**S**	**L**	**M**	**S**
No. of viewers - High	M	L	L	H	M	M	H	H	M	H	H	H
No. of viewers - Medium	L	L	N	M	M	L	H	M	M	H	H	M
No. of viewers - Low	L	N	N	M	L	L	M	M	L	H	M	M
No. of viewers - Very Low	N	N	N	L	N	N	L	L	L	M	L	L

Magnitude of Visibility: N= negligible L= low M=medium H= high

The categories of Magnitude of Visibility are defined below.

Negligible - very minor loss or alteration to one or more key element/features/characteristics of the baseline visual character (i.e. pre-development landscape or view) and/or introduction of elements that are not uncharacteristic to the existing landscape, which approximates the 'no change' situation.

Low - minor loss of or alterations to one or more key elements/features/characteristics of the baseline visual character (i.e. pre-development landscape or view) and/or introduction of elements that are not uncharacteristic of the existing landscape.

Medium - partial loss of or alteration to one or more key elements/features/characteristics of the baseline visual character (i.e. pre-development landscape or view) and/or introduction of elements that may be prominent but not considered to be substantially uncharacteristic of the existing landscape.

High - total loss of key elements/features/characteristics of the baseline visual character (i.e. pre-development landscape or view) and/or introduction of elements considered to be totally uncharacteristic of the existing landscape.

3.4 View Situations Analysis

3.4.1 Introduction

The site analysis carried out as part of the visual assessment identified a total of 23 land based view situations and four water areas from which the proposed LNG facility, bridge and access road could potentially be visible. They included public roads, bridges, urban areas, public lookouts, Gladstone marina, Gladstone Harbour and 'The Narrows' waterway. These view situations are listed in Table 3-3 below and their location shown on Figure 3-1.

Table 3-3 View Situations

VS 1a	South End Township
VS 1b	South End Jetty
VS 2	Facing Island
VS 3	Quoin Island
VS4	Turtle Island
VS 5	Witt Island
VS 6	Tide Island
VS 7	Auckland Lookout
VS 8	Spinnaker Park
VS 9	Corner of Goondoon & Yarron Streets in commercial centre of Gladstone
VS 10	Corner of Vincent & George Streets in Gladstone
VS 11	Round Hill Lookout
VS 12	Hanson Road
VS 13	Hanson Road adjoining Power Station (no photo available)
VS 14	Bridge over Calliope River
VS 15	Mount Larcom-Gladstone Road
VS 16	Bridge over Calliope River at Anabranch
VS 17	Mount Larcom-Gladstone Road
VS 18	Reid Rd./ Mount Larcom-Gladstone Road intersection
VS 19	Mount Larcom-Gladstone Road
VS 20	Mount Larcom-Gladstone Road
VS 21	Landing Road
VS 22	Landing Road (north end)
VS 23	Yarwun township
VS 24	The Narrows shipping channel
VS 25	Port Gladstone shipping channel
VS 26	North Channel (southern section)
VS 27	North Channel (north section)

Each view situation was analysed in detail and the results presented in the annotated photographs presented on the following pages.

Client

Project

GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
LNG FACILITY

Drawn: CA | Approved: JB | Date: 07-01-2009

Job No: 4262 6220 | File No: 42626220-g-713.wor

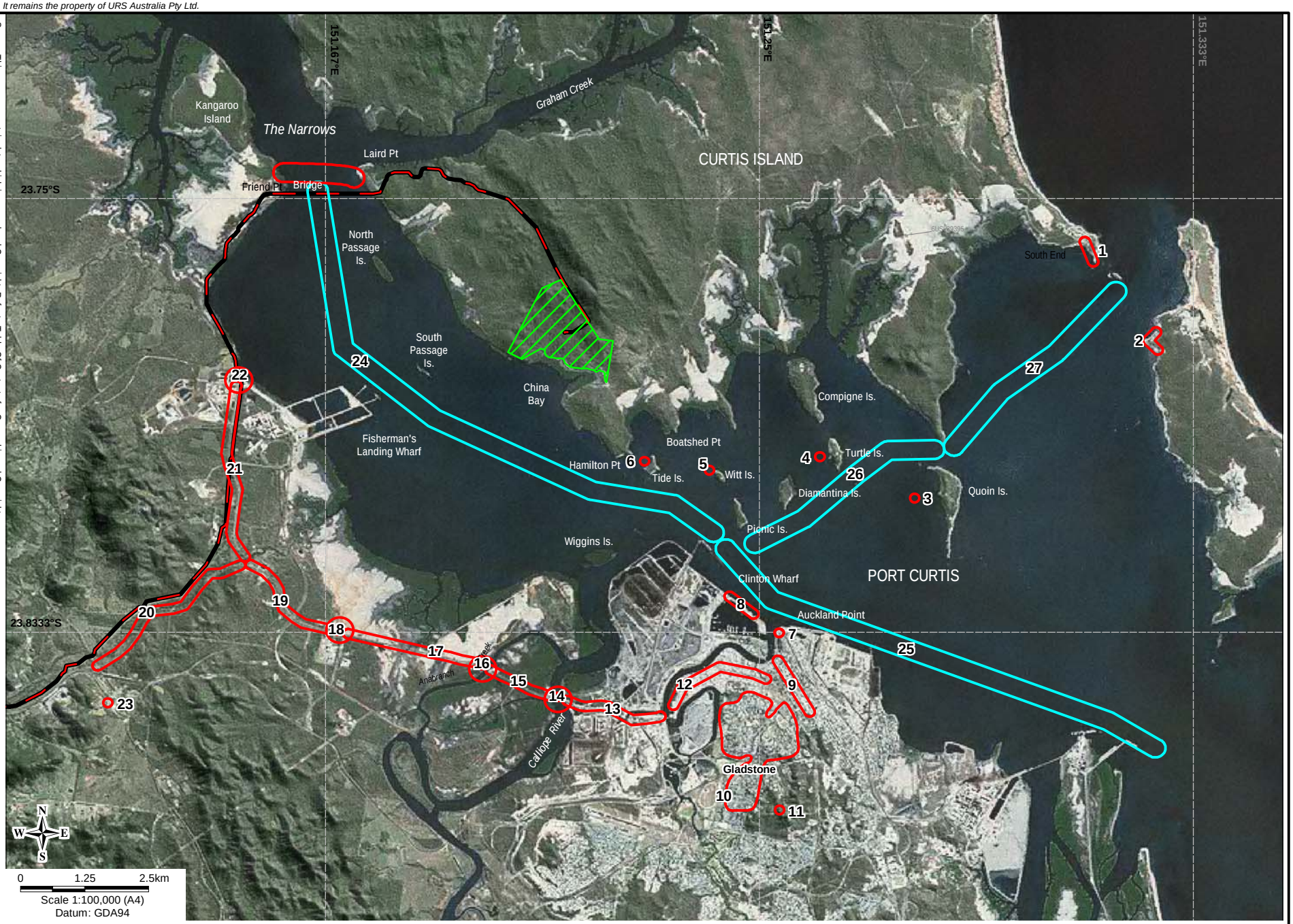
Title

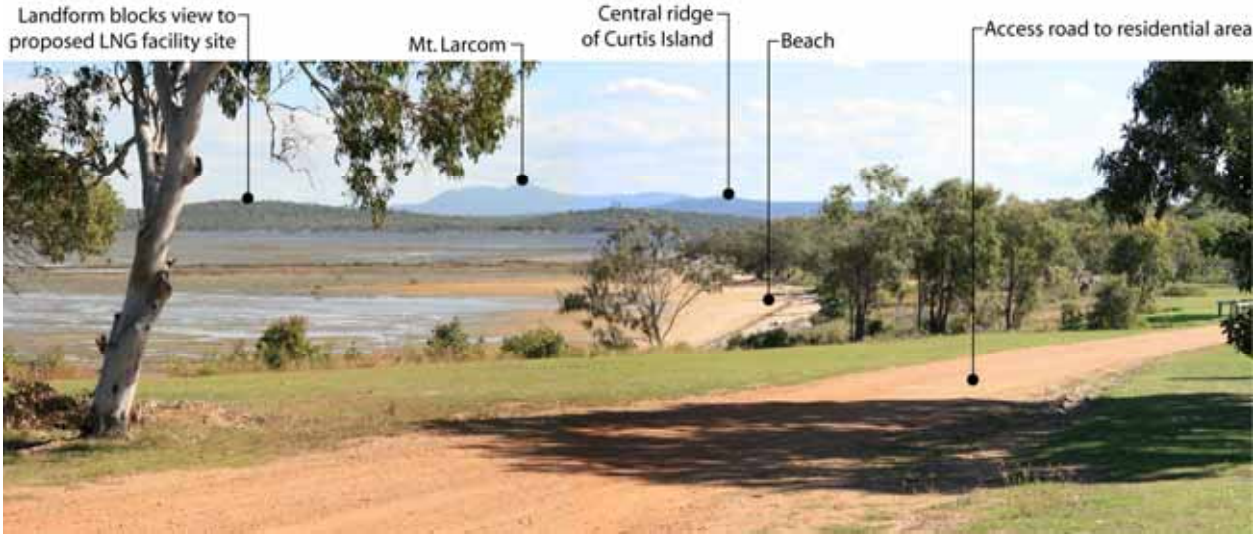
VIEW SITUATIONS

Figure: 3.1

Rev: A

A4





VS 1a - South End Township, view to west

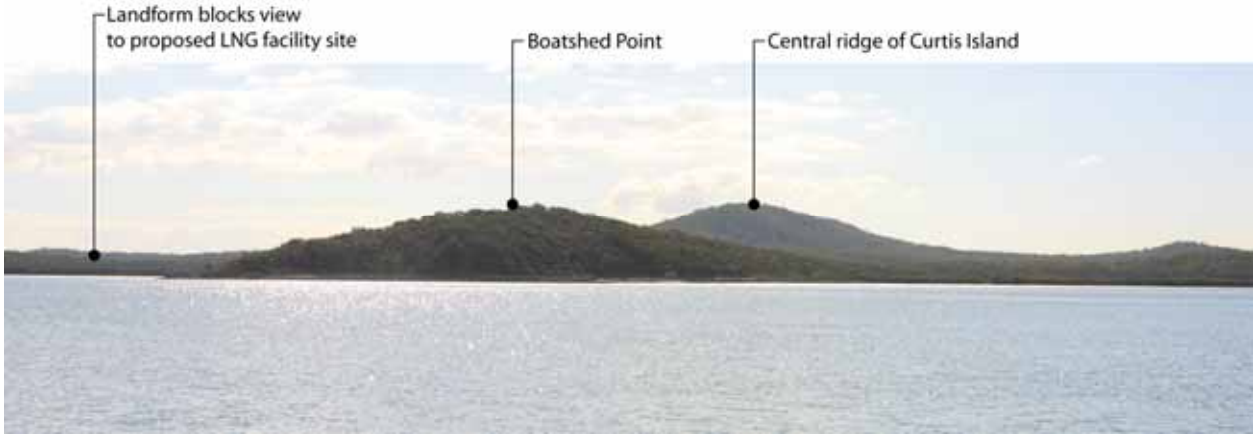
VS 1b - South End Jetty, view to west

VS 2 - Facing Island, view to west

Section 3 Visual Assessment

VS 3 - Quoin Island, view to west

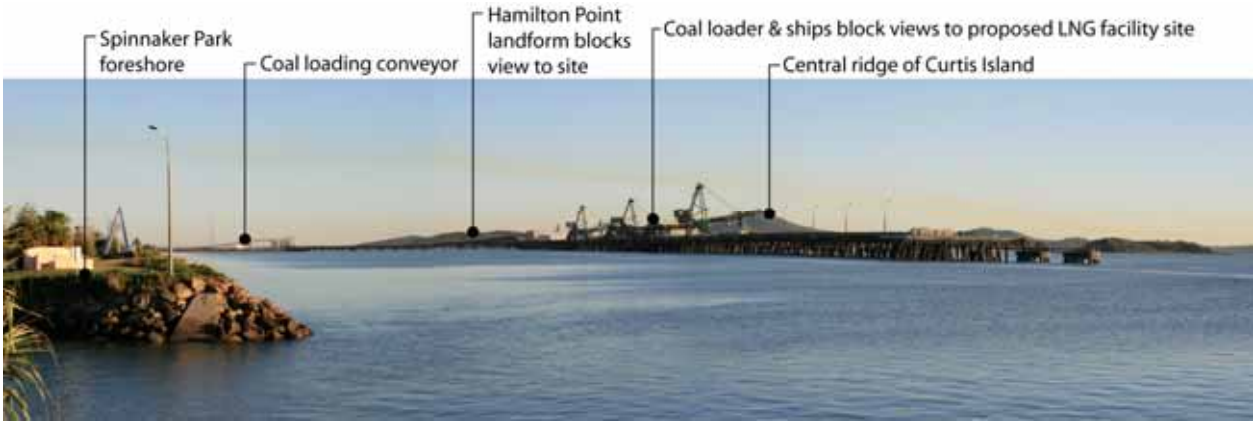
VS 4 - Turtle Island, view to west



VS 5 - Witt Island, view to west

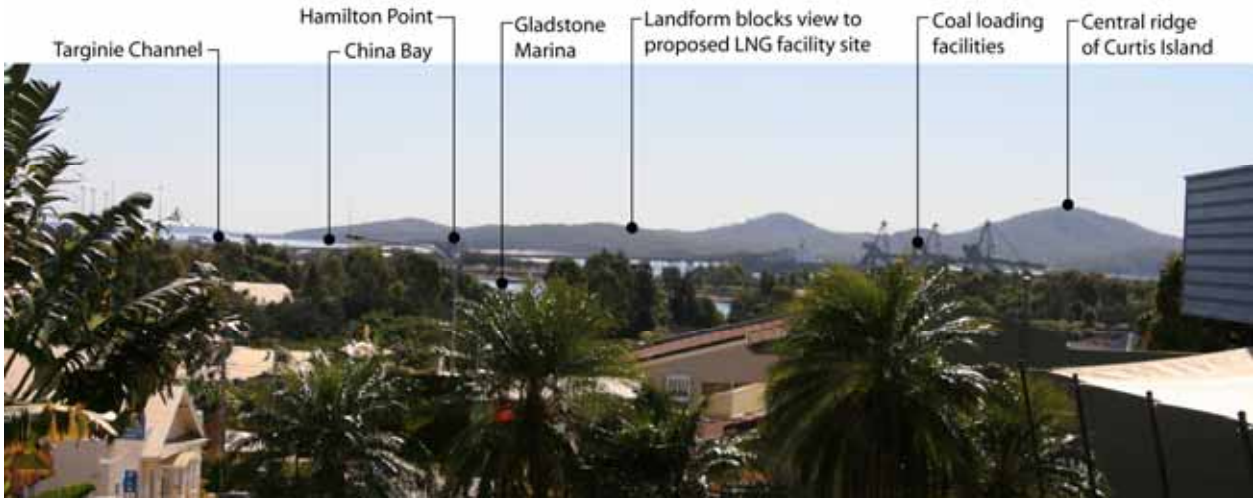
VS 6 - Tide Island, view to west

VS 7 - Auckland Lookout, view to north west



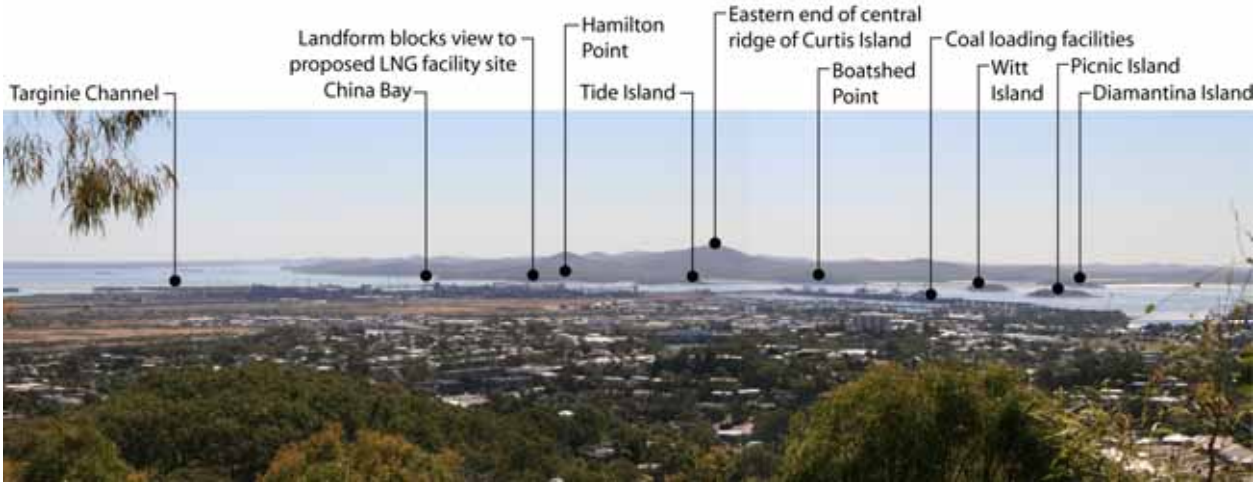
VS 8 - Spinnaker Park, view to north west

Section 3 Visual Assessment



VS 9 - Corner of Goodoon & Yarroon Streets in commercial centre of Gladstone, view to north west

VS 10 - Corner of Vincent & George Streets in Gladstone, view to north west

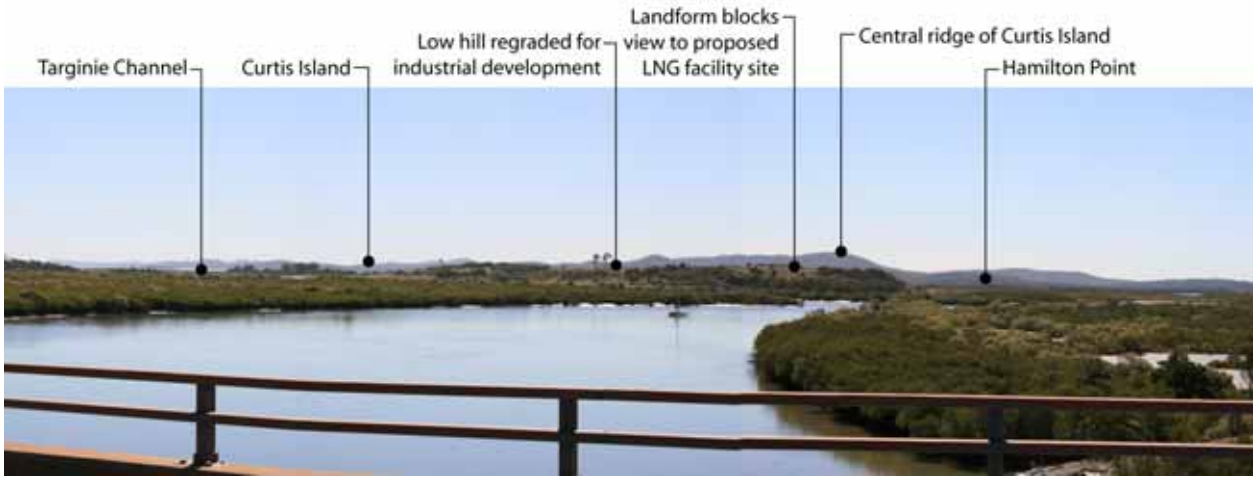


VS 11 - Round Hill Lookout, view to north west

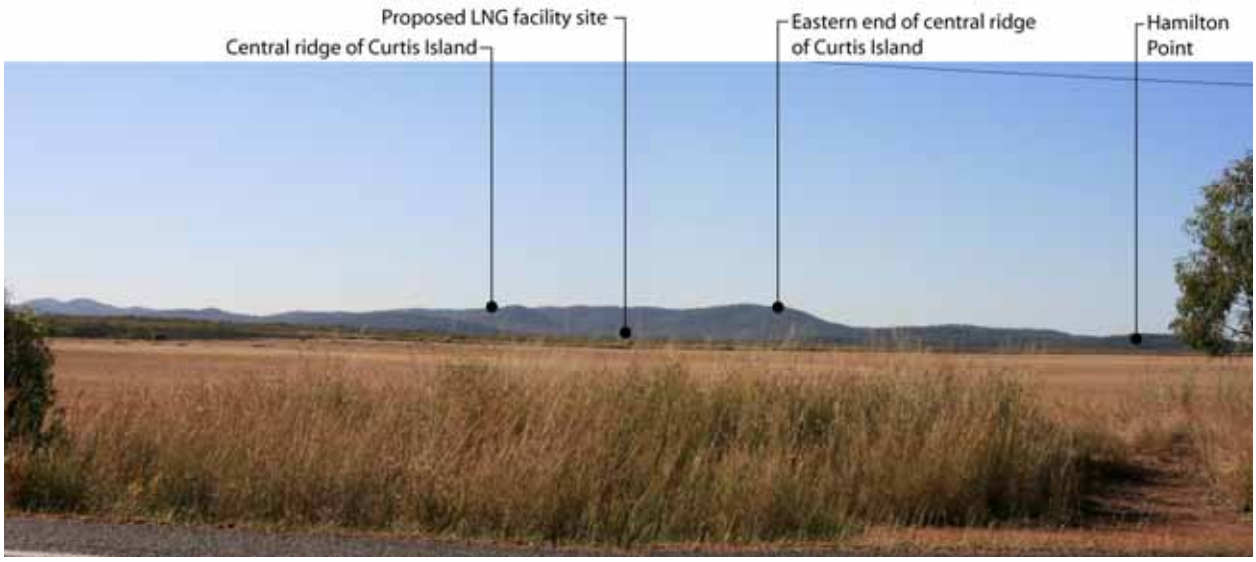
VS 12 - Hanson Road, view to south west

VS 13 - Hanson Road adjoining Power Station

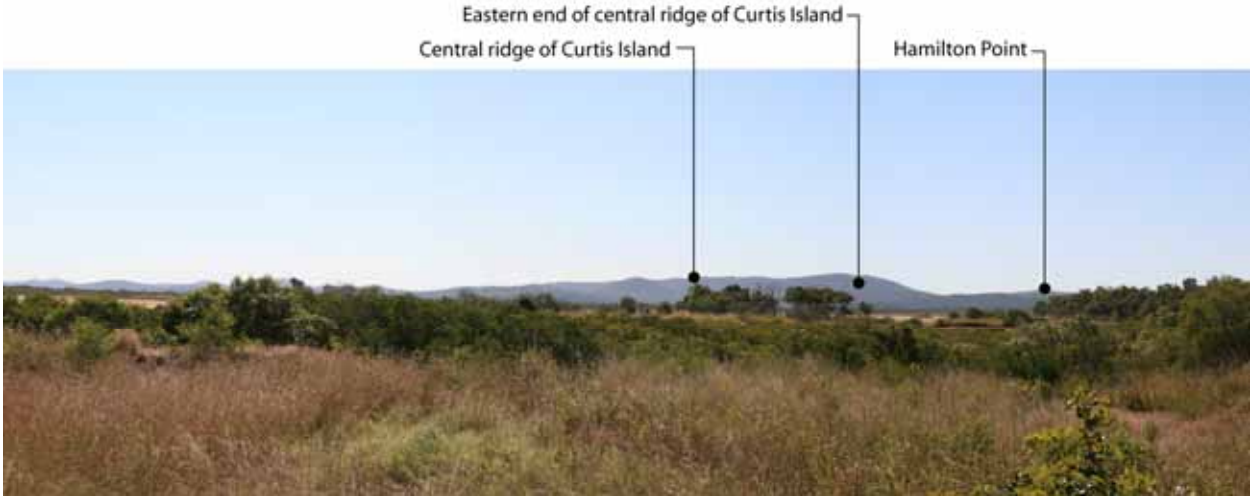
Section 3 Visual Assessment



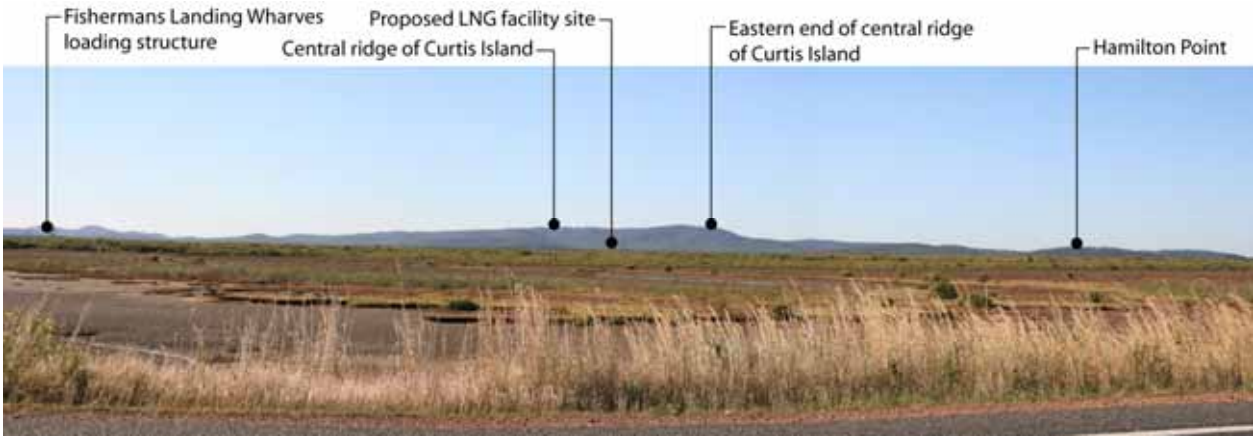
VS 14 - Bridge over Calliope River, view to north



VS 15 - Mount Larcom – Gladstone Road, view to north

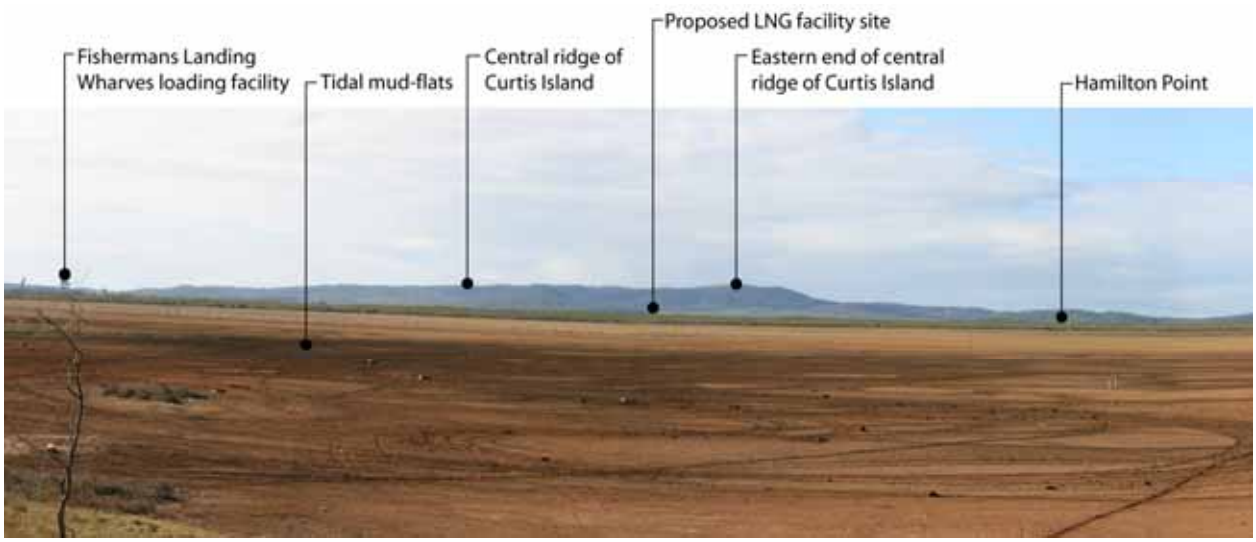


VS 16 - Bridge over Calliope River at Anabranch, view to north



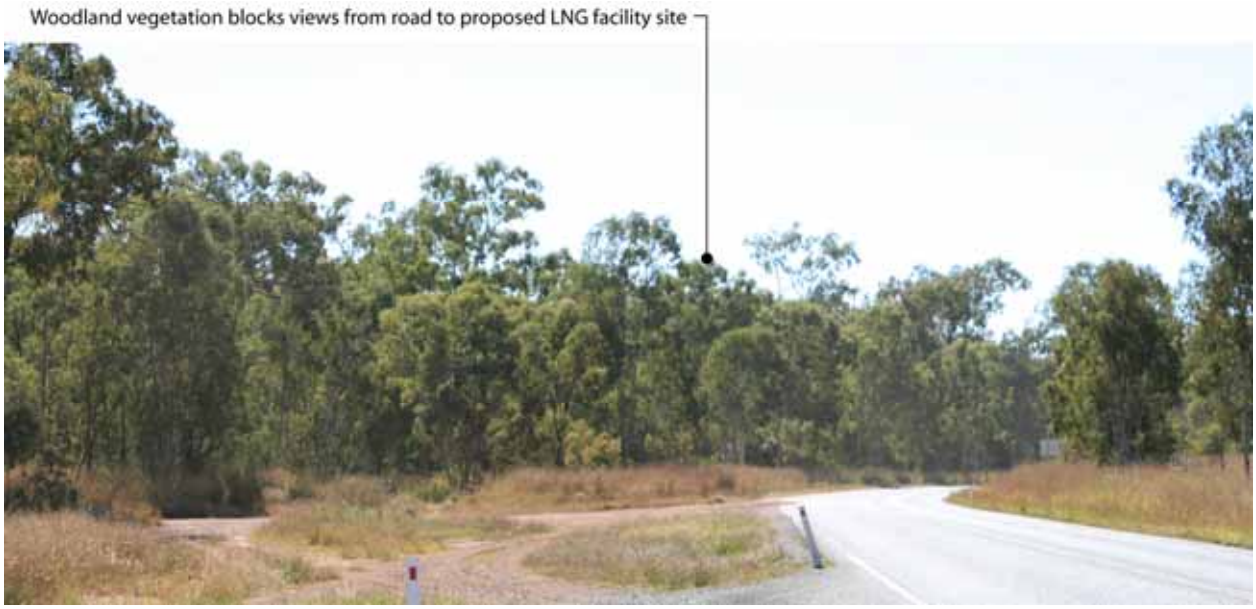
VS 17 - Mount Larcom-Gladstone Road, view to north

Section 3 Visual Assessment



VS 18 - Reid Road/ Mount Larcom-Gladstone Road intersection, view to north

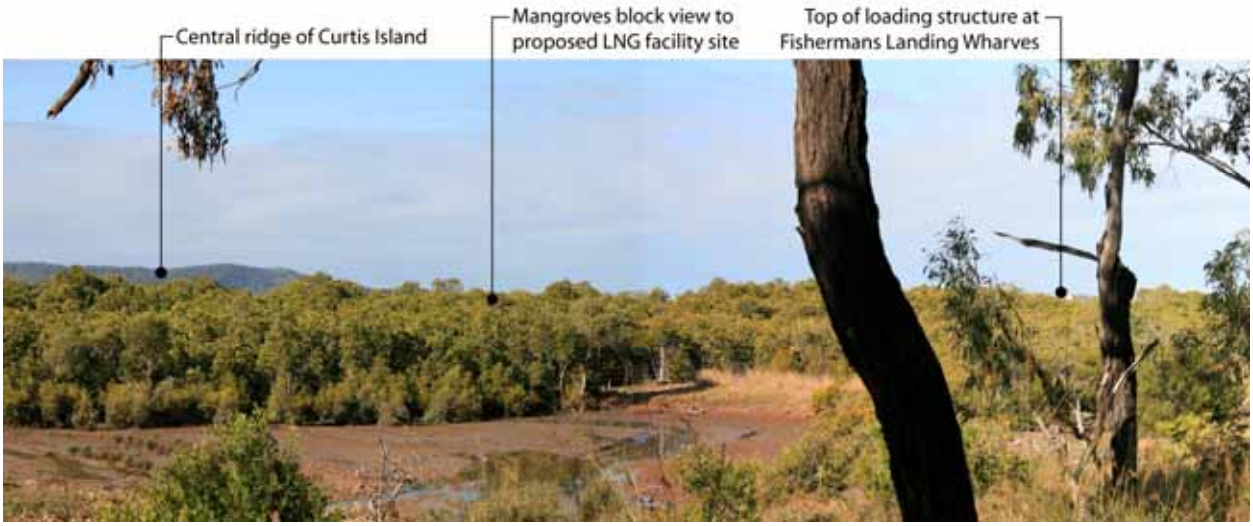
VS 19 - Mount Larcom-Gladstone Road, view to east



VS 20 - Mount Larcom-Gladstone Road, view to north east

VS 21 - Landing Road, view to north east

Section 3 Visual Assessment



VS 22 - Landing Road (north end), view to north east

VS 23 - Yarwun township, view to north east

VS 24 - The Narrows shipping channel, view to south east

VS 25 - Port Gladstone shipping channel, view to north from Auckland Lookout

VS 26 - North Channel (southern section), view to west

Section 3 Visual Assessment

VS 27 - North Channel (north section), view to west

3.5 Visibility Assessment

As described previously the proposed LNG facility will incorporate a number of major components that will vary significantly in height and size. For example, the flare stacks will be approximately 80 metres high with flare heights up to approximately 80 metres. Note: flaring is not a regular operating practice. Flaring coincides with an upset within the facility, which is rare. In contrast, the LNG train structures are expected to be in the order of 25 metres high and storage tanks approximately 40 metres. Consequently, the potential visibility of each of the major components of the LNG facility was assessed separately to determine if they are likely to be visible from the view situations identified in Section 3.4.1.

Photographs were taken from a helicopter hovering at the approximate height and at the approximate location of the major components of the proposed LNG facility (based on information at the time of the assessment), which are listed in Table 3-4. The locations from which the photographs were taken from the hovering helicopter are shown on Figure 3-2. The photographs, which are presented on the following pages, were analysed to determine the extent to which the individual components of the LNG facility would potentially be visible.

Table 3-4 Heights of LNG Facility Components

Component of LNG Facility	Approximate Height	Comment
Flare stack top	80m	Aircraft safety lighting required
Flame top above flare stack (intermittent, only occurs during facility upset)	160m	Flare events will occur intermittently
LNG Train	25m	Lighting is required for night operations
LNG Storage Tank	40m	
LNG Loading Dock	30m	Ships will be higher than the dock structure
Bridge across 'The Narrows' between Friend Point & Laird Point	40m	Clearance for yachts and navigation lighting

Client

Project

GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
LNG FACILITY

Drawn: CA | Approved: JB | Date: 23-02-2009

Job No: **4262 6220** | File No: 42626220-g-714.wor

Title

LOCATIONS OF PHOTOS FROM HELICOPTER

Figure: **3-2**

Rev:B

A4

Locations of Photos from Helicopter

LNG Facility Site

1. Approximate Location of Flare Stack Nº1
2. Approximate Location of Flare Stack Nº2
3. Approximate Location of LNG Train
4. Approximate Location of LNG Storage Tank
5. Approximate Location of LNG Loading Dock

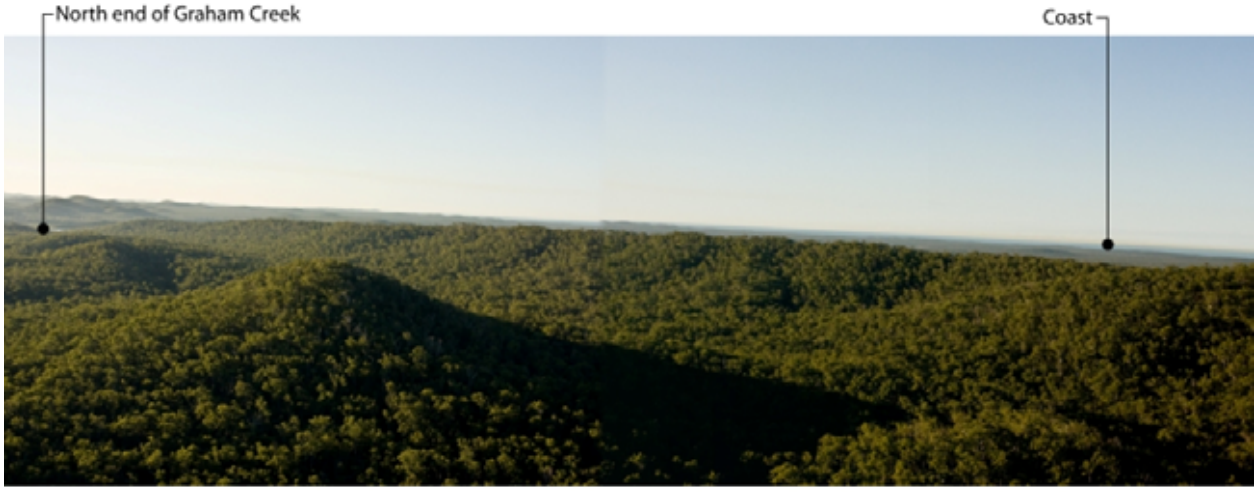
N W E S

0 250m 500m

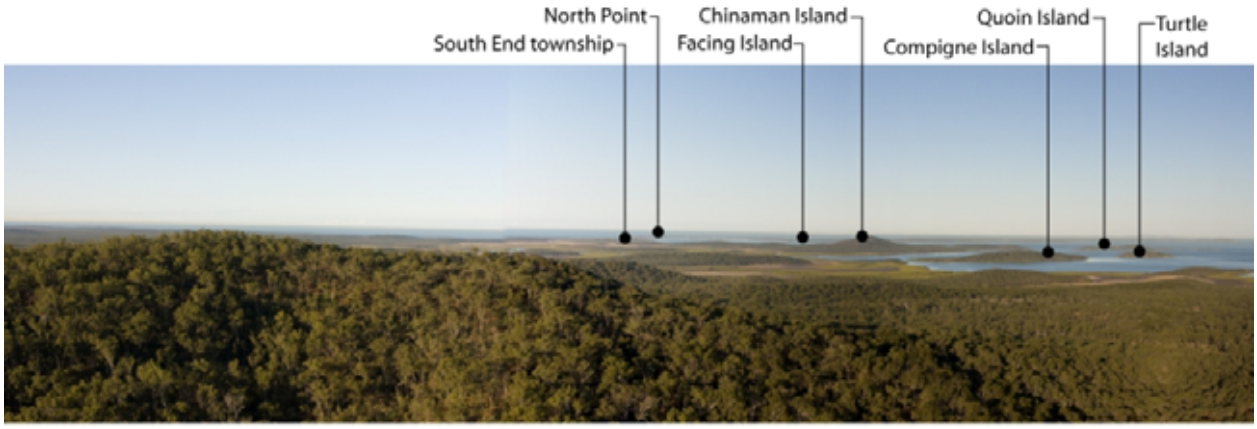
Scale 1:15 000 (A4)
Datum : GDA94 (MGA56)

Section 3 Visual Assessment

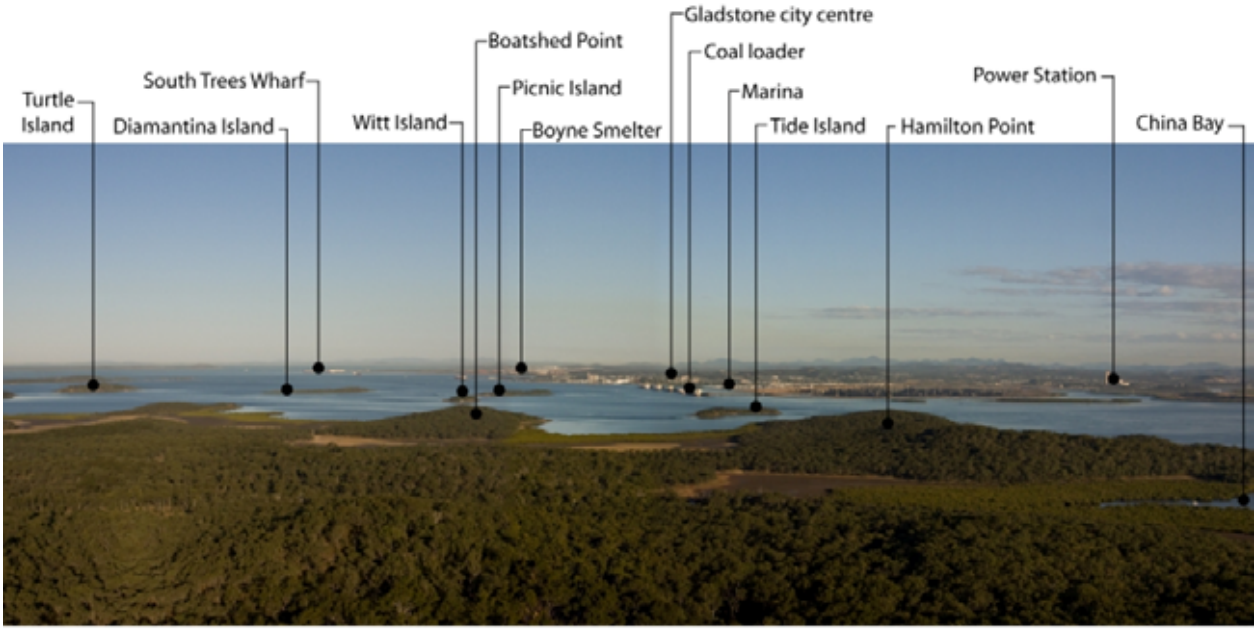
Location 1 - Flare Stack No. 1 (top of intermittent flame, only occurs during facility upset)



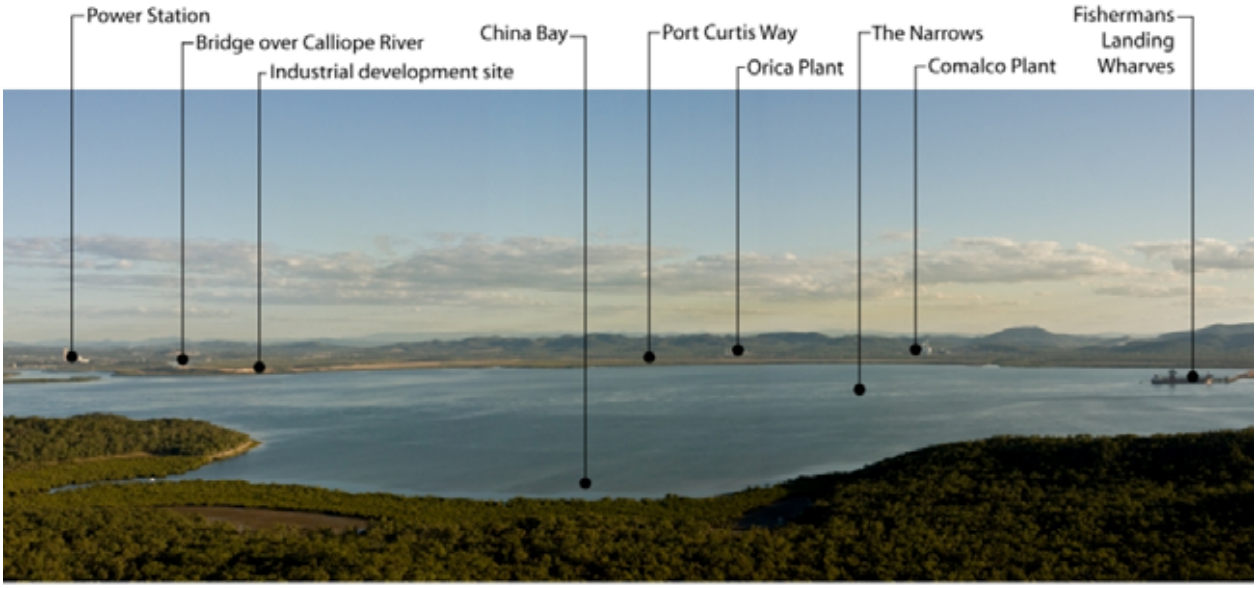
Location 1 - View north over Curtis Island



Location 1 - View east towards coast



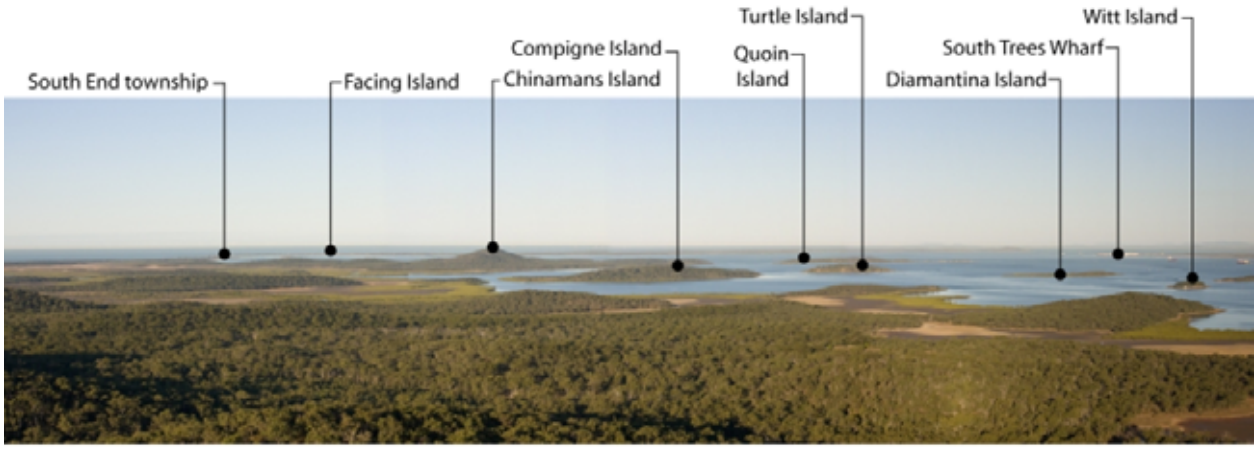
Location 1 - View south east across Gladstone Harbour to port facilities & city centre



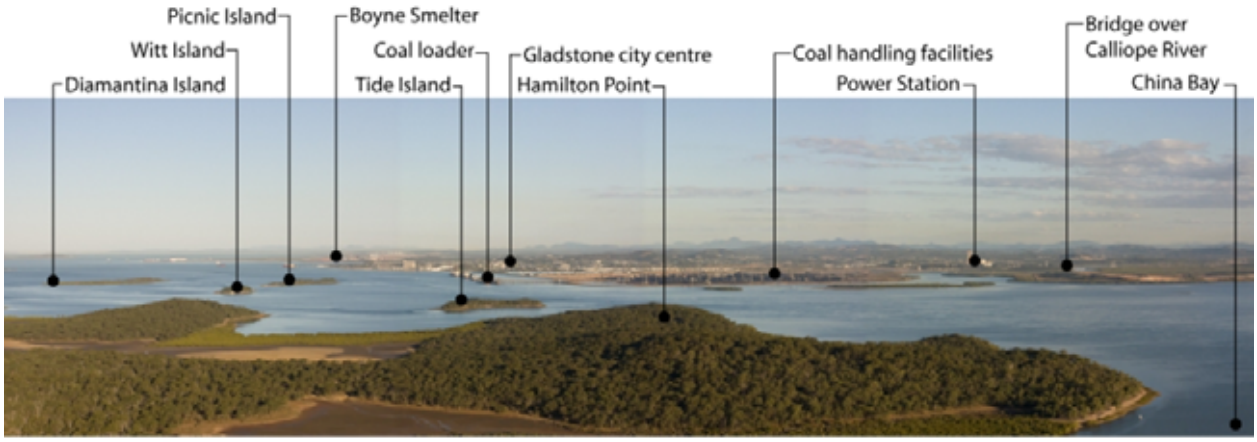
Location 1 - View south across The Narrows to western sector of Gladstone

Section 3 Visual Assessment

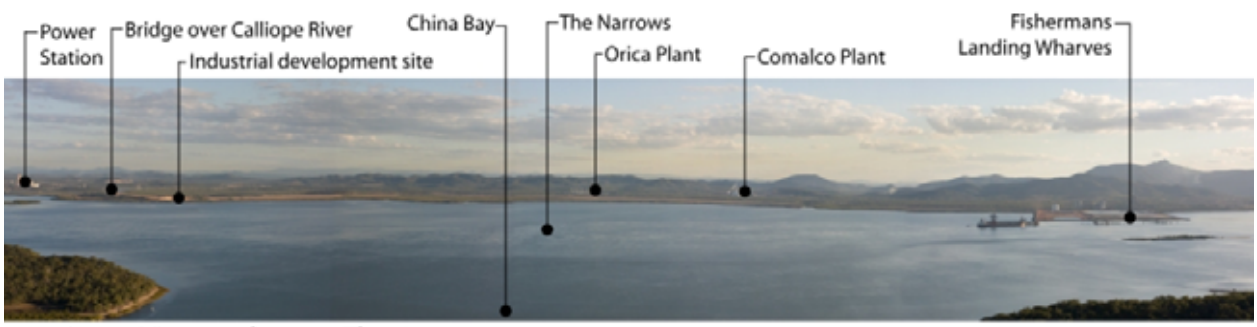
Location 2 - Flare Stack No. 2 (top of intermittent flame, only occurs during facility upset)



Location 2 - View east towards the coast

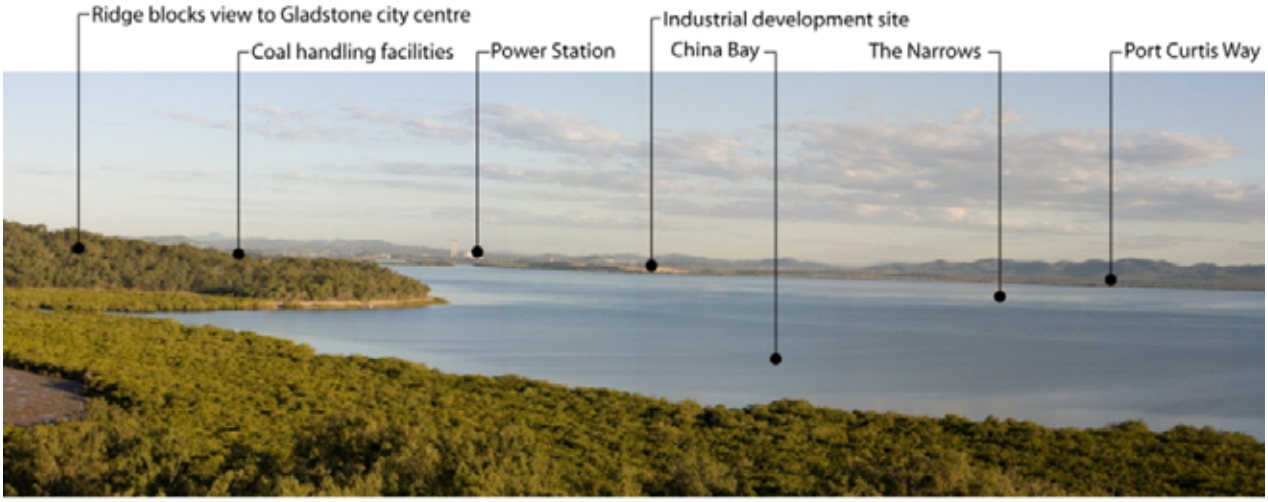


Location 2 - View south east towards City of Gladstone

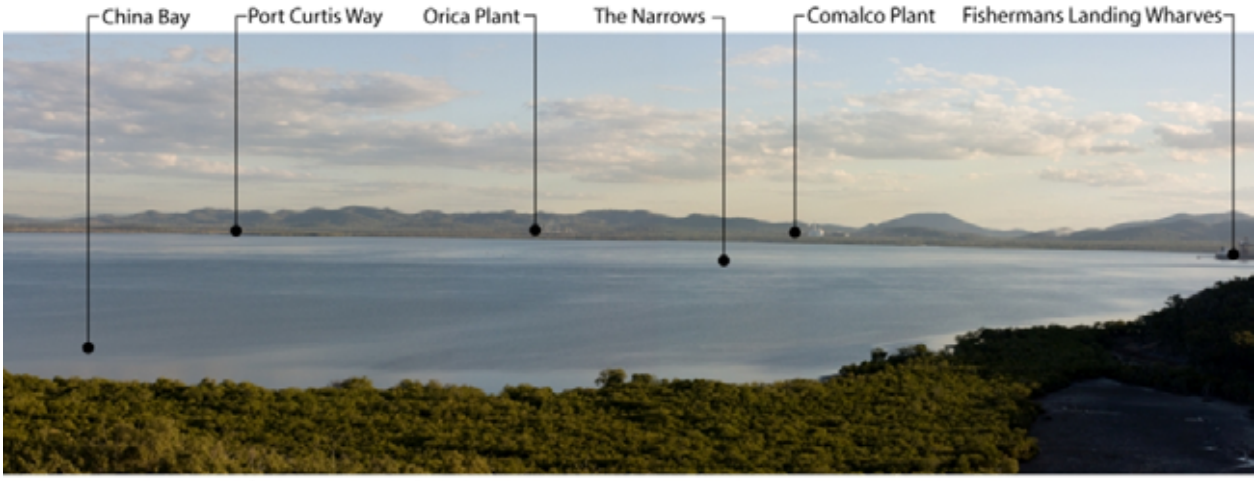


Location 2 - View south across The Narrows

Location 3 – LNG Train



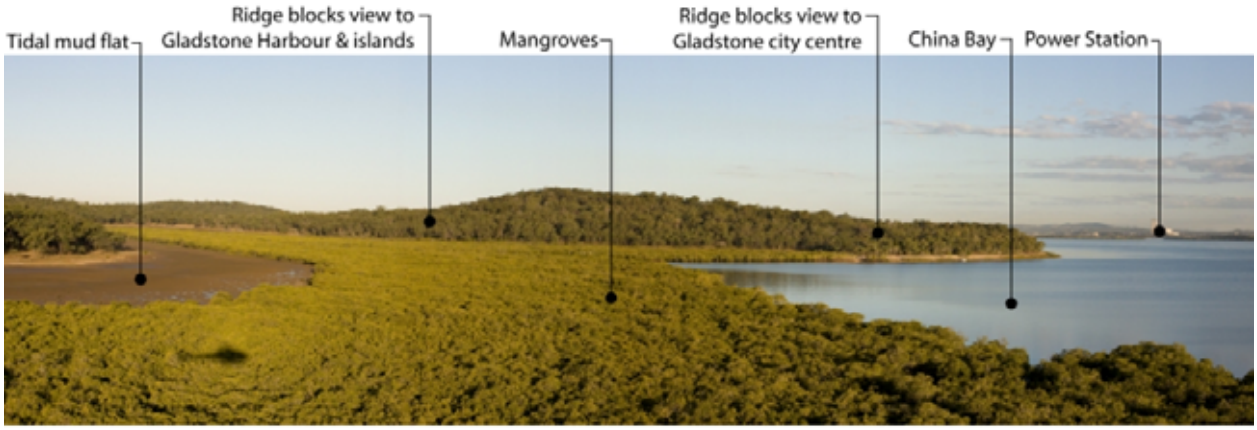
Location 3 - View south across The Narrows to western section of Gladstone



Location 3 - View south west across The Narrows

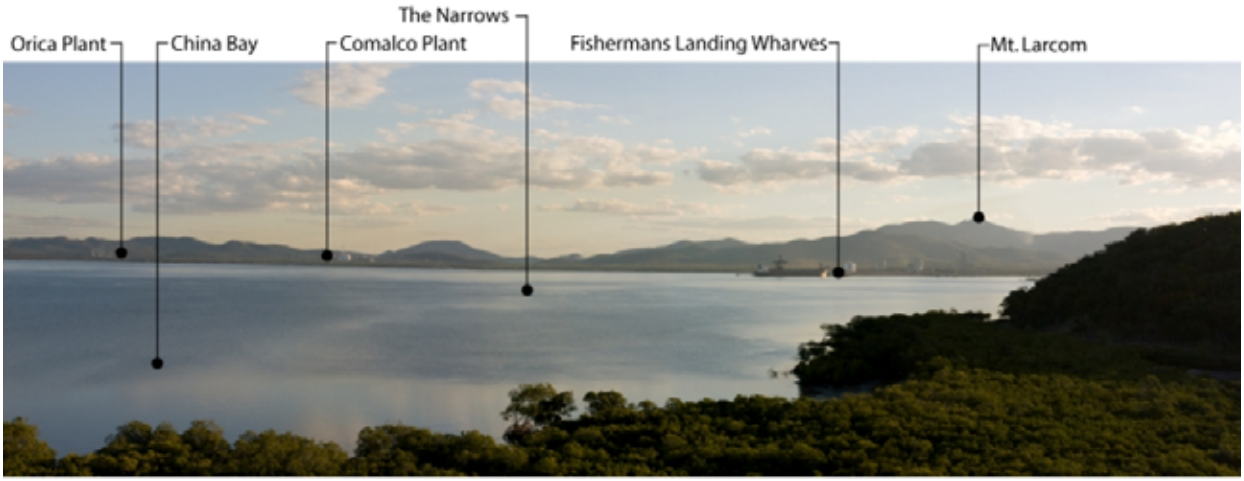
Section 3 Visual Assessment

Location 4 - LNG Storage Tank



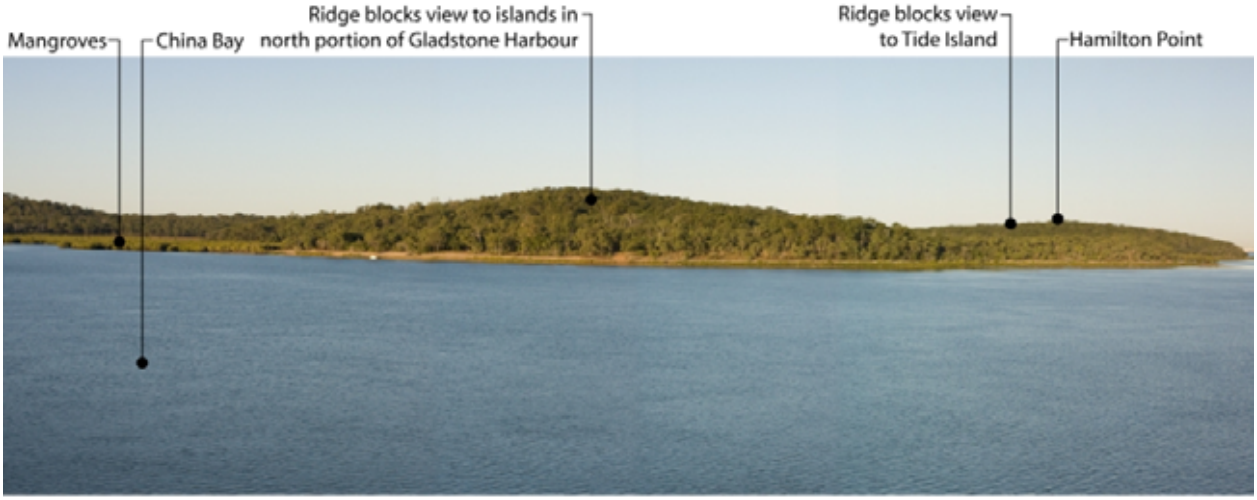
Location 4 - View south east towards Hamilton Point

Location 4 - View south east across The Narrows



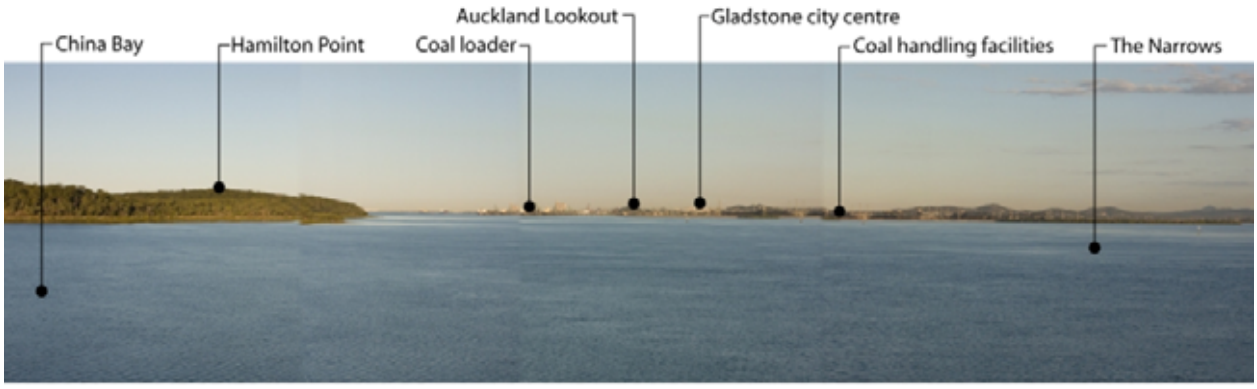
Location 4 - View south west across The Narrows

Location 5 - LNG Loading Dock



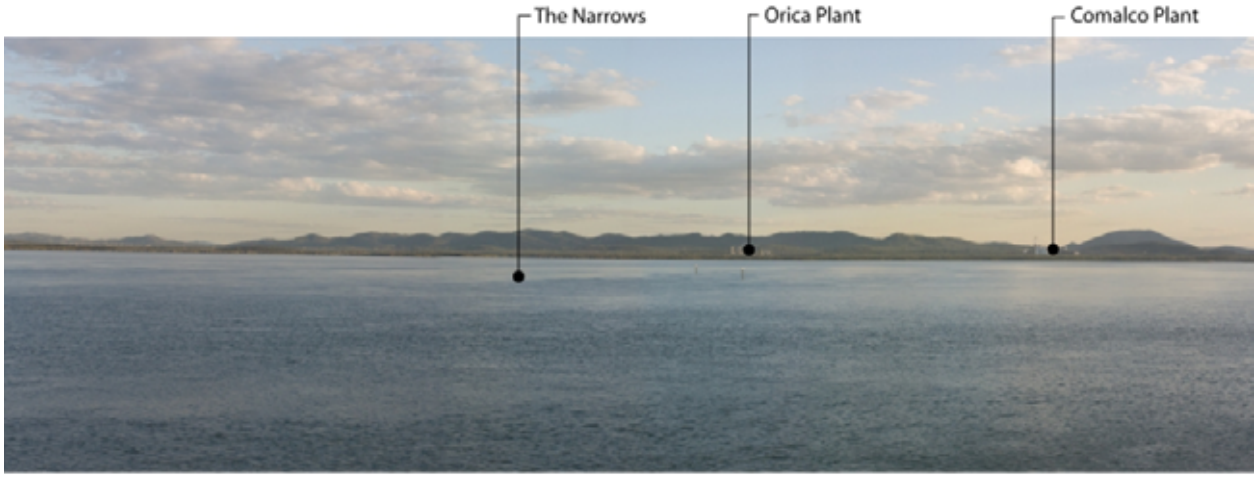
Location 5 - View east across China Bay

Section 3 Visual Assessment



Location 5 - View north east across Gladstone Harbour

Location 5 - View south towards Gladstone Power Station



Location 5 - View south west across The Narrows

Based on the results of the assessment of visibility the primary view sheds of the LNG facility, the flare stacks, the bridge and access road were identified separately and the results presented in Figure 3-3**.** The primary view shed is defined as the approximate area from which the structure or flare is likely to visible. It should be noted however that within the view shed there are likely to be locations from which the structure or flare will not be visible as a result of the view being blocked by local landform, vegetation or structures. Similarly the view may include only part of the structure due to partial screening by local landform, vegetation or structures.

Key aspect of the view sheds shown in Figure 3-3 are that:

- the view shed of the flare would be much larger than the LNG facility bridge and access road, if the vertical flare stack option is adopted;
- the view shed of the LNG facility (excluding the flare stack) is relatively confined by the visual screening provided by the landform of the valley in which it will be located;
- the view shed of the bridge/access road is generally confined to 'The Narrows' waterway and adjoining foreshore areas;
- the extent and shape of the three view sheds vary significantly;
- the only area in which the three view sheds overlap is the section of 'The Narrows' waterway adjoining the LNG facility site at China Bay.

Client

URS

LNG

Source: This map may contain data which is sourced and Copyright. Refer to Table Of Contents for Ownership and Copyright.

Project

GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
LNG FACILITY

Drawn: CA | Approved: JB | Date: 11-02-2009

Job No: **4262 6220** | File No: 42626220-g-715.wor

Title

VIEWSHED ANALYSIS

Figure: **3.3**

Rev: A

A4

Results of the visibility assessment of the major components of the LNG facility from each of the view situations identified on Figure 3-1 are presented in Table 3.5.

Table 3-5 Visibility of Major Components of LNG Facility Bridge and Access Roads

LNG Facility Components	LNG Train	LNG Storage Tank	Flare Stack	Flame	LNG Loading Dock	Bridge	Curtis Island – Access Road	Mainland – Access Road
VIEW SITUATION								
1. South End township & jetty	N	N	P	Y	N	N	N	N
2. Facing Island settlement	N	N	P	Y	N	N	N	N
3. Quoin Island	N	N	P	Y	N	N	N	N
4. Turtle Island	P	P	P	Y	N	N	N	N
5. Witt Island	P	P	P	Y	N	N	N	N
6. Tide Island	P	P	P	Y	N	N	N	N
7. Auckland Lookout	N	N	P	Y	Y	Y	N	N
8. Spinnaker Park	N	N	P	Y	N	N	N	N
9. Gladstone Commercial Centre	N	N	P	Y	N	N	N	N
10. Gladstone Urban Area	N	N	P	Y	N	N	N	N
11. Round Hill Lookout	N	N	P	Y	Y	Y	N	N
12. Hanson Rd.	N	N	P	Y	N	N	N	N
13. Hanson Rd. at Power Station	N	N	N	N	N	N	N	N
14. Bridge over Calliope River	N	N	P	Y	N	N	N	N
15. Mt. Larcom-Gladstone Rd.	Y	Y	Y	Y	N	N	N	N
16. Calliope River Anabranch Bridge	Y	Y	Y	Y	N	N	N	N
17. Mt. Larcom-Gladstone Rd.	Y	Y	Y	Y	N	N	N	N
18. Reid Rd./Mt. Larcom-Gladstone Rd.	Y	Y	Y	Y	N	N	N	N
19. Mt. Larcom-Gladstone Rd. (west of Reid Rd.)	N	N	N	N	N	N	N	N
20. Mt. Larcom-Gladstone Rd. (west of Landing Rd. intersection)	N	N	N	N	N	N	N	N
21. Landing Rd.	N	N	N	N	N	N	N	N
22. Landing Rd. foreshore	N	N	P	Y	N	Y	N	N
23. Yarwun township	N	N	N	N	N	N	N	N
24. The Narrows	Y	Y	Y	Y	Y	Y	Y	Y
25. Port Gladstone	N	N	P	Y	N	N	N	N
26. North Channel (south section)	N	N	P	Y	N	N	N	N
27. North Channel (north section)	N	N	P	Y	N	N	N	N

Y – Yes Visible N – Not visible P – Partly visible (upper portion of the structure)

Section 3 Visual Assessment

Key findings of the visibility assessment are summarised by the following points:

- All components of the LNG facility as well as the bridge and access roads would be visible from 'The Narrows' waterway;
- The flare stack and flame would be visible to varying degrees from most of the view situations identified on Figure 3-1, with the exception of those sections of the Mt Lacom-Gladstone Road from which views are blocked by roadside vegetation and sections of Hanson Road;
- The LNG train and storage tanks would not be visible from most view situations due to visual screening created by the tree-covered ridges that define the valley in which the LNG facility would be located. However, these structures would be visible from The Narrows and adjoining sections of Mount Larcom-Gladstone Rd. and the upper portions the structures would be visible from Tide, Witt and Turtle Islands;
- The proposed bridge and access roads would not be visible from most view situations shown on Figure 3-1 due to screening by vegetation and/or landforms but it would be highly visible from The Narrows. The bridge would also be visible from the Auckland and Round Hill public lookouts even though the views are 13 km and 16 km respectively.
- Ships moored at the LNG loading dock China Bay will be visible from The Narrows and sections of the Mount Larcom Gladstone Road. These ships will be visually prominent due size and the visual contract between ship and the natural landscape character of Curtis Island which will form a visual background. When a ship is moored at the LNG loading dock it will block views of the land-based components of the LNG facility.

3.6 Visual Impact Assessment

The level of significance of the potential visual impact of the proposed LNG facility development is dependent on the **Magnitude** of change to existing views and the **Sensitivity** of the viewers to that change.

The **Magnitude** of change to existing views will depend on a combination of scale, extent and duration of the views. It is influenced by the:

- extent of area from which components of the LNG facility development would be visible;
- number and type of viewers who would see the development;
- distance of the view to the proposed development;
- duration of change to the view (i.e. temporary or permanent, continuous or intermittent) that would result from the development;
- scale of change to the view that would result from the development (i.e. proportion of the view occupied by the proposed development);
- degree of contrast of form, scale, line, height, colour and texture between components of the proposed development and the existing landscape in which they are viewed.

Viewer Sensitivity is the extent to which a viewer is willing to accept the change to the landscape character that would result from the proposed LNG development without perceiving it as an adverse impact on the existing landscape character or the values attributed to the current view. Sensitivity of the viewers will depend on their location, expectations and activity. It will also be influenced by the perceived importance of the view, which may

be reflected by the extent to which it is identified in tourist guides, referenced in publications as well as the availability of facilities for public access and interpretation.

Categories of viewers with high sensitivity are likely to include people visiting lookouts or public parks or open space where enjoyment of views is a key aspect of the site. Residents of properties where the view is a key value associated with the property are also likely to have a high sensitivity to changes to that view. Low viewer sensitivity is most likely to be associated with people at their place of work, particularly at industrial plants, loading/unloading ships and construction sites. The level of visual sensitivity of motorists will vary depending on the purpose of their trip with those travelling to and from work less sensitive than tourists travelling by boat or car with the intention of enjoying views of the landscape.

The various levels of **Visual Impact Significance** that are predicted to result from the combinations of **Magnitude of Visibility** and **Viewer Sensitivity** are presented in Table 3-6.

Table 3-6 Visual Impact Significance Matrix

	Viewer Sensitivity		
	Low	Medium	High
Visibility Magnitude			
High	Moderate	High	High
Medium	Low/Moderate	Moderate	High
Low	Low	Low/Moderate	Moderate
Negligible	Negligible	Negligible/Low	Low

Note: the levels of Visual Impact Significance in shaded cells are not considered to be significant enough to constitute potential barriers of the proposed development. However mitigation measures may still be required.

The **Levels of Visual Impact Significance** are defined as:

Negligible Visual Impact - only a very small part of the proposed LNG facility development would be discernible and/or it would be located at such a distance that it would be scarcely visible.

Low Visual Impact – the proposed LNG facility development would constitute only a minor component of the wider view and might be missed by the casual observer; awareness of the development would not have a marked effect on the overall quality of the view.

Moderate Visual Impact - the LNG facility development may form a visible and recognisable new element within the overall scene and may be readily noticed by an observer.

High Visual Impact - the LNG facility development would form a significant and immediately apparent part of the view that would affect and change its overall character (the change may be positive or negative).

The predicted level of significance of potential visual impact of the LNG facility development was assessed by applying the methodology described previously to determine the Magnitude of Visibility. An assumed Level of Viewer Sensitivity was then combined with the Magnitude of Visibility rating to determine the level of Visual Impact Significance at each View Situation in accordance with Table 3-6.

Section 3 Visual Assessment

3.6.1 LNG Facility

As illustrated in Figure 3-3 and Table 3-5 there is a significant difference in the extent to which the flare stack and flame are visible compared to the other major components of the proposed LNG facility, which include the LNG train, storage tanks and loading dock. This difference is primarily due to the significantly greater height of the flare stack and flame. In addition, the occurrence of the flame at the flare stack is intermittent and irregular, while the other structures are permanent. Consequently the assessment of potential visual impact has considered the flare stack and flame separately from the other components of the LNG facility. Table 3-7 presents the results of the assessment of the visual impact predicted to result from the LNG train, storage tanks and loading dock while Table 3-8 presents the results of the separate assessment of the flare stack and flame.

The View Situation Assessment Criteria used in Tables 3-7, Table 3-8 and Table 3-9 are defined in Table 3-1 and summarised here.

View Distance	L=Long	M=Medium	S=Short	VS=Very short
Period of View	L=Long term	M=Moderate term	S=Short term	
Number of Viewers	H=High	M=Moderate	L=Low	VL=Very low

The categories of Magnitude of Visibility, which are defined Table 3.2, are also summarised here.

Magnitude of Visibility	N= negligible	L= low	M=medium	H= high
Viewer Sensitivity	L=low	M=Medium	H=high	

Table 3-7 Visual Impact Assessment of Proposed LNG Train, Storage Tanks & Loading Dock

Assessment Criteria	Category Of Viewer	Approximate Distance to Site	Approx. Period of View	Relative No. of Viewers	Magnitude of Visibility	Viewer Sensitivity	Visual Impact Significance	Comments
VIEW SITUATION								
1. South End township & jetty	Residents & visitors						N	Facilitynot visible
2. Facing Island settlement	Residents & visitors						N	Facilitynot visible
3. Quoin Island	Residents						N	Facilitynot visible
4. Turtle Island	Residents	L	L	VL	N	H	L	Not visible from houses
5. Witt Island	Residents	M	L	VL	L	H	M	Not visible from houses
6. Tide Island	Residents	M	L	VL	L	H	M	Not visible from houses
7. Auckland Lookout	Visitors						N	Facilitynot visible
8. Spinnaker Park	Visitors						N	Facilitynot visible
9. Gladstone Commercial Centre	Workers & Visitors						N	Facilitynot visible
10. Gladstone Urban Area	Residents						N	Facilitynot visible
11. Round Hill Lookout	Visitors	L	M	L	N	H	L	Loading dock & ship visible
12. Hanson Road	Motorists						N	Facilitynot visible
13. Hanson Rd. at Power	Motorists						N	Facilitynot visible

Assessment Criteria	Category Of Viewer	Approximate Distance to Site	Approx. Period of View	Relative No. of Viewers	Magnitude of Visibility	Viewer Sensitivity	Visual Impact Significance	Comments
Station								
14. Bridge over Calliope River	Motorists						N	Facilitynot visible
15. Mt. Larcom-Gladstone Rd. (west of Calliope River)	Motorists	L	M	M	L	H	M	Low hill partly blocks view to site
16. Bridge over Calliope River Anabranch	Motorists	L	S	M	N	H	L	Low hill partly blocks view to site
17. Mt. Larcom-Gladstone Rd.	Motorists	L	M	M	L	H	M	Open view across tidal mud flats, Mangroves block part of site
18. Mt. Larcom-Gladstone Rd. /Reid Rd. intersection	Motorists	L	S	M	L	H	M	Open view across tidal mud flats, Mangroves block view of site foreshore
19. Mt. Larcom-Gladstone Rd. (west of Reid Rd.)	Motorists						N	Facilitynot visible
20. Mt. Larcom-Gladstone Rd.	Motorists						N	Facilitynot visible
21. Landing Rd.	Motorists						N	Facilitynot visible
22. Landing Rd. foreshore	Visitors						N	Facilitynot visible
23. Yarwun township	Residents						N	Facilitynot visible
24. 'The Narrows'	Passeng-ers & crew	S	M	L	M	H	H	Open views from boats to site & bridge
25. Port Gladstone	Passeng-ers & crew						N	Views to site blocked by islands & Hamilton Point
26. North Channel (south)	Passeng-ers & crew						N	Views to site generally blocked by islands & ridge
27. North Channel (north)	Passeng-ers & crew						N	Views to site generally blocked by Chinaman Is.

Visual Impact Significance: N=negligible L=low M=medium H=high

Key aspects of the Visual Impact Assessment of the LNG train, storage tanks and loading dock, which are presented in Table 3-7, include:

- The only view situation in which the level of visual impact is predicted to be high is passengers and crew of vessels on The Narrows waterway; this includes pleasure craft as well as ships entering and leaving the Fisherman's Landing Wharf;
- View situations from which the level of visual impacts is predicted to be moderate include Witt and Tide Island as well as the section of the Mount Larcom – Gladstone Road between Calliope River the Reid Road intersection;
- View situations in which the potential visual impact is predicted to be low include Turtle Island, Round Hill Lookout, and the bridge over Calliope River;
- The level of visual impact in all other view situations identified in Table 3-7 is predicted to be negligible.

Section 3 Visual Assessment

The structures and storage tanks to be constructed as part of the LNG facilities and the associated alteration of landforms will not result in obstruction of sunlight on areas adjoining the development. The materials to be used in the structures of the LNG facility will be selected with the aim of avoiding reflections the would impact on areas of land and water adjoining the LNG facility.

There are no existing light sources within the LNG facilities site and immediately surrounding areas. Consequently, lighting associated with the LNG facility will introduce a new source of illumination into to predominantly natural landscape setting. The visual simulations presented in Section 3.6 illustrate the level of illumination that would be visible in views from the key view situations identified in the visual assessment. However, as the portion of Curtis Island adjacent to the proposed LNG facility is undeveloped remnant woodland there will not be any impact on existing residents. The main category of viewer that will be impacted by lighting on the LNG facility will be crew and passengers of recreation craft on The Narrows waterway and ships berthing at the Fisherman's Landing Wharf. While the illumination of the LNG facility will be visible from other locations listed in Table 3-7 assessed as medium or low visual impact most of these include existing lighting associated with urban development or port facilities.

Table 3-8 Visual Impact Assessment of Proposed LNG Facility Flare Stack & Flame

Assessment Criteria	Category of Viewer	Approximate Distance to Site	Approx. Period of View	Relative No. of Viewers	Magnitude of Visibility	Viewer Sensitivity	Visual Impact Significance	Comments
VIEW SITUATION								
1. South End township & jetty	Residents & visitors	L	M	L	N	H	L	Trees generally block views from houses
2. Facing Island settlement	Residents & visitors	L	M	L	N	H	L	Houses oriented west
3. Quoin Island	Residents	L	M	VL	N	H	L	Houses oriented west
4. Turtle Island	Residents	L	M	VL	N	H	L	House oriented to east
5. Witt Island	Residents	M	M	VL	N	H	L	House oriented to east
6. Tide Island	Residents	M	M	VL	N	H	L	House oriented to east
7. Auckland Lookout	Visitors	L	M	L	N	M	N	Coal loader mid distance
8. Spinnaker Park	Visitors	L	M	L	N	M	N	Coal loader in foreground
9. Gladstone Commercial Centre	Workers & Visitors	L	M	H	L	M	L	Views generally blocked by buildings
10. Gladstone Urban Area	Residents	L	M	H	L	M	L	Views generally blocked by buildings
11. Round Hill Lookout	Visitors	L	M	L	N	H	L	View distance 12km
12. Hanson Road	Motorists	L	M	M	L	M	L	Views generally blocked by buildings
13. Hanson Rd. at Power Station	Motorists						N	Views generally blocked by buildings & trees
14. Calliope River Bridge	Motorists	L	S	M	N	M	L	No stopping on bridge
15. Mt. Larcom-Gladstone Rd. (west of Calliope River)	Motorists	L	M	M	L	M	L	Low hill partly blocks view to site
16. Bridge over Calliope River Anabranch	Motorists	L	S	M	N	M	L	Low hill partly blocks view to site
17. Mt. Larcom-Gladstone Rd.	Motorists	L	M	M	L	M	M	Open view across tidal mud flats, Mangroves block view to lower portion of site

Assessment Criteria	Category of Viewer	Approximate Distance to Site	Approx. Period of View	Relative No. of Viewers	Magnitude of Visibility	Viewer Sensitivity	Visual Impact Significance	Comments
18. Mt. Larcom-Gladstone Rd. /Reid Rd. intersection	Motorists	L	S	M	N	M	M	Open view across tidal mud flats, Mangroves block view of site foreshore
19. Mt. Larcom-Gladstone Rd. (west of Reid Rd.)	Motorists						N	Views from road blocked by trees
20. Mt. Larcom-Gladstone Rd.	Motorists						N	Views from road blocked by trees
21. Landing Rd.	Motorists						N	Views from road blocked by trees
22. Landing Road foreshore open space area	Visitors	L	M	L	N	H	L	Views partly blocked by Mangroves
23. Yarwun township	Residents						N	View to site blocked by landform & vegetation
24. The Narrows	Passeng-ers & crew	S	M	L	M	H	H	Open views from boats to site & bridge
25. Port Gladstone	Passeng-ers & crew	L	M	L	N	H	L	Views to site blocked by islands & Hamilton Point
26. North Channel	Passeng-ers & crew	L	M	L	N	H	L	Views to site blocked by islands & ridge
27. North Channel	Passeng-ers & crew	L	M	L	N	H	L	Views to site generally blocked by Chinaman Is.

Visual Impact Significance: N=negligible L=low M=medium H=high

The assessment of predicted visual impact of the flare stack and flame presented in Table 3-8 indicates that the number of view situations impacted is higher than for the LNG train, tanks and loading dock, which are addressed in Table 3-7. This more extensive visual impact results from the greater height of the stacks but more significantly from the flame that would be highly visible at night. It should however be emphasised that flaring at night is only expected to occur on a small number of occasions during the year.

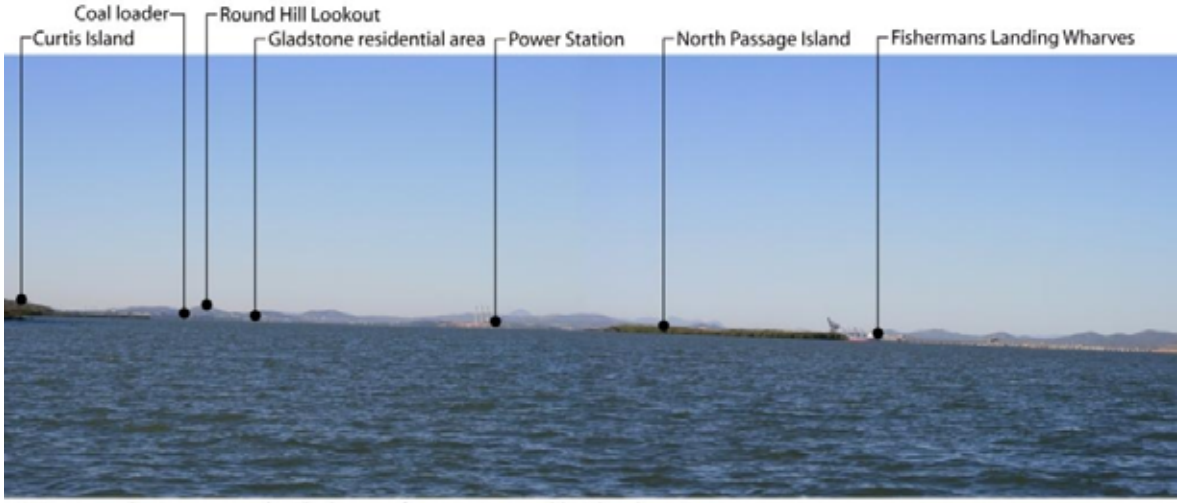
Due to the height of the flare stacks aircraft safety lighting will be required by the Civil Aviation Safety Authority (CASA). Clause 9.4.2.4 (c) of the CASA Manual of Standards Part 139 – Aerodromes will require the aircraft safety lighting to consist of steady red lights that are visible from all directions. In views from areas south west of the site the red light will be seen together with the lighting of the LNG against a backdrop of the tree-covered central ridge of Curtis Island. The cumulative visual impact of the aircraft safety lighting is not predicted to be high as it will be seen in the context of general lighting of the LNG facility.

3.6.2 Bridge and Access Road

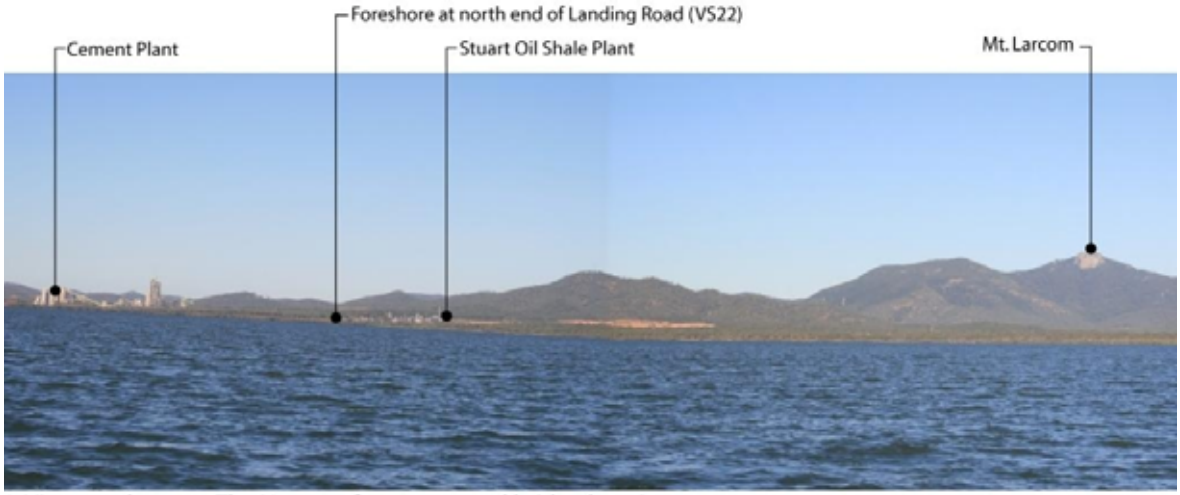
As the proposed bridge across The Narrows to Curtis Island and the associated access road are linear elements of infrastructure and generally separated from the LNG facility, their potential visual impact has been assessed separately

In order to assess the extent to which the bridge may be visible, a series of photographs was taken from a boat at the location of the proposed bridge crossing of The Narrows. The following annotated photographs illustrate views from the proposed bridge site. It should be noted that the photographs were taken at water level and the bridge structure will be at a significantly higher level in order to allow vessels to pass under it.

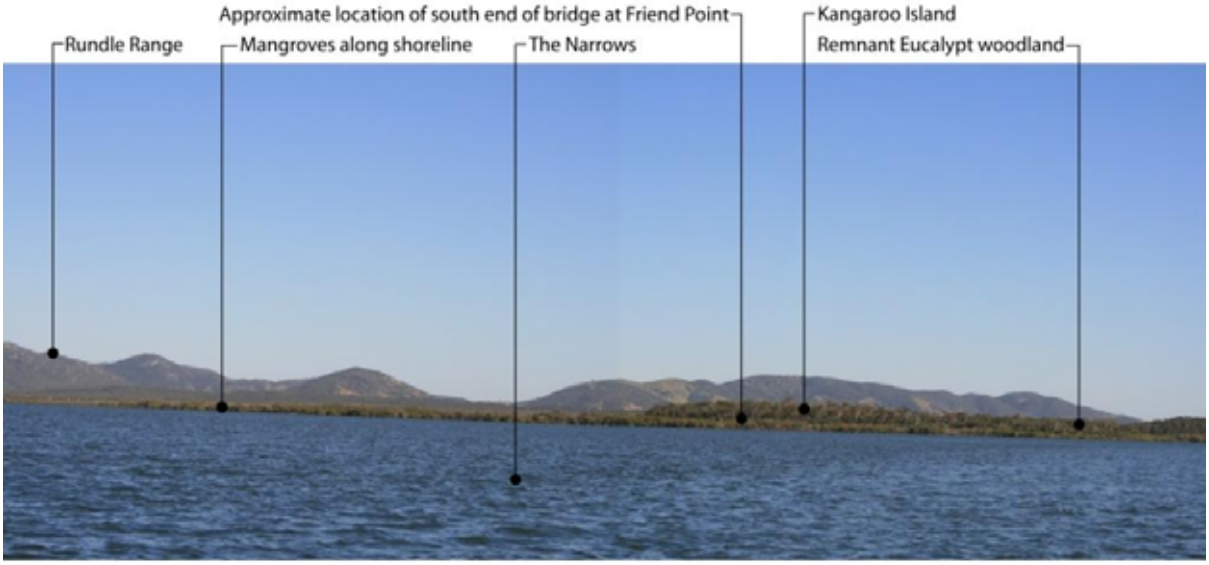
Section 3 Visual Assessment



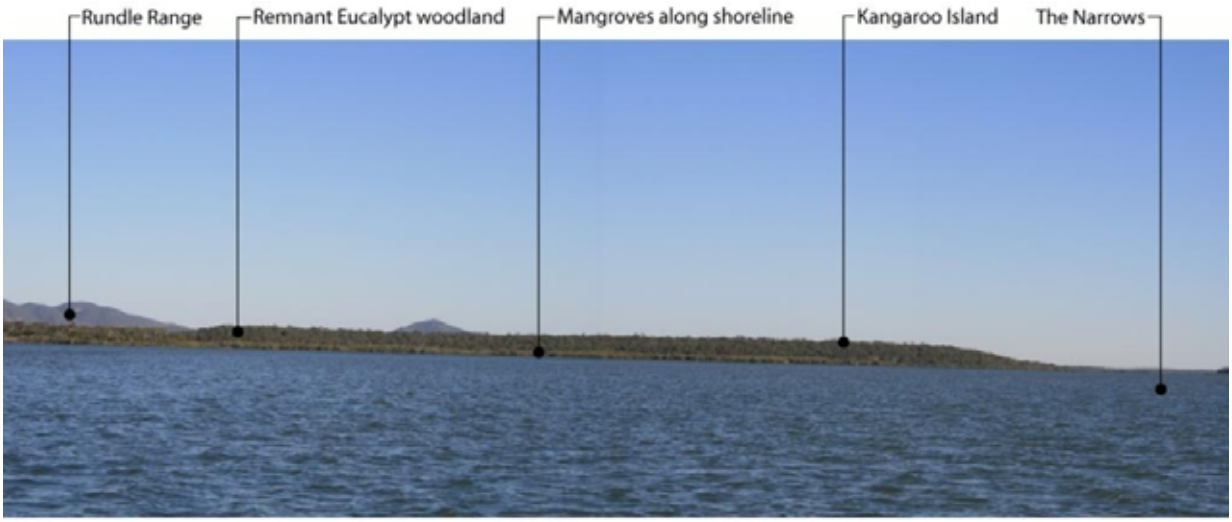
1. View south east towards Gladstone from proposed bridge location



2. View south across The Narrows from proposed bridge location

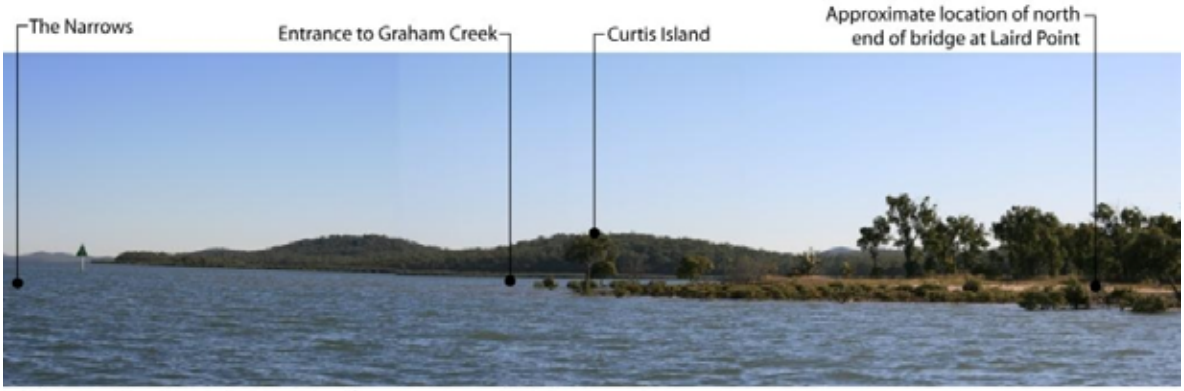


3. View south west across The Narrows from proposed bridge location

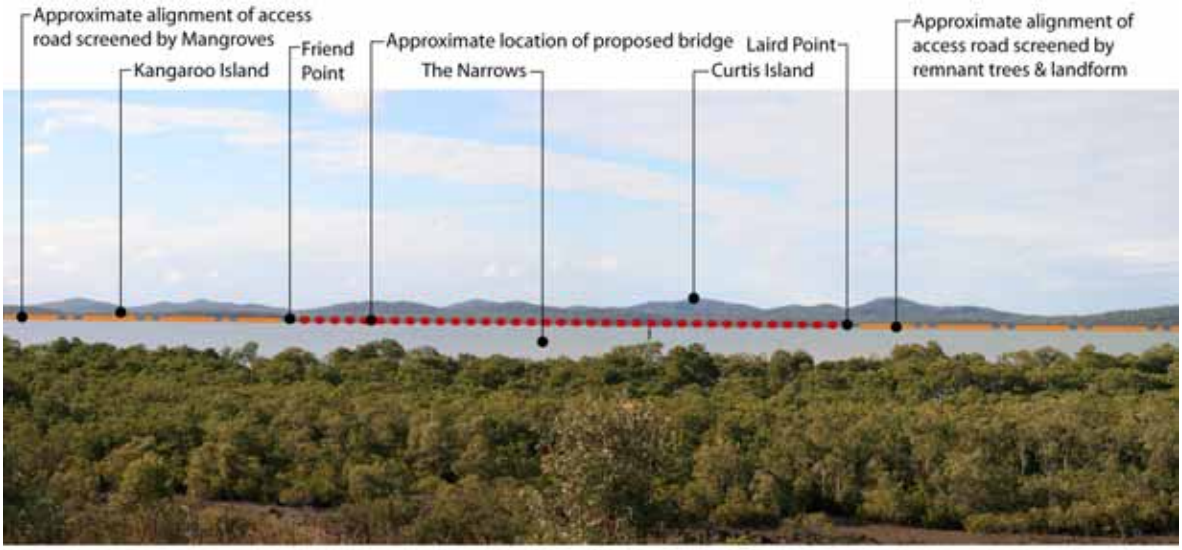


4. View west across The Narrows to Kangaroo Point from proposed bridge location

Section 3 Visual Assessment



5. View north along The Narrows from proposed bridge location



6. View north to proposed bridge location from north end of Landing Road (View Situation 22)

One of the few locations currently accessible to the public from which the proposed bridge crossing point can be seen is the foreshore public open space at the northern end of Landing Road, which is identified as View Situation 22 on Figure 3-1. The annotated photograph above shows the approximate extent of the proposed bridge and access road. It should be noted that the location of this photograph is currently accessed by an unsealed gravel track from the northern end of Landing Road and the track is primarily used by fishermen gaining access to the foreshore. However, it is the proposed location for an intersection between the new access road to Curtis Island and the existing road to the Fisherman's Landing wharf. Due to the slightly elevated landform at this location the proposed bridge to Curtis Island will be visible from the proposed intersection.

The primary view situation from which the proposed Curtis Island bridge would be visible is from vessels travelling along The Narrows or moored at the Fisherman's Landing wharf. The likely level of significance of visual impact for crews and passengers on vessels will vary significantly depending on the nature of their activities. Passengers on pleasure craft travelling through The Narrows are likely to experience a higher level of visual impact than the crew of commercial vessels using the Fisherman's Landing wharf. However, for many pleasure craft passengers the visual impact may not necessarily be negative as the new bridge will form a visual gateway that will clearly mark the northern boundary of Gladstone Harbour. It will form a landmark structure

separating the Harbour, with its predominantly industrial character, from the natural landscape character associated with The Narrows and Graham Creek north of the bridge, incorporating the Mackay Capricorn Marine Park.

The predicted level of significance of the visual impact associated with the proposed bridge was assessed using the similar criteria as for the LNG facility. Results of the assessment are presented in Table 3-9.

Table 3-9 Visual Impact Assessment of Proposed Bridge

Assessment Criteria	Category of Viewer	Approximate	Approx. Period of View	Relative No. of Viewers	Magnitude of Visibility	Viewer Sensitivity	Visual Impact Significance	Comments
VIEW SITUATION								
1. South End township & jetty	Residents & visitors						N	Bridge site not visible
2. Facing Island settlement	Residents & visitors						N	Bridge site not visible
3. Quoin Island	Residents						N	Bridge site not visible
4. Turtle Island	Residents						N	Bridge site not visible
5. Witt Island	Residents						N	Bridge site not visible
6. Tide Island	Residents						N	Bridge site not visible
7. Auckland Lookout	Visitors	L	M	L	N	H	L	View distance 13km
8. Spinnaker Park	Visitors						N	Coal loader blocks view to bridge site
9. Gladstone Commercial Centre	Workers & Visitors	L	M	H	L	M	L	View distance 13km
10. Gladstone Urban Area	Residents	L	M	H	L	M	L	View distance 13km
11. Round Hill Lookout	Visitors	L	M	L	N	H	L	View distance 16km
12. Hanson Road	Motorists						N	Bridge site not visible
13. Hanson Rd. at Power Station	Motorists						N	Bridge site not visible
14. Bridge over Calliope River	Motorists	L	S	M	N	M	L	View distance 12km
15. Mt. Larcom-Gladstone Rd. (west of Calliope River)	Motorists						N	Bridge site not visible
16. Bridge over Calliope River Anabranch	Motorists						N	Bridge site not visible
17. Mt.Larcom-Gladstone Rd.	Motorists						N	Bridge site not visible
18. Mt.Larcom-Gladstone Rd. /Reid Rd. intersection	Motorists						N	Bridge site not visible
19. Mt. Larcom-Gladstone Rd. (west of Reid Rd.)	Motorists						N	Bridge site not visible
20. Mt.Larcom-Gladstone Rd.	Motorists						N	Bridge site not visible
21. Landing Rd.	Motorists						N	Bridge site not visible

Section 3 Visual Assessment

Assessment Criteria	Category of Viewer	Approximate	Approx. Period of View	Relative No. of Viewers	Magnitude of Visibility	Viewer Sensitivity	Visual Impact Significance	Comments
22. Landing Road foreshore open space area	Visitors	M	M	VL	N	H	L	
23. Yarwun township	Residents						N	Bridge site not visible
24. The Narrows	Passeng-ers & crew	VS	M	L	M	H	H	Some boats will pass under bridge
25. Port Gladstone	Passeng-ers & crew						N	Views to bridge blocked by coal loader & Hamilton Pt.
26. North Channel (Picnic Is. to Tail Point)	Passeng-ers & crew						N	Views to bridge blocked by Curtis Island
27. North Channel (Tail Point to South End)	Passeng-ers & crew						N	Views to bridge blocked by Curtis Island

Visual Impact Significance: N=negligible L=low M=medium H=high

One section of the new road that will be constructed to provide access to the LNG facility will run along the western side of the Narrows from a new intersection at the north end of Landing Road to the western end of the bridge at Friend Point. The other section of access road will run from the eastern end of the bridge at Laird Point along the southern side of Graham Creek before turning south east to run along a valley to the LNG facility at China Bay.

North of the Landing Road intersection the access road will run parallel to the foreshore but it will not generally be visible from vessels moving through The Narrows due to the visual screening by the strip of Mangroves growing in the intertidal zone as well as a strip of remnant eucalypt woodland that will be retained along most of the eastern edge of the proposed road corridor. The section of access road that would run across the tidal flats south of Friend Point is to be constructed on an embankment and will have less screening by the Mangroves. This section of the access road will be partly visible from vessels travelling along The Narrows.

Mangroves growing along the southern edge of Graham Creek will screen potential views of the access road from vessels travelling through The Narrows and along Graham Creek. The section of access road that will run along the valley west of the central ridge of Curtis Island will be screened from view by the tree-covered hills and ridges west of the valley.

The headlights of vehicles travelling along the section of access road north of the intersection with Landing Road are not expected to visible due to the screening effect of the Mangroves and remnant eucalypt woodland. However, vehicles travelling at night along the section of access road immediately south west of the bridge as well as the bridge itself will be visible from The Narrows.

Lighting on the bridge, which would include any required navigational lighting, will create a new reference for vessels travelling along The Narrows.

The vehicle headlights along the section of access road on Curtis Island are not expected to be visible from The Narrows or vessels berthing at Fisherman's Landing Wharf due to the screening effect of the tree-covered hills and ridges to the south of the access road route.

3.7 Visual Simulations

The Production Department (TPD) Media was engaged by URS on behalf of Santos to prepare a series of visual simulations of the LNG facility as well as the proposed bridge Curtis Island and access road. These visual simulations present photo realistic images of what the LNG facility, bridge and access road are expected to look like from key view locations. In the case of the bridge/road the view is from an aircraft. The visual simulations have been prepared to show both day and night views. The night view visual simulations include the appearance when flare stacks are operating as well as normal lighting of the facility when the flare is not operating.

TPD provided the following description of the process that was followed to prepare the visual simulations.

"For the GLNG facility visual simulation Santos supplied a 3D model of the proposed LNG facility (document STO-GCOR-000514). In 3D, TPD Media recreated the area surrounding the proposed facility site. With the provided GPS coordinates of the photograph locations and the bearing of the proposed facility from the GPS locations, which could then be matched to the exact focal distance and perspective of the facility itself.

In Photoshop, the 3D rendered image is brought in and matched up and composited into the photographs. At this stage, a level of shade, fog, colour and any other design elements that help match the 3D facility match the current environment were added.

Night versions of selected photos were created to show how the proposed LNG facility would visually look like with the lights and flare. Adobe After Effects was used for the night photographs to create the correct light effects emitted from the facility and flare.

Programs used included Lightwave 3D 9, Adobe Photoshop CS3 and Adobe After Effects CS3."

The locations of the views used to prepare the visual simulations are shown on Figure 3-4.

Client

Project

GLADSTONE LNG PROJECT
VISUAL AMENITY ASSESSMENT
LNG FACILITY

Drawn: RG/CA | Approved: JB | Date: 11-02-2009

Job No: **4262 6220** | File No: 42626220-g-506.wor

Title

VISUAL SIMULATION LOCATIONS

Figure: **3.4**

Rev: A

A4

LNG Facility Site

Gas Transmission Pipeline

Visual Simulation Location

0 2.5 5km

Scale: 1:150,000 (A4)

Projection: MGA Zone 56 (GDA94)

Location		Easting	Northing
1	Auckland Lookout	321641	7363493
2	Radar Hill	322865	7361204
3	Gladstone Marine	321245	7363311
4	Calliope River Bridge	317831	7361690
5	Reid Road Intersection	311729	7364483
6	Canoe Point	333558	7351692
7	Southend	327567	7371691
8	Turtle Island	322918	7366860
9	Witt Island	320748	7366538
10	Tide Island	319500	7366758

Visual Simulation 1a – Evening view from Auckland Park Lookout towards the LNG facility site with coal loader in mid distance and Curtis Island forming skyline

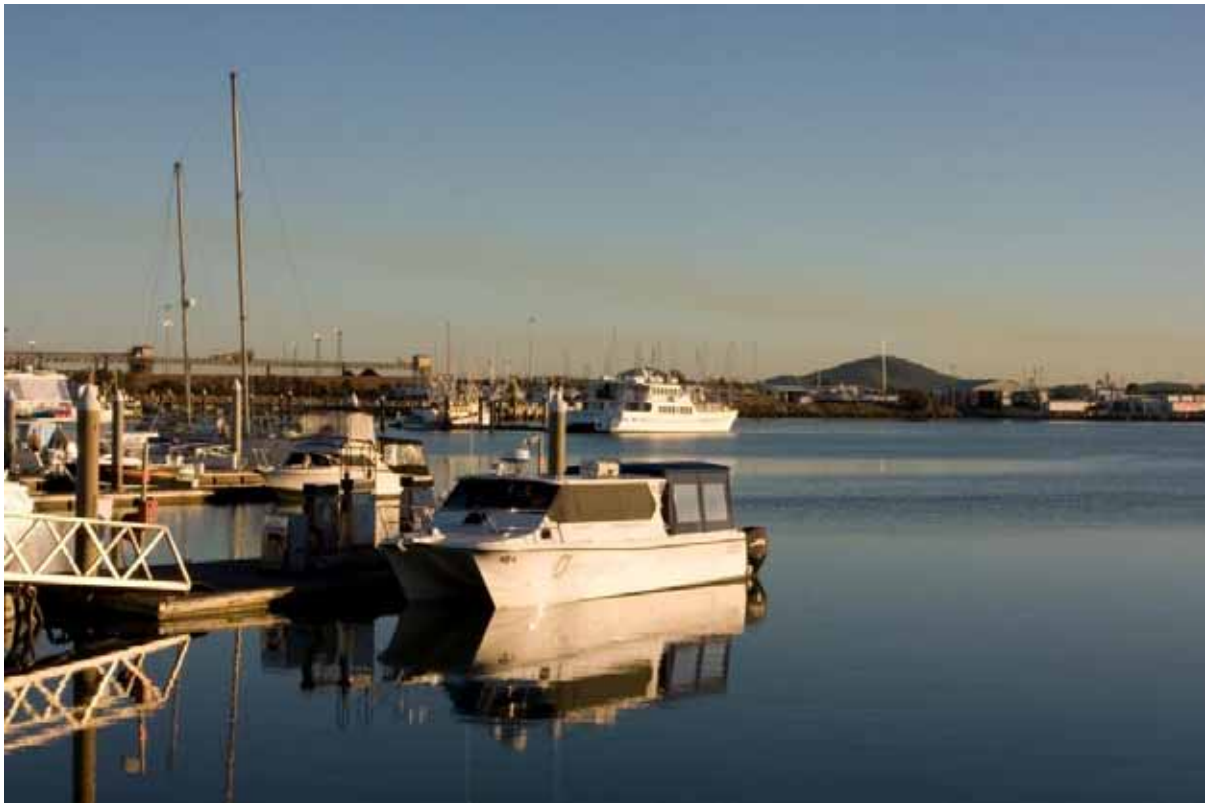
Section 3 Visual Assessment

Visual Simulation 1b - View from Auckland Park Lookout with LNG facility flare on skyline

Visual Simulation 2a - View from Radar Hill with Gladstone urban area in foreground & Curtis Island on horizon

Section 3 Visual Assessment

Visual Simulation 2b - View from Radar Hill with coal loader lighting on left & LNG facility flare right of the centre of the photo



Visual Simulation 3a - View from Gladstone Marina with Curtis Island central ridge visible on horizon

Section 3 Visual Assessment

Visual Simulation 3b - View from Gladstone Marina at night with LNG facility flare visible on horizon

Visual Simulation 4a - View from Calliope River bridge with Curtis Island visible on horizon

Visual Simulation 4b - View from Calliope River bridge at night with LNG facility and intermittent flare during facility upset visible on horizon

Visual Simulation 5a - View from Mount Larcom to Gladstone Road at Reid Road intersection with proposed LNG facility visible on Curtis Island (white LNG storage tanks in centre of photo, flare stack above right hand tank, LNG train to right of tanks)

Section 3 Visual Assessment

Visual Simulation 5b - View from Mount Larcom to Gladstone Road at Reid Road intersection with LNG facility lighting visible to right and Fisherman's Landing Wharf lighting to left

Visual Simulation 5c - View from Mount Larcom to Gladstone Road at Reid Road intersection with LNG facility lighting and intermittent flare from facility upset visible to right and Fisherman's Landing Wharf lighting visible to left

Visual Simulation 6a - View from Canoe Point, Tannum Sands with Curtis Island visible on horizon near centre

Section 3 Visual Assessment

Visual Simulation 6b - View from Canoe Point, Tannum Sands with LNG facility intermittent flare during facility upset visible on horizon

Visual Simulation 7a - View from South End Township with Mount Larcom on horizon in centre and Curtis Island to right

Visual Simulation 7b - View from South End with LNG facility intermittent flare during facility upset near centre

Visual Simulation 8a - View from near Turtle Island with LNG facility flare stacks in right and Mount Larcom in left portion of photo

Section 3 Visual Assessment

Visual Simulation 8b - View from near Turtle Island with LNG Facility lighting and intermittent flare during facility upset

Visual Simulation 9a - View from near Witt Island with LNG facility flare stacks and upper portion of structures on skyline

Visual Simulation 9b - View from near Witt Island with LNG facility lighting

Visual Simulation 9c - View from near Witt Island with LNG facility lighting and intermittent flare during facility upset

Section 3 Visual Assessment

Visual Simulation 10a - View from near Tide Island with LNG facility flare stacks, tanks and structures visible on skyline

Visual Simulation 10b - View from near Tide Island with LNG facility lighting

Visual Simulation 10c - View from near Tide Island with LNG facility lighting and intermittent flare during facility upset

Visual Simulation 11a - View from above Curtis Island looking south over proposed bridge across The Narrows and the mainland Access Road

Section 3 Visual Assessment

Visual Simulation 11b - View looking north over proposed bridge across The Narrows to Curtis Island

Mitigation Measures

Section 4

While the overall potential visual impact of the proposed LNG facility on most the view situations identified in the visual assessment has been assessed as low to moderate, mitigations measures are recommended in order to minimise the potential visual impacts. The mitigation measures are considered particularly necessary due to the high landscape quality of the LNG facility site and proposed bridge and mainland access road location, which is recognised by the Curtis Coast Regional Management Plan that classifies Curtis Island as an 'Area of State Significance'.

The primary objectives of mitigation measures are to:

- Minimise the visual contrast between the LNG facility structures and the tree-covered slopes of Curtis Island which form the backdrop against which the structures would be viewed;
- Minimise the height of structures in order to maximise the visual screening that is provided by the system of tree-covered ridges and hills that define the valley in which the LNG facility is to be located;
- Minimise the visibility of structures and flames associated with flaring operations in the LNG facility;
- Minimise the visibility of lighting that could be seen against the dark tree-covered slopes of Curtis Island that will form the backdrop to the LNG facility.

In order to meet the above objective the following mitigation measures are proposed:

- While the LNG storage tanks will need to white in order to minimise heat gain, the selection of colours for the other components of the LNG facility will aim to minimise where possible the visual contrast between the structures and the tree-covered slopes against which they will be seen. A detailed colour scheme is to be prepared as part of the detailed design process that will include input from a qualified landscape architect with experience in major industrial/infrastructure projects;
- The practicality of adopting a ground level flare option is to be investigated by Santos as a mitigation measure to minimise the visual impact of flaring, particularly at night;
- Planning and management of site works is to minimise tree clearing, with revegetation works on disturbed areas is to be implemented as quickly as possible after completion of earthworks;
- Retention of mangrove vegetation along the foreshore of China Bay is to provide partial visual screening of the ground level components of the LNG facility;
- Design of the LNG facility lighting is to minimise light spill and avoid direct views of lights from outside the plant, in particular The Narrows waterway and view situations located south of The Narrows, by controlling the direction of lights and using hoods where necessary;
- Aircraft safety lighting on the flare stacks is to consist of a steady red light as per clause 9.4.2.4 (c) of the CASA Manual of Standards Part 139 – Aerodromes, as the light will be seen against the backdrop of the central ridge of Curtis Island, which can be considered to be an environmentally sensitive location;
- The use of obstacle markings is to be avoided as this would highlight the flare stacks when viewed against the backdrop of the tree-covered central ridge of Curtis Island during the day;
- Design of the proposed bridge between Friend Point and Laird Point will aim to minimise the visual bulk of the structure when viewed from 'The Narrows' waterway and from southern foreshore areas;

Section 4 Mitigation Measures

- Planning of the proposed bridge construction works is to minimise the area of vegetation clearing at the bridge approaches and implementation of revegetation works as soon as possible;
- Design of the LNG facility access road is to minimise tree clearing and retain foreshore vegetation as a buffer to block views from 'The Narrows' waterway as well as public land-based view situations;
- Design of the ship loading dock is to minimise the visual bulk, particularly when viewed from 'The Narrows' waterway and from view situations to the south.

Implementation of the above mitigation measures will involve on-going collaboration between the design engineers and landscape architects during the detailed design and documentation process as well as during implementation of the works.

Conclusions Section 5

This visual assessment concludes that construction of the proposed LNG facility, bridge and access road would result in a fundamental change to the existing landscape character of the site at China Bay on Curtis Island. This change would result from the combinations of clearing existing woodland vegetation, earthworks and construction of the LNG facility structures, which include the LNG train, storage tanks, flare stacks, jetty and LNG loading dock.

However, the Visual Impact Assessment concludes that most components of the proposed LNG facility would only be visible from a limited number of view situations that are accessible to the general public. Potential views of the LNG train, storage tanks and other structures would generally be blocked by the system of hills and ridges that define the valley in which the LNG facility is to be located. The result would be a low to moderate visual impact for most view situations. The main exception to this finding would be The Narrows waterway, where the visual impact is predicted to be high due to availability of direct views into the proposed LNG facility site.

The Visual Assessment determined that the level of visual impact that would result from the vertical flare stack would be significantly greater than other components of the LNG facility. This is due to the fact that the LNG train, storage tanks and other structures are substantially lower than the flare stack and generally screened form view by the natural landforms of the valley in which the site is located.

The vertical flare option would result in an approximately 80 metre high structure with a flame up to approximately 80 metre high above the stack during the periods when flaring occurs. While the flame is predicted to only occur irregularly and for limited periods of time, it would be highly visible due to its height and the visual contrast with the natural landscape setting of Curtis Island against which it would be seen. The visual impact would be significantly increased when flaring occurs at night when the flare would be seen against the dark background of Curtis Island. The visibility of the plant at night, with and without the flare is illustrated by the visual simulations presented in Section 3.7. A ground level flare would be a mitigation option to the vertical flare stack as it would eliminate the potential visual impact of flaring. However, the practicality of the ground flare option needs to be determined by Santos.

The proposed mitigation measures presented with this visual assessment take account of the classification of Curtis Island as an ‘Area of State Significance (Scenic Coastal Landscapes)’ within the Curtis Coast Regional Management Plan. The mitigation measures aim to ensure that the high landscape values of the site and adjoining areas of Curtis Island are maintained to the maximum extent possible.

While the proposed bridge between Friend Point and Laird Point, which would provide access to the LNG facility site on Curtis Island, will be highly visible from vessels moving along The Narrows waterway and adjoining foreshore areas, it will generally not be visible from many of the other view situations that were identified in this visual assessment process. High quality design and careful management of the bridge construction process would result in the creation of a visually prominent new structure that would form a visual marker along The Narrows waterway separating Gladstone Harbour from the more natural landscape character associated with the Mackay/Capricorn Marine Park north of the bridge.

Section 6 References

U.S. Department of the Interior, Bureau of Land Management, (1984). *Visual Resource Management: BLM Manual Handbook H–8400.*

Queensland Government, Environmental Protection Agency and Queensland Parks & Wildlife Service, (2003). *Curtis Coast Regional Coastal Management Plan*.