APPENDIX 17

ARROW LNG PLANT

Landscape and Visual Impact Assessment

arrow energy
go further

Arrow LNG Plant: 60194954

Coffey Environments

Final Report

30th September 2011

Arrow LNG Plant

Landscape and Visual Impact Assessment

Arrow LNG Plant

Landscape and Visual Impact Assessment:

Prepared for

Coffey Environments Australia Pty Ltd on behalf of Arrow CSG (Australia) Pty Ltd

Prepared by

AECOM Australia Pty Ltd
Level 8, 540 Wickham Street, PO Box 1307, Fortitude Valley QLD 4006, Australia
T +61 7 3553 2000 F +61 7 3553 2050 www.aecom.com
ABN 20 093 846 925

30th September 2011

AECOM Project Number: 60194954

AECOM Project Name: 09513188.02 ARROW LNG PLANT

Quality Information

Document	Arrow LNG Plant
Ref	AECOM Project Number: 60194954 AECOM Project Name: 09513188.02 ARROW LNG PLANT
Date	30th September 2011
Prepared by	Rachael Piper , Wendy Davies, Michael Clarkson, Kusulta Shrestha, Geoff Williams, Katie Johnston,
Reviewed by	Wendy Davies

Revision History

Submission Date	Details	Authorised	
		Name/Position	Signature
11th June 2010	First Draft for information	Mark Blanche Associate Director	
15th July 2010	First Draft	Mark Blanche Associate Director	
18th April 2011	Second Draft (First Draft of Revised Project Description)	Wendy Davies Associate Director	
26th May 2011	Third Draft (Second Draft of Revised Project Description)	Wendy Davies Associate Director	
2nd June 2011	Fourth Draft	Wendy Davies Associate Director	
26th July 2011	Final Draft	Wendy Davies Associate Director	
25th August 2011	Final Report	Wendy Davies Associate Director	
1st September 2011	Revised Final Report	Wendy Davies Associate Director	
19th September 2011	Further Revised Final Report	Wendy Davies Associate Director	
30th September 2011	Final Revised Final Report	Wendy Davies Associate Director	

Table of Contents

Figures

Tables

Executive Summary

AECOM Design + Planning Australia (AECOM) has prepared a Landscape and Visual Impact Assessment (LVIA) for Coffey Environments Australia Pty Ltd (Coffey Environments) on behalf of Arrow CSG (Australia) Pty Ltd (Arrow Energy). The LVIA has been prepared for Arrow Energy's proposed Arrow LNG Plant (the project) located in the Gladstone region of Queensland. The project comprises proposals for a Liquefied Natural Gas (LNG) export plant, to be located on Curtis Island, and associated infrastructure including a feed gas pipeline that crosses Port Curtis, marine infrastructure (e.g., LNG jetty, launch site and materials offloading facility) as well as ancillary structures relating to accommodation for the workforce.

The LVIA has been undertaken to address Section 3.2.4 of the project Terms of Reference published by the Coordinator-General of the state of Queensland in January 2010 which concerns the potential impacts of the project on landscape and visual amenity.

The LNG plant has potential to impact landscape and visual values of the area due to activities during construction (including vegetation removal) and operational phases on account of the large size of many of the components of the plant; the tallest element of the LNG plant is the steel emergency flare at 110 m high, up to three bulky concrete LNG storage tanks each at 45 m height and many steel vent stacks ranging from approximately 25 m to up to 45 m high. A large area of the site will be occupied by residential construction camp buildings. In addition, LNG tankers would frequently be visible in the landscape.

The project area is sited within the Great Barrier Reef World Heritage Area which was listed on the basis of criteria including "…exceptional natural beauty…", although lies outside of the Great Barrier Reef Marine Park. In addition a number of areas lying close to the EIS study area are listed on the Australian Heritage Commission Register of the National Estate and are considered to form part of the landscape and visual context of the project including the eastern part of Curtis Island which is noted to "…contain a high diversity of regional coastal vegetation and landscape types, which are generally among the best remaining examples of their type"; The Narrows, recognised as "…an uncommon passage landscape and one of only five narrow tidal passages separating large continental islands from the mainland in Australia…" and the Mount Larcom Range which provides "…a scenic backdrop to the city of Gladstone…". These areas and associated coastal landscapes are also designated within the Curtis Coast Regional Coastal Management Plan as Scenic Coastal Landscapes which are "…areas of outstanding and distinctive scenic quality and are high priority areas for scenic landscape management within Queensland…". However, despite these values, much of the study area, including the LNG plant site on Curtis Island, has been zoned by the Queensland Government as the Gladstone State Development Area (GSDA) the purpose of which is to secure and protect a large area of suitable land for large scale industrial development.

As there are no national or state guidelines for landscape and visual impact assessment in Australia, the LVIA has been undertaken with reference to accepted guidelines from elsewhere, primarily Guidelines for Landscape and Visual Impact Assessment (2002), produced by The Landscape Institute and Institute of Environmental Management and Assessment (UK). Based on this method, firstly the landscape and visual resource is assessed and described based upon desk-top and field-based assessment. This includes the identification and sensitivity appraisal of landscape character types and features as well as sensitive viewer groups and views. The significance of the impacts of the scheme on landscape and visual values are then assessed based on a judgement of the likely magnitude of the impact on the affected receptor. Both day-time and night-time impacts are considered.

Eight landscape character types have been identified in the area within and around the LVIA study area based on landform, natural and built landcover elements. A large part of the EIS study area is assessed as LCT 5: Industrial/Extractive due to the presence of many existing large scale industrial facilities and export wharves. The LNG plant on Curtis Island falls within the 'undulating or flat forest' landscape type (LCT 2) which comprises open eucalypt forest with a mangrove shrub foreshore. Other infrastructure is located over a range of the identified landscape types. Fifteen vantage points were selected through the assessment process to represent the likely impacts of the project on the sensitive viewer groups identified, which include residents of Gladstone and South End (Curtis Island), residents on the islands of Port Curtis, recreational users of parks and scenic lookouts within and around the city (including Auckland Point and Mount Larcom), recreational vessels on Port Curtis/The Narrows, as well as people travelling along the various major and minor roads through the study area. The impacts upon these viewers has been explored through Zones of Theoretical Visibility (ZTV) studies as well as

through computer modelling to produce photo-realistic visualisations (artist's impressions) that illustrate the likely appearance of the scheme.

The LVIA considers the project against two scenarios: an assumed baseline and the 'current' or 'project' landscape context. The assumed baseline considers two other LNG projects on Curtis Island as real projects given they have been approved and passed the financial investment decision, albeit at the time of assessment construction activity had only recently commenced. These two projects are Queensland Curtis LNG (QCLNG) and Gladstone LNG Project (GLNG). In general terms, the presence of these other LNG plants reduces impact significance of many of the landscape and visual effects since the Arrow LNG project would be viewed against a heavily industrialised backdrop.

Against the baseline scenario of the QCLNG and GLNG Projects the assessment concludes that the impacts of greatest significance for designated landscapes would be the moderate-major impact on Garden Island (Australian Heritage Commission Register of the National Estate) during the construction phase and the moderate impact on the 'Coastal Wetland' landscapes of 'Curtis Island and the Narrows' (identified in the Curtis Coast Regional Coastal Management Plan) during the operation phase. Some other designated landscapes would sustain impacts of up to minor-moderate significance against the baseline including the Great Barrier Reef World Heritage Area and Marine Park, The Narrows (Register of the National Estate) and a number of landscapes of state significance included in the Curtis Coast Regional Coastal Management Plan (i.e., Islands and Offshore Features (Curtis Island), and Coastal Mountain Ranges (Curtis Island Strike Ridge). It is noted that the impact on the Australian Heritage Commission Registered landscape on Curtis Island is negligible due to the distance and lack of intervisibility between the designated area and the scheme. The impact on the Great Barrier Reef World Heritage Area is judged to be minor-moderate since, although the project would introduce industry onto the currently non-industrial and largely natural environment of Curtis Island, there are already large areas of industrial activity visible in this part of the World Heritage Area and construction has already commenced on the QCLNG and GLNG plants, located immediately adjacent to the Arrow LNG Plant. It is noted that a third project – Australia Pacific LNG (APLNG) has also been approved for construction on the island which further diminishes the relative contrast and prominence of the Arrow LNG project.

With regard to landscape features and character, the area that is most affected by the project is LCT 7: Coastal or Estuarine Plain which is judged to experience an impact of, at greatest, moderate to major significance. Landscape Character Types LCT 1: Forested Mountain or Ridge; LCT 2: Undulating or Flat Forest and LCT 3: Wooded Rural are anticipated to experience impacts of up to moderate significance against the baseline. These impacts relate to direct and indirect effects associated with removal of vegetation and characteristic elements and the influence of the project on the setting of the remaining areas.

The viewpoint assessment indicates that the views experiencing the greatest magnitude of change would be those obtained by people using boats (for either recreational or travel purposes) on Port Curtis, particularly close to those smaller islands located near the LNG plant, i.e., Tide, Witt and Turtle Islands and the main shipping channel. Against the baseline, which would already be highly influenced by views of the QCLNG and GLNG plants, these viewpoints are anticipated to experience an impact of up to moderate significance during both construction and operational phases. This level of impact is also indicative of the private views obtained by island residents, although as there are very few residents living on those islands closest to the site few residents would experience these views. . Vantage points located on the mainland (e.g., Auckland Point, Round Hill, Gladstone CBD and Spinnaker Park) are anticipated to be used by a much greater number of people. However, because most views towards the project from these vantage points already contain significant amounts of industrial elements and due to the distance from the LNG plant, the magnitude of the impact is generally less. Of these views, Auckland Point and Spinnaker Park are anticipated to experience the impact of greatest significance (moderate) and will be affected by the LNG plants currently under construction. Due to the effects of distance and Arrow Energy's proposals to limit night time construction working hours, where possible, associated with the LNG plant (the impacts during the construction phase are generally similar to those experienced at 'operation' i.e., when all components of the plant are complete. Night-time impacts caused by the lighting of the plant, including the emergency flare, are generally less significant than daytime effects - being rated as moderate significance or lower. Again, this is due to the context of current high light levels associated with the industrial landscape of Gladstone and because those viewpoints most affected at night – from Port Curtis – are unlikely to be accessed by a high number of people at night.

A range of projects that are likely to cause cumulative impacts were examined. The significance of landscape and visual impacts on the Gladstone landscape increases associated with these projects. A number of measures have been designed into the scheme to reduce visual impact (e.g. site terracing). In addition, a range of mitigation

measures are proposed that seek to further integrate the plant into the landscape and minimise the landscape and visual impact to the greatest extent possible including, for example, detailed design of retaining structures. However, whilst these measures would diminish the impacts at a localised (site) level they are unlikely to change the significance of the identified impacts because the size of the project components and technical requirement to be adjacent to open water mean there is little opportunity for measures that seek to 'screen' or 'hide' the plant within landform, such as are frequently used for other industrial projects.

In conclusion, against the baseline created by the approved QCLNG and GLNG projects, the Arrow LNG Plant project would have impacts of:

- up to moderate to major significance on designated landscapes, including areas listed on the Australian Heritage Commission Register of the National Estate;
- up to moderate to major significance on landscape character; and,
- up to moderate significance on views, including views towards Curtis Island from Port Curtis and popular and well-frequented vantage points in Gladstone.

Glossary and Abbreviations

AHD	Australian Height Datum
APLNG Project	Australian Pacific Liquefied Natural Gas Project (ConocoPhilips and Origin)
AILA	Australian Institute of Landscape Architects
AECOM	AECOM Australia Pty Ltd (Design + Planning)
Arrow Energy	Arrow Energy Limited
Arrow LNG Plant	*abbr* Arrow Liquefied Natural Gas Plant
CBD	Central Business District
CCRCMP	Curtis Coast Regional Coastal Management Plan
CIC	Common Infrastructure Corridor
CG	Coordinator-General of the State of Queensland
Coordinator-General	Coordinator-General of the State of Queensland
CSG	Coal Seam Gas
DEM	Digital Elevation Model
DERM	Queensland Department of Environment and Resource Management
DIP	Department of Infrastructure and Planning
DSEWPC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ETP	Drainage and Effluent Treatment Plant
GBR	Great Barrier Reef
GIS	Geographic Information System
GLNG	Gladstone Liquefied Natural Gas Project
GPS	Global Positioning System
GSDA	Gladstone State Development Area
GQAL	Good Quality Agricultural Land
HDD	Horizontal Directional Drilling
LCT	Landscape Character Type
LNG	Liquefied Natural Gas
LVIA	Landscape and Visual Impact Assessment
MOF	Materials Offloading Facility
Mtpa	Million Tonnes Per Annum
OLS	Obstacle Limitation Surface (Plan)
The Project	Arrow LNG Plant
QCLNG	Queensland Curtis Liquefied Natural Gas Project (QGC)
ROW	Right of Way

SLR	Single Lens Reflex
WHA	World Heritage Area
Study Area	The area required to determine and assess the direct and indirect environmental, social and economic impacts of a proposal. The study area will vary according to the specific environmental value being assessed. The EIS Study Area is as defined by Coffey Environments. The LVIA Study Area extends beyond this to consider impacts to the extent of the ZTV for the LNG plant.
TBM	Tunnel Boring Machine
TWAF	Temporary Workers Accommodation Facility
WHS	World Heritage Site
ZTV	zone of theoretical visibility
2D	Two dimensional

1.0 Introduction and Project Description

This Landscape and Visual Impact Assessment (LVIA) report has been prepared by AECOM Design + Planning Australia (hereinafter referred to as AECOM) on behalf of Coffey Environments Australia Pty Ltd (hereinafter referred to as Coffey Environments) for Arrow CSG (Australia) Pty Ltd (hereinafter referred to as Arrow Energy). The LVIA concerns Arrow Energy's proposed Liquefied Natural Gas (LNG) project located in Gladstone on the Central Queensland Coast, officially termed the Arrow LNG Plant but frequently referred to hereinafter as 'the project'. The location of the EIS study area is illustrated on **Figure 1**.

The project comprises a LNG export facility to be located on Curtis Island; with associated infrastructure on Curtis Island and the mainland including: workers' accommodation; marine terminal options; a feed gas pipeline, and a tunnel under Port Curtis. An overall project description is provided in **Section 1.3** of this report whilst a description of the key elements of the proposal considered most relevant to the assessment of landscape and visual values is provided in **Section 5.1**. **Figure 2** and **Figure 3** illustrate the key components of the study area.

1.1 Terms of Reference

The Landscape and Visual Impact Assessment has been undertaken in accordance with the Shell Australia LNG Project Environmental Impact Statement Terms of Reference (as Arrow CSG was formerly known as Shell CSG). These were published by the Coordinator-General of the State of Queensland in January 2010. Section 3.2.4 of the terms of reference relating to landscape character and visual amenity are provided below:

Description of environmental values

This section should describe the existing character of the landscape that will be affected by the project. Information should be presented in the form of maps, sections, elevations and photographs, and should include:

- *Image and townscape objectives identified in any town planning scheme or strategic plan relevant to the project area.*
- *Major views, existing viewing outlooks, ridgelines and other features contributing to the amenity of the area.*
- *Focal points, landmarks (built form or topography), gateways associated with project site and immediate surrounding areas, waterways, and other features contributing to the visual quality of the area and the project site.*
- *Character of the local and surrounding areas including character of built form (scale, form, materials and colours) and vegetation (natural and cultural vegetation) directional signage and land use.*
- *Identification of the areas that have the capacity to absorb land use changes without detriment to the existing visual quality and landscape character.*
- *The value of existing vegetation as a visual screen.*

Potential impacts and mitigation measures

The potential impacts of the project upon the landscape character of the site and the surrounding area should be described.

Particular mention should be made of any changes to the broad-scale topography and vegetation character of the area. Measures to be undertaken to mitigate or avoid the identified impacts should be detailed and illustrated.

This section should analyse and discuss the visual impact of the project on particular panoramas and outlooks, when viewed from public places.

The assessment is to address the visual impacts of the project structures and associated infrastructure, using appropriate simulation. Sketches, diagrams, computer imaging and photos are to be used where possible to portray the near views and far views of the completed structures and their surroundings from visually sensitive locations.

Special consideration is to be given to public roads, public thoroughfares, and places of residence or work, which are within the line-of-sight of the project.

The design and colour of any major structures, buildings and all proposed visual screens should be described, and their role in the minimisation of the visual impacts of the project should be outlined.

The obstruction of sunlight due to the construction of buildings or alteration of landforms should be considered, as well as major illumination or reflection impacts on adjacent properties or roads.

An assessment should be undertaken of potential impacts of light sources within the project site and its immediate surroundings. Of particular interest would be:

- *Visual aspect at night in relation to the location of the project in rural settings.*
- *Impacts of the lighting of the LNG facilities on navigation of vessels in Gladstone harbour.*
- *Potential impact of increased vehicular and rail movements at night.*
- *Proximity of light sources to significant receptor areas such as fauna habitats, residential and business establishments.*

It is noted that impacts of lighting on navigation of vessels and sensitive fauna habitats are not addressed in this LVIA report but are included in other technical studies as listed in Table 1.

1.2 LVIA Reference to Terms of Reference

The following table outlines where this report addresses each of the terms of reference applicable to landscape and visual impact identified by DERM:

Table 1 Terms of Reference Cross Reference Table for the Landscape and Visual Impact Assessment Technical Study

Terms of reference		EIS	
Section	**EIS requirement**	**Technical Study Name**	**Technical specialist report section**
3.2.4.1 Description of environmental values	This section should describe the existing character of the landscape that will be affected by the project. Information should be presented in the form of maps, sections, elevations and photographs, and should include:	Visual Amenity and Landscape Character Technical Study	**Section 4.0**
	• Image and townscape objectives identified in any town planning scheme or strategic plan relevant to the project area.	Visual Amenity and Landscape Character Technical Study	**Section 2.0**
	• Major views, existing viewing outlooks, ridgelines and other features contributing to the amenity of the area.	Visual Amenity and Landscape Character Technical Study	**Section 4.5**
	• Focal points, landmarks (built form or topography), gateways associated with project site and immediate surrounding areas, waterways and other features contributing to the visual quality of the area and the project site.	Visual Amenity and Landscape Character Technical Study	**Section 4.4**
	• Character of the local and surrounding areas including character of built form (scale, form, materials and colours) and vegetation (natural and cultural vegetation) directional signage and land use.	Visual Amenity and Landscape Character Technical Study	**Section 4.4.2**
	• The value of existing vegetation as a visual screen.	Visual Amenity and Landscape Character Technical Study	**Section 4.4**
3.2.4.2 Potential impacts and mitigation	The potential impacts of the project upon the landscape character of the site and the surrounding area should be described.	Visual Amenity and Landscape Character Technical Study	**Section 4.4.11**

measures			
	Particular mention should be made of any changes to the broad-scale topography and vegetation character of the area. Measures to be undertaken to mitigate or avoid the identified impacts should be detailed and illustrated.	Visual Amenity and Landscape Character Technical Study	**Section 6.0**
	This section should analyse and discuss the visual impact of the project on particular panoramas and outlooks, when viewed from public places.	Visual Amenity and Landscape Character Technical Study	**Section 5.3**
	The assessment is to address the visual impacts of the project structures and associated infrastructure, using appropriate simulation. Sketches, diagrams, computer imaging and photos are to be used where possible to portray the near views and far views of the completed structures and their surroundings from visually sensitive locations.	Visual Amenity and Landscape Character Technical Study	**Section 5.3.3**
	Special consideration is to be given to public roads, public thoroughfares, and places of residence or work, which are within the line-of-sight of the project.	Visual Amenity and Landscape Character Technical Study	**Section 5.3.3**
	The design and colour of any major structures, buildings and all proposed visual screens should be described, and their role in the minimisation of the visual impacts of the project should be outlined.	Visual Amenity and Landscape Character Technical Study	**Section 5.1**
	The obstruction of sunlight due to the construction of buildings or alteration of landforms should be considered, as well as major illumination or reflection impacts on adjacent properties or roads.	Visual Amenity and Landscape Character Technical Study	**Section 5.3**
	An assessment should be undertaken of potential impacts of light sources within the project site and its immediate surroundings. Of particular interest would be: • visual aspect at night in relation to the location of the project in rural settings	Visual Amenity and Landscape Character Technical Study	**Section 4.5** and **5.4**
	• impacts of the lighting of the LNG facilities on navigation of vessels in Gladstone harbour	EIS – Chapter 7: Project Description – LNG Plant	
	• potential impact of increased vehicular and rail movements at night	Visual Amenity and Landscape Character Technical Study	**Section 5.0** (generally)
	• proximity of light sources to significant receptor areas such as fauna habitats, residential and business establishments.	Terrestrial Ecology Technical Study.	Section 5.1
		Marine and Estuarine Ecology Technical Study	Section 5.4
		Visual Amenity and Landscape Character Technical Study	**Section 4.5** and **5.4**

Source of Figure: Figure F0036 Regional Context (Coffey Environments)	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Regional Context	Figure No: 1

1.3 Project Description

1.3.1 Arrow LNG Plant

Arrow Energy proposes to construct an LNG plant in the Curtis Island Industry Precinct at the south-western end of Curtis Island, approximately 6 km north of Gladstone and 85 km southeast of Rockhampton, off Queensland's central coast. In 2008, approximately 10% of the southern part of the island was added to the Gladstone State Development Area to be administered by the Queensland Department of Local Government and Planning. Of that area, approximately 1,500 ha (25%) has been designated as the Curtis Island Industry Precinct and is set aside for LNG development. The balance of the Gladstone State Development Area on Curtis Island has been allocated to the Curtis Island Environmental Management Precinct, a flora and fauna conservation area.

The LNG plant will be supplied with coal seam gas from gas fields in the Surat and Bowen basins via high-pressure gas pipelines to Gladstone, from which a feed gas pipeline will provide gas to the LNG plant on Curtis Island. A tunnel is proposed for the feed gas pipeline crossing of Port Curtis.

The project is described below in terms of key infrastructure components: LNG plant, feed gas pipeline and dredging.

1.3.2 LNG Plant

Overview. The LNG plant will have a base-case capacity of 16 Mtpa, with a total plant capacity of up to 18 Mtpa. The plant will consist of four LNG trains, each with a nominal capacity of 4 Mtpa. The project will be undertaken in two phases of two trains (nominally 8 Mtpa), with a financial investment decision undertaken for each phase.

Operations infrastructure associated with the LNG plant includes the LNG trains (where liquefaction occurs; see 'Liquefaction Process' below), LNG storage tanks, cryogenic pipelines, seawater inlet for desalination and stormwater outlet pipelines, water and wastewater treatment, a 110 m high flare stack, power generators (see 'LNG Plant Power' below), administrative buildings and workshops.

Construction infrastructure associated with the LNG plant includes construction camps (see 'Workforce Accommodation' below), a concrete batching plant and laydown areas.

The plant will also require marine infrastructure for the transport of materials, personnel and product (LNG) during construction and operations (see 'Marine Infrastructure' below).

Construction Schedule. The plant will be constructed in two phases. Phase 1 will involve the construction of LNG trains 1 and 2, two LNG storage tanks (each with a capacity of between 120,000 m^3 and 180,000 m^3), Curtis Island construction camp and, if additional capacity is required, a mainland workforce accommodation camp. Associated marine infrastructure will also be required as part of Phase 1. Phase 2 will involve the construction of LNG trains 3 and 4 and potentially a third LNG storage tank. Construction of Phase 1 is scheduled to commence in 2014 with train 1 producing the first LNG cargo in 2017. Construction of Phase 2 is anticipated to commence approximately five years after the completion of Phase 1 but will be guided by market conditions and a financial investment decision at that time.

Construction Method. The LNG plant will generally be constructed using a modular construction method, with preassembled modules being transported to Curtis Island from an offshore fabrication facility. There will also be a substantial stick-built component of construction for associated infrastructure such as LNG storage tanks, buildings, underground cabling, piping and foundations. Where possible, aggregate for civil works will be sourced from suitable material excavated and crushed on site as part of the bulk earthworks. Aggregate will also be sourced from mainland quarries and transported from the mainland launch site to the plant site by roll-on, roll-off vessels. A concrete batching plant will be established on the plant site. Bulk cement requirements will be sourced outside of the batching plant and will be delivered to the site by roll-on roll-off ferries or barges from the mainland launch site.

LNG Plant Power

Power for the LNG plant and associated site utilities may be supplied from the electricity grid (mains power), gas turbine generators, or a combination of both, leading to four configuration options that will be assessed:

- Base case (mechanical drive): The mechanical drive configuration uses gas turbines to drive the LNG train refrigerant compressors, which is the traditional powering option for LNG facilities. This configuration would use coal seam gas and end flash gas (produced in the liquefaction process) to fuel

the gas turbines that drive the LNG refrigerant compressors and the gas turbine generators that supply electricity to power the site utilities. Construction power for this option would be provided by diesel generators.

- Option 1 (mechanical/electrical – construction and site utilities only): This configuration uses gas turbines to drive the refrigerant compressors in the LNG trains. During construction, mains power would provide power to the site via a cable (30-MW capacity) from the mainland. The proposed capacity of the cable is equivalent to the output of one gas turbine generator. The mains power cable would be retained to power the site utilities during operations, resulting in one less gas turbine generator being required than the proposed base case.
- Option 2 (mechanical/electrical): This configuration uses gas turbines to drive the refrigerant compressors in the LNG trains and mains power to power site utilities. Under this option, construction power would be supplied by mains power or diesel generators.
- Option 3 (all electrical): Under this configuration mains power would be used to supply electricity for operation of the LNG train refrigerant compressors and the site utilities. A switchyard would be required. High-speed electric motors would be used to drive the LNG train refrigerant compressors. Construction power would be supplied by mains power or diesel generators.

Liquefaction Process

The coal seam gas enters the LNG plant where it is metered and split into two pipe headers which feed the two LNG trains. With the expansion to four trains the gas will be split into four LNG trains. For each LNG train, the coal seam gas is first treated in the acid gas removal unit where the carbon dioxide and any other acid gases are removed. The gas is then routed to the dehydration unit where any water is removed and then passed through a mercury guard bed to remove mercury. The coal seam gas is then ready for further cooling and liquefaction.

A propane, precooled, mixed refrigerant process will be used by each LNG train to liquefy the predominantly methane coal seam gas. The liquefaction process begins with the propane cycle. The propane cycle involves three pressure stages of chilling to pre-cool the coal seam gas to -33°C and to compress and condense the mixed refrigerant, which is a mixture of nitrogen, methane, ethylene and propane. The condensed mixed refrigerant and precooled coal seam gas are then separately routed to the main cryogenic heat exchanger, where the coal seam gas is further cooled and liquefied by the mixed refrigerant. Expansion of the mixed refrigerant gases within the heat exchanger removes heat from the coal seam gas. This process cools the coal seam gas from -33°C to approximately -157°C. At this temperature the coal seam gas is liquefied (LNG) and becomes 1/600th of its original volume. The expanded mixed refrigerant is continually cycled to the propane precooler and reused.

LNG is then routed from the end flash gas system to a nitrogen stripper column which is used to separate nitrogen from the methane, reducing the nitrogen content of the LNG to less than 1 mole per cent (mol%). LNG separated in the nitrogen stripper column is pumped for storage on site in full containment storage tanks where it is maintained at a temperature of - 163°C.

A small amount of off-gas is generated from the LNG during the process. This regasified coal seam gas is routed to an end flash gas compressor where it is prepared for use as fuel gas.

Finally, the LNG is transferred from the storage tanks onto LNG carriers via cryogenic pipelines and loading arms for transportation to export markets. The LNG will be regasified back into sales specification gas on shore at its destination location.

Workforce Accommodation

The LNG plant (Phase 1), tunnel, feed gas pipeline, and dredging components of the project each have their own workforces with peaks occurring at different stages during construction. The following peak workforces are estimated for the project:

- LNG plant Phase 1 peak workforce of 3,500, comprising 3,000 construction workers: 350 engineering, procurement and construction (EPC) management workers and 150 Arrow Energy employees.
- Tunnel peak workforce of up to 100.
- Feed gas pipeline (from the mainland to Curtis Island) peak workforce of up to 75.
- A dredging peak workforce of between 20 and 40.

Two workforce construction camp locations are proposed: the main construction camp at Boatshed Point on Curtis Island, and a possible mainland overflow construction camp, referred to as a temporary workers

accommodation facility (TWAF). Two potential locations are currently being considered for the mainland TWAF; in the vicinity of Gladstone city on the former Gladstone Power Station ash pond No.7 (TWAF7) or in the vicinity of Targinnie on a primarily cleared pastoral grazing lot (TWAF8). Both potential TWAF sites include sufficient space to accommodate camp infrastructure and construction laydown areas. The TWAF and its associated construction laydown areas will be decommissioned on completion of the Phase 1 works.

Of the 3,000 construction workers for the LNG plant, it is estimated that between 5% and 20% will be from the local community (and thus will not require accommodation) and that the remaining fly-in, fly-out workers will be accommodated in construction camps. The 350 EPC management and 150 Arrow Energy employees are expected to relocate to Gladstone with the majority housed in company facilitated accommodation.

The tunnel workforce of 100 people and gas pipeline workforce of 75 people are anticipated to be accommodated in the mainland in company facilitated accommodation. The dredging workforce of 20 to 40 workers will be housed onboard the dredge vessel.

Up to 2,500 people will be housed at Boatshed Point construction camp. Its establishment will be preceded by a pioneer camp at the same locality which will evolve into the completed construction camp.

1.3.3 Marine Infrastructure

Marine facilities include the LNG jetty, materials offloading facility (MOF), personnel jetty and mainland launch site.

LNG Jetty. LNG will be transferred from the storage tanks on the site to the LNG jetty via above ground cryogenic pipelines. Loading arms on the LNG jetty will deliver the product to an LNG carrier. The LNG jetty will be located in North China Bay, adjacent to the northwest corner of Hamilton Point.

MOF. Delivery of materials to the site on Curtis Island during the construction and operations phases will be facilitated by a MOF where roll-on, roll-off or lift-on, lift-off vessels will dock to unload preassembled modules, equipment, supplies and construction aggregate. The MOF will be connected to the LNG plant site via a heavy-haul road.

Boatshed Point (MOF 1) is the base-case MOF option and would be located at the southern tip of Boatshed Point. The haul road would be routed along the western coastline of Boatshed Point (abutting the construction camp to the east) and enters the LNG plant site at the southern boundary. A quarantine area will be located south of the LNG plant and will be accessed via the northern end of the haul road.

Two alternative options are being assessed, should the Boatshed Point option be determined to be not technically feasible:

- South Hamilton Point (MOF 2): This MOF option would be located at the southern tip of Hamilton Point. The haul road from this site would traverse the saddle between the hills of Hamilton Point to the southwest boundary of the LNG plant site. The quarantine area for this option will be located southwest of the LNG plant near the LNG storage tanks.
- North Hamilton Point (MOF 3): This option involves shared use of the MOF being constructed for the Santos Gladstone LNG Project (GLNG Project) on the northwest side of Hamilton Point (south of Arrow Energy's proposed LNG jetty). The GLNG Project is also constructing a passenger terminal at this site, but it will not be available to Arrow Energy contractors and staff. The quarantine area for this option would be located to the north of the MOF. The impacts of construction and operation of this MOF option and its associated haul road were assessed as part of the GLNG Project and will not be assessed in this EIS.

Personnel Jetty. During the peak of construction, base case of up to 1,100 people may require transport to Curtis Island from the mainland on a daily basis. A personnel jetty will be constructed at the southern tip of Boatshed Point to enable the transfer of workers from the mainland launch site to Curtis Island by high-speed vehicle catamarans (Fastcats) and vehicle or passenger ferries (ROPAX). This facility will be adjacent to the MOF constructed at Boatshed Point. The haul road will be used to transport workers to and from the personnel jetty to the construction camp and LNG plant site. A secondary access for pedestrians will be provided between the personnel jetty and the construction camp.

Mainland Launch Site. Materials and workers will be transported to Curtis Island via the mainland launch site. The mainland launch site will contain both a passenger terminal and a roll-on, roll-off facility. The passenger

terminal will include a jetty and transit infrastructure, such as amenities, waiting areas and car parking. The barge or roll-on ,roll-off facility will have a jetty, associated laydown areas, workshops and storage sheds.

The two location options for the mainland launch site are:

- Launch site 1: This site is located north of Gladstone city near the mouth of the Calliope River, adjacent to the existing RG Tanna coal export terminal.
- Launch site 4N: This site is located at the northern end of the proposed reclamation area for the Fishermans Landing Northern Expansion Project, which is part of the Port of Gladstone Western Basin Master Plan. The availability of this site will depend on how far progressed the Western Basin Dredging and Disposal Project is at the time of construction.

1.3.4 Feed Gas Pipeline

An approximately 8-km long feed gas pipeline will supply gas to the LNG plant from its connection to the Arrow Surat Pipeline (formerly the Surat Gladstone Pipeline) on the mainland adjacent to Rio Tinto's Yarwun alumina refinery. The feed gas pipeline will be constructed in three sections:

- A short length of feed gas pipeline will run from the proposed Arrow Surat Pipeline to the tunnel launch shaft, which will be located on a mudflat south of Fishermans Landing, just south of Boat Creek. This section of pipeline will be constructed using conventional open-cut trenching methods within a 40-m wide construction right of way.
- The next section of the feed gas pipeline will traverse Port Curtis harbour in a tunnel to be bored under the harbour from the mainland tunnel launch shaft to a receival shaft on Hamilton Point. The tunnel under Port Curtis will have an excavated diameter of up to approximately 6 m and will be constructed by a tunnel boring machine that will begin work at the mainland launch shaft. Tunnel spoil material will be processed through a de-sanding plant to remove the bentonite and water and will comprise mainly a finely graded fill material, which will be deposited in a spoil placement area established within bund walls constructed adjacent to the launch shaft. Based on the excavated diameter, approximately 223,000 m^3 of spoil will be treated as required for acid sulfate soil and disposed of at this location.
- From the tunnel receival shaft on Hamilton Point, the remaining section of the feed gas pipeline will run underground to the LNG plant, parallel to the above ground cryogenic pipelines. This section will be constructed using conventional open-cut trenching methods within a 30-m wide construction right of way. A permanent easement up to 30-m wide will be negotiated with the relevant land manager or owner.

Should one of the electrical plant power options be chosen, it is intended that a power connection will be provided by a third party to the tunnel launch shaft, whereby Arrow Energy would construct a power cable within the tunnel to the LNG plant.

Other infrastructure, such as communication cables, water and wastewater pipelines, may also be accommodated within the tunnel.

1.3.5 Dredging

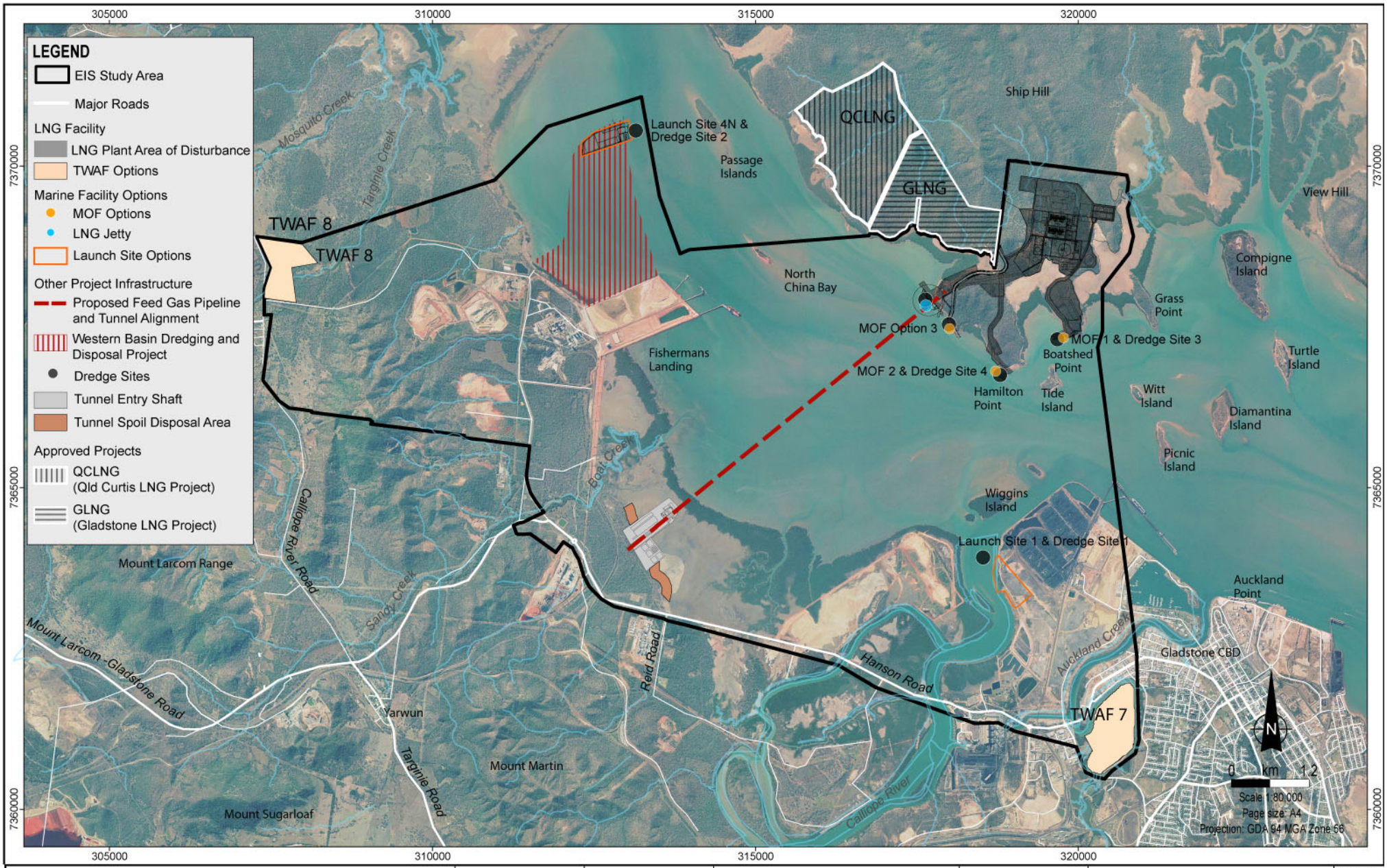
Dredging required for LNG shipping access and swing basins has been assessed under the Gladstone Ports Corporation's Port of Gladstone Western Basin Dredging and Disposal Project. Additional dredging within the marine environment of Port Curtis may be required to accommodate the construction and operation of the marine facilities. Up to five sites may require dredging:

- Dredge site 1 (dredge footprint for launch site 1): The dredging of this site would facilitate the construction and operation of launch site 1. This dredge site is located in the Calliope River and extends from the intertidal area abutting launch site 1, past Mud Island to the main shipping channel. The worst-case dredge volume estimated at this site is approximately 900,000 m^3.
- Dredge site 2 (dredge footprint for launch site 4N): The dredging of this site would facilitate the construction and operation of launch site 4N. This dredge site would abut launch site 4N and extend east from the launch site to the shipping channel. The worst-case dredge volume identified at this site is approximately 2,500 m^3.
- Dredge site 3 (dredge footprint for Boatshed Point MOF 1): The dredging of this site would facilitate the construction and operation of the personnel jetty and MOF at Boatshed Point. This dredge site would

encompass the area around the marine facilities, providing adequate depth for docking and navigation. The worst-case dredge volume identified at this site is approximately 50,000 m^3.

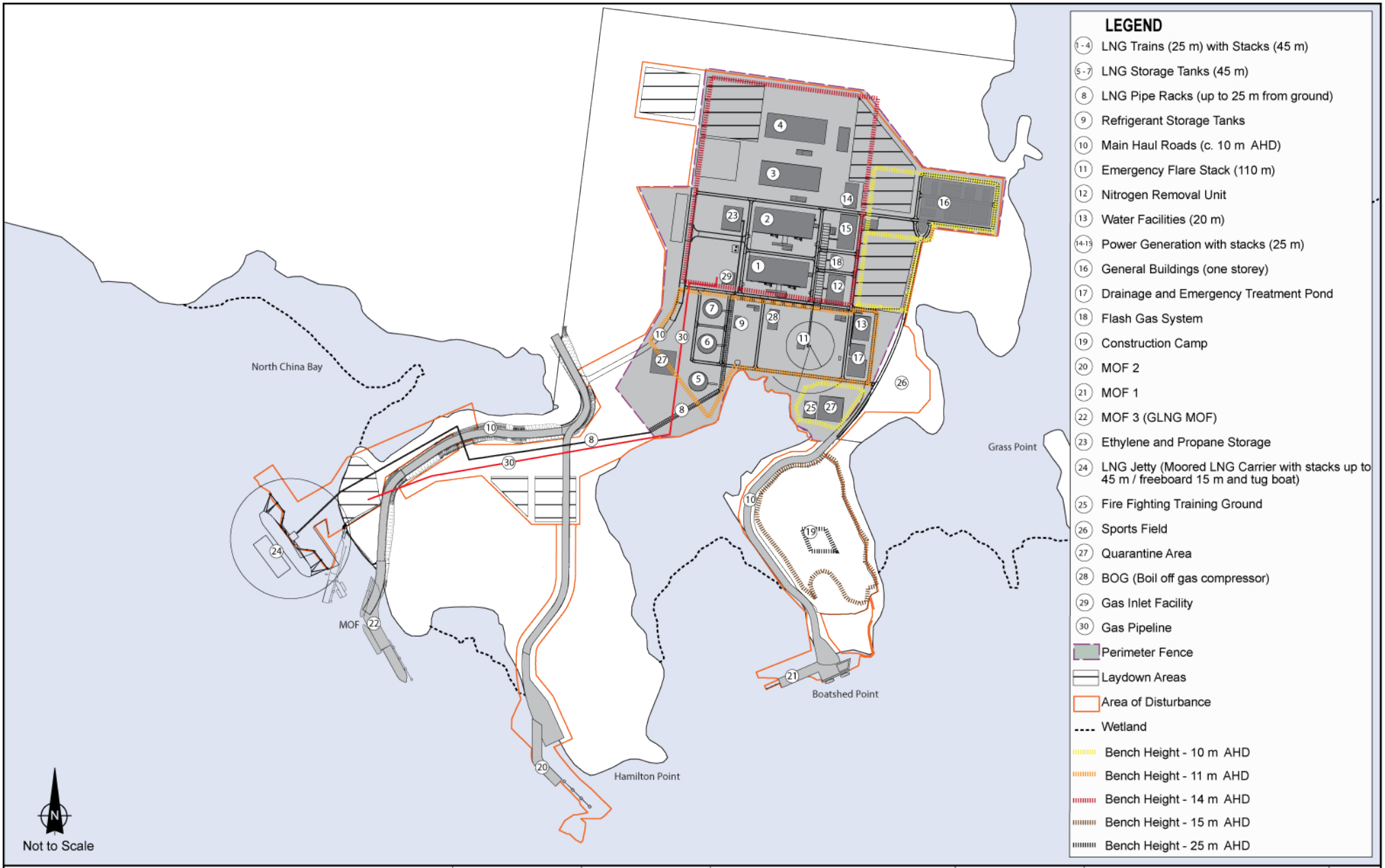
- Dredge site 4 (dredge footprint for Hamilton Point South MOF 2): The dredging of this site would facilitate the construction and operation of the MOF at Hamilton Point South. This dredge site would encompass the area around the marine facilities, providing adequate depth for docking and navigation. The worst-case dredge volume identified at this site is approximately 50,000 m^3.
- Dredge site 5 (dredge footprint for LNG jetty): The dredging of this site will facilitate the construction of the LNG jetty at Hamilton Point. This dredge site extends from the berth pocket to be dredged as part of the Western Basin Strategic Dredging and Disposal Project to the shoreline and is required to enable a work barge to assist with construction of the jetty. The worst-case dredge volume identified is approximately 120,000 m^3.

The spoil generated by dredging activities will be placed and treated for acid sulfate soils (as required) in the Port of Gladstone Western Basin Dredging and Disposal Project reclamation area.



	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Arrow LNG Plant Location Plan

Figure No: 2



AECOM	Arrow Energy Arrow LNG Plant	arrowenergy	Key Visible LNG Plant Components

Figure No: 3

2.0 Legislative Context and Standards

This section summarises the key planning designations, policies and guidance relating to landscape and visual amenity within the LVIA study area at the international, national, state and local level.

The emphasis of this section is to identify image and townscape objectives covered in planning schemes or strategic plans that are relevant to the study area. Accordingly this section describes key designations and issues noted in policy that are *directly* relevant to landscape and visual amenity values as well as those that are considered to *indirectly* relevant to landscape and visual amenity to a significant degree. Although many of the designations and policies do not strictly relate to maintaining and enhancing landscape character and visual amenity, their intentions potentially influence and affect the landscape and visual resource within the study area. The relevant designations, policies and guidelines are discussed in the table below and shown on **Figure 4**, **Figure 5** and **Figure 6**. The discussion of relevance to the current assessment considers the following key issues:

- Whether the purpose of the designation is related to the protection/management of landscape and/or visual values
- If the project has potential to theoretically directly or indirectly affect those landscape/visual values for which it has been designated - depending on the nature of the specific values this may be affected by factors such as proximity, the presence of intervening landform that may restrict intervisibility, probable levels of recreation use etc. It is noted that whether a designation falls inside or outside of the EIS study area is not of primary relevance to the consideration of potential for landscape/visual impacts since the visibility of project components may extend considerably beyond this boundary.

2.1 International Legislative Context

Table 2 Summary of international legislative context relevant to landscape and visual amenity

International Planning Designation, Policy and Guidelines	
Designation / Policy	**Relevance to landscape and visual values and the project**
Great Barrier Reef World Heritage Area (GBRWHA)	***Landscape and Visual Values:*** A large part of the study area, including Curtis Island, falls within the Great Barrier Reef (GBR) which was declared a World Heritage Area (WHA) in 1981. The GBRWHA extends approximately 2000 km along the coast of Queensland and covers around 35 million hectares. The EIS study area is located in the southern sector of the GBRWHA. For the Great Barrier Reef to obtain a WHA designation it was required to demonstrate a number of internationally significant values including aesthetic attributes. In particular, of the four World Heritage Criteria pertaining to the GBRWHA designation, criteria Vii, is of key consideration in the context of this assessment i.e., *"to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*". The other three criteria do not relate directly to landscape or visual values and are not considered further. The GBRWHA nomination for the GBR states that for a natural heritage property to be included as a WHA (i.e., an area included on the World Heritage List), it must be found to meet one or more of five criteria. Criteria three states "…*contain unique, rare or superlative natural phenomena, formations or features or areas of exceptional natural beauty*" e.g., most important ecosystems to man, natural features, sweeping vistas covered by natural vegetation and exceptional combinations of natural and cultural elements (Great Barrier Reef Marine Park Authority, 1981). The nomination, states that even though "*individual sites may not possess the most spectacular or outstanding single example...it is when the sites are viewed in broader perspective with a complex of many surrounding features of significance*, *the entire area may qualify to demonstrate an array of features of global significance."* ***Relevance to Arrow LNG Plant LVIA:*** Scenic qualities are a key aspect of the GBRWHA designation, which covers most of the study area. The impact on these values will need to be explored through this assessment.
Great Barrier Reef Marine Park Act	***Landscape and Visual Values:*** Most of the GBRWHA (described above) is protected under the *Great Barrier Reef Marine Park Act 1975*, Commonwealth legislation which

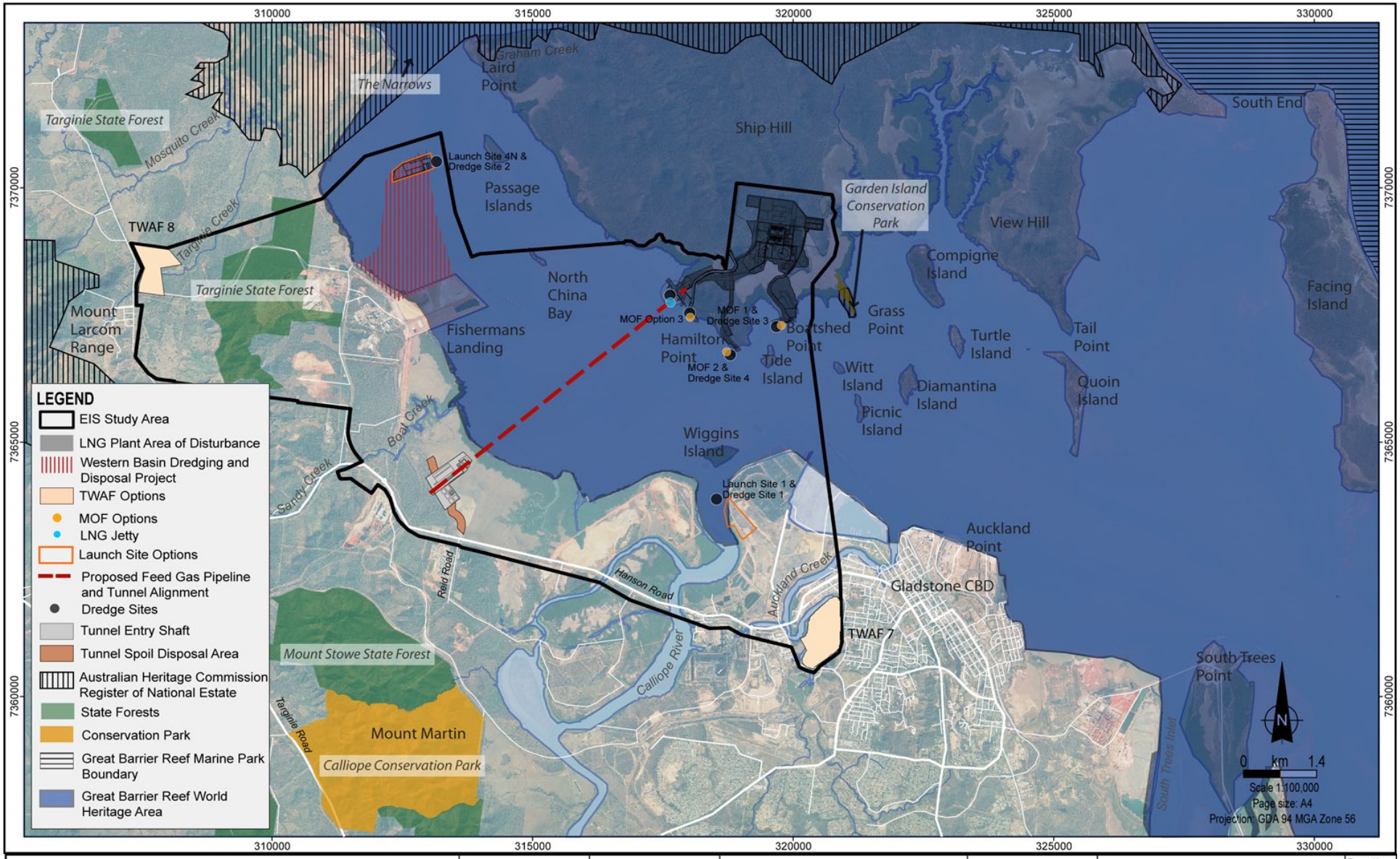
International Planning Designation, Policy and Guidelines	
Designation / Policy	**Relevance to landscape and visual values and the project**
1975 *as amended by the* ***Great Barrier Reef Marine Park and Other Legislation Amendment Act 2008****, No. 125, 2008*	established the Great Barrier Reef Marine Park (GBR Marine Park) and the Great Barrier Reef Marine Park Authority (GBR Marine Park Authority) as a Commonwealth Statutory Authority responsible for its protection. The GBR Marine Park Authority works in the policy framework of the Commonwealth Government and is the principal advisor on the control, care and development of the GBR Marine Park. The main objective of this act is stated as to "*provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region.*" The other objectives include: (a) (i) *public enjoyment and appreciation*. ***Relevance to Arrow LNG Plant LVIA:*** The project study area is located approximately 8 km due west of the area designated as GBR Marine Park and therefore the legislation does not directly apply. However, it is reasonable to expect that those accessing the GBR Marine Park (e.g., via boat) may pass through the EIS study area the impact on visual values that may affect public enjoyment and appreciation are considered further through this assessment.

2.2 National Legislative Context

Table 3 Summary of national legislative context relevant to landscape and visual amenity

National Planning Designation, Policy and Guidelines	
Designation / Policy	**Relevance to landscape and visual values and the project**
Australian Heritage Council Act 2003*:* Australian Heritage Commission Register of the National Estate (see **Figure 4**)	***Landscape and Visual Values***: The Australian Heritage Commission had from 1975 maintained a list of significant heritage locations on the *Register of the National Estate*. More than 13,000 items were listed including natural, Indigenous and historic heritage places. With the introduction of the ***Australian Heritage Council Act,*** **2003**, the Register of the National Estate was closed to new entries from February 2007. The register remains a statutory instrument until February 2012, with the Minister required to consider it, along with the newly created lists, when making decisions under the ***Environment Protection and Biodiversity Conservation Act 1999*** (EPBC Act). From February 2012, all reference to the Register of the National Estate will be removed from the *EPBC Act* though it will remain a publicly accessible archive.' Key criteria for inclusion on the Register of the National Estate pertinent to landscape and visual issues, are: *Criterion A: Its importance in the course, or pattern, of Australia's natural or cultural history: A.3 Importance in exhibiting unusual richness or diversity of flora, fauna, landscapes or cultural features*. *Criterion E: Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group: E.1 Importance for a community for aesthetic characteristics held in high esteem or otherwise valued by the community*. Under that Act, the following places falling within the potential viewshed of the LVIA study area were registered: **Curtis Island** (Place ID: 14675; Registered 22/06/1993) The National Estate area occupies the eastern half of Curtis Island. The citation notes *"The Curtis Island area contains a high diversity of regional coastal vegetation and landscape types, which are generally among the best remaining examples of their type. Coastal landscapes present include cliffed coastlines, parabolic dunes, parallel beach ridges, saltpans, rock platforms, mud flats and marine plain."* **Balaclava Island and The Narrows** (Place ID: 18811; Registered 26/10/1999): Citation states *"The Narrows represent an uncommon passage landscape and are one of only five narrow tidal passages separating large continental islands from the mainland in*

National Planning Designation, Policy and Guidelines	
Designation / Policy	**Relevance to landscape and visual values and the project**
	Australia." **Garden Island Conservation Park** (Place ID: 8820; Registered 21/10/1980): Citation largely considers ecological aspects although notes "*The beach on the eastern side of Garden Island receives frequent recreational visitation by boat*" **Mount Larcom Range**: (Place ID14674; Indicative i.e., not fully registered): Citation states *"The outstanding feature of this mountain is as a scenic backdrop to the city of Gladstone. The area is an important local recreational resource."* It is noted that the places listed above have not yet been included on the new national heritage list. ***Relevance to Arrow LNG Plant LVIA:*** **Curtis Island:** The registered area of Curtis Island is separated from the LNG plant by landform therefore, it is considered the landscape and visual values recorded will *not* be affected by the project. **Balaclava Island and The Narrows:** The Narrows lies approximately 7 km from the LNG plant and lies close to a potential launch site and may potentially be affected by the project. Balaclava Island is *not* considered further within this assessment as it lies 34 km from the facility so its listed values would not be meaningfully impacted. **Garden Island Conservation Park:** As this lies approximately 2.5 km due east of the proposed LNG plant it is considered that landscape and visual values, particularly recreational, could be affected. **Mount Larcom Range:** At its closest point this area lies approximately 13.5 km from the LNG plant, but due to its elevated nature, has potential to fall in the viewshed of the project.
Nature Conservation Act 1992: Curtis Island National Park	***Landscape and Visual Values:*** The National Parks designation in Queensland derives from the *Nature Conservation Act 1992*. The object of this act is to protect areas for the "*conservation of nature"* although, indirectly scenic values are protected. The northern part of Curtis Island is protected as a National Park. Many National Parks including Curtis Island are used for recreation purposes. ***Relevance to Arrow LNG Plant LVIA:*** The EIS study area is approximately 8 km south of Curtis Island National Park at its closest point with the LNG plant some 13 km away. The few tourist visitors primarily access Curtis Island via private boat, 4WD or hiking via South End and typically use the east coast and northern part of the park where the three camp sites are sited. Due to the conservation focus of the act, low number of visitors and distance from the project the Curtis Island National Park designation is not considered further in relation to the LVIA.



	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Key Landscape and Visual Amenity Related Designations	Figure No: 4

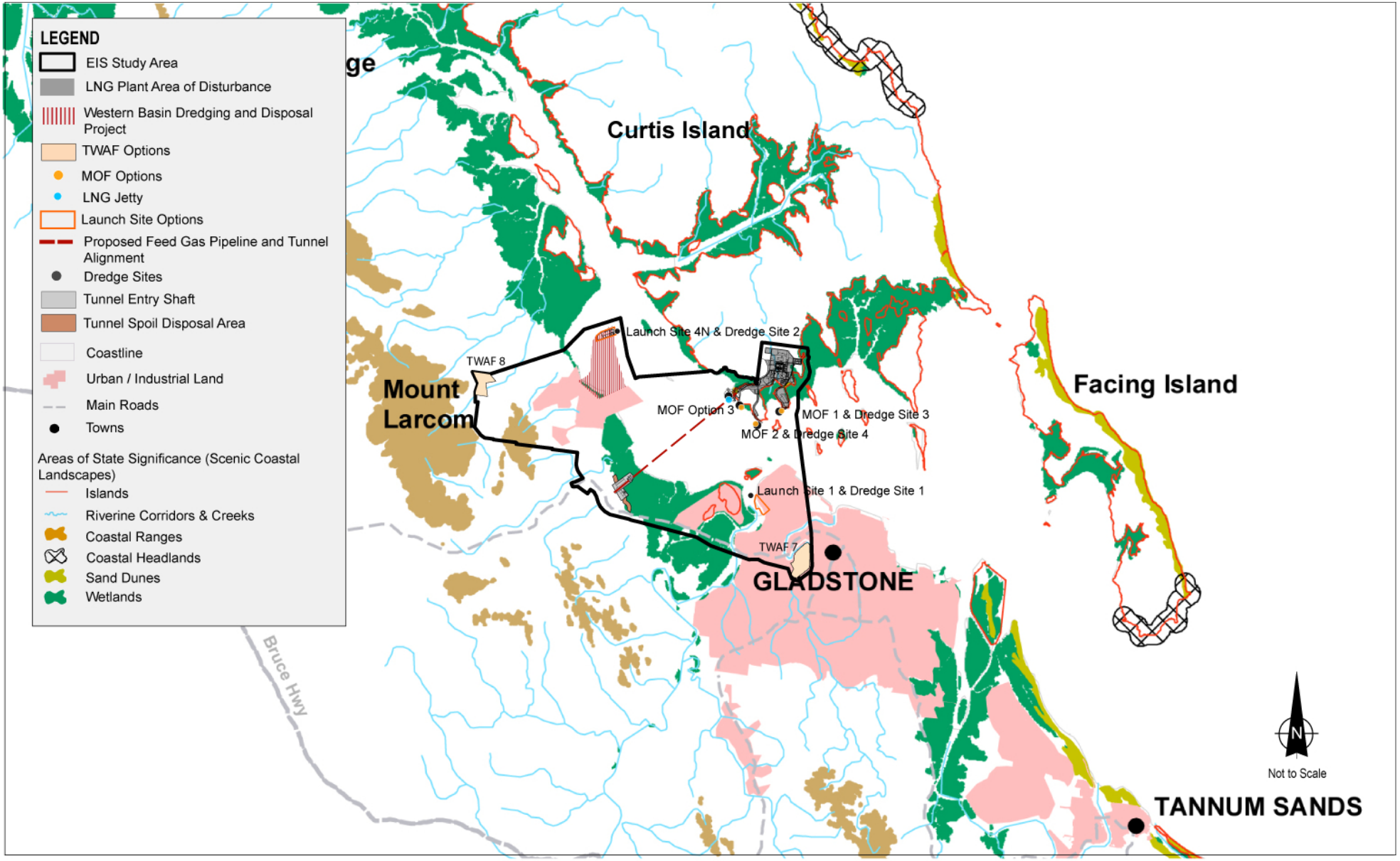
2.3 State Legislative Context

Table 4 Summary of State legislative context related to landscape and visual amenity

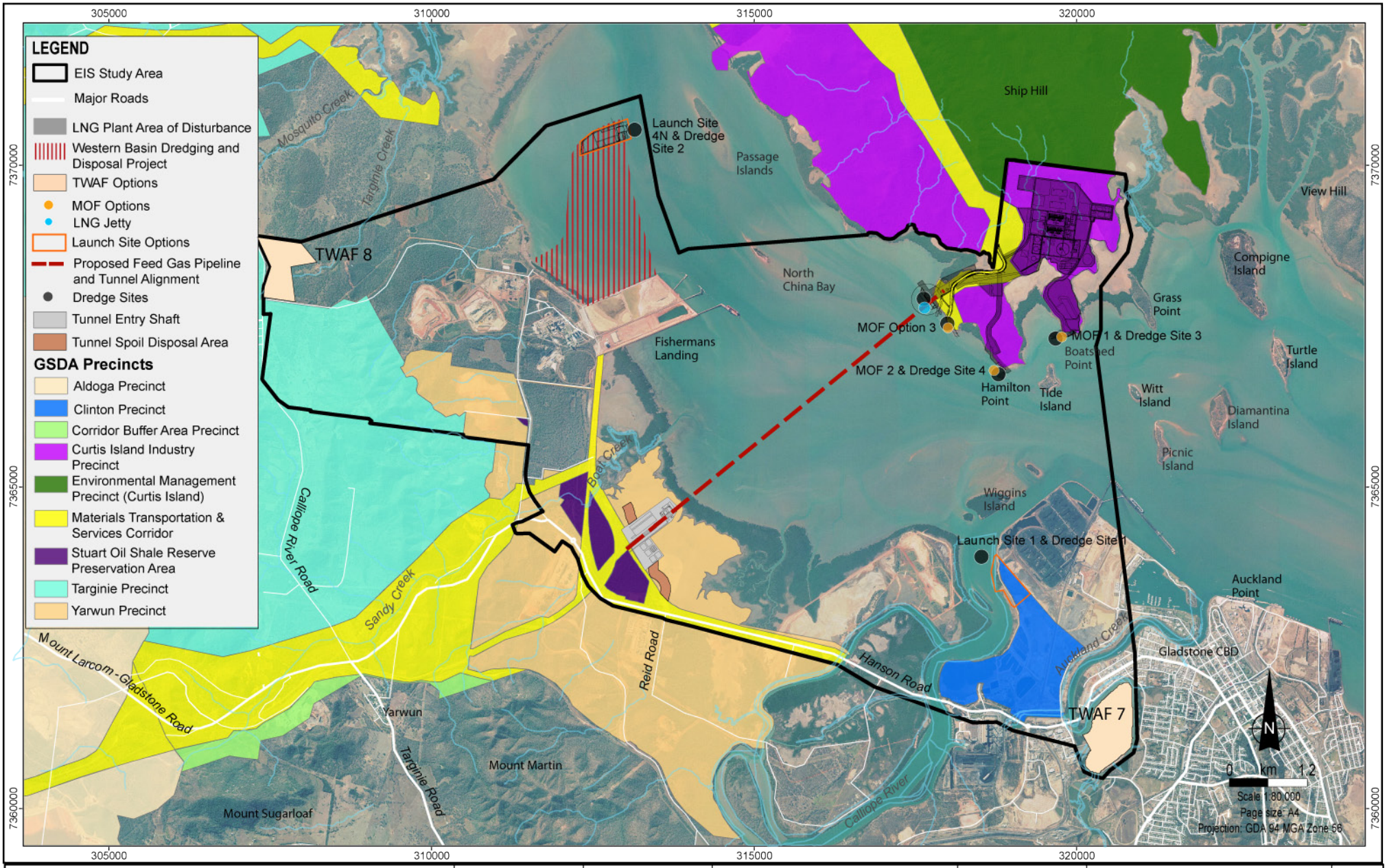
State Planning Designation, Policy and Guidelines	
Designation / Policy	**Relevance to landscape and visual values and the project**
Coastal Protection and Management Act 1995 (Qld): State Coastal Management Plan **Curtis Coast Regional Coastal Management Plan** Environmental Protection Agency (September, 2003) (see **Figure 5**). Note: In March 2011, the Queensland Government announced it had approved the Queensland Coastal Plan. While the Queensland Coastal Plan has government approval it has not formally commenced under the Coastal Act and the Sustainable Planning Act 2009. Until the Queensland Coastal Plan commences (proposed for mid-2011), the existing State Coastal Management Plan and regional coastal management plans (i.e. Curtis Coast regional coastal management plan) remain in effect.	***Landscape and Visual Values:*** The Curtis Coast Regional Coastal Management Plan (CCRCMP) is the key document designating coastal landscapes and features of scenic value within the study area. It sets out desired environmental outcomes and measures to protect the designated Scenic Coastal Landscapes of state significance which are *"areas of outstanding and distinctive scenic quality and are high priority areas for scenic landscape management within Queensland".* The CCRCMP identifies the following elements of the Curtis Coast landscape as contributing to the scenic coastal landscape values of the region (areas of state significance):"…*islands and offshore features (including large and small coastal islands); coastal wetlands; coastal headlands; estuaries and inlets; riverine corridors and creeks; shorelines; sand dunes; coastal mountain ranges; and coral cays and reefs."* The State Coastal Management Plan includes a policy on Coastal Landscapes. Policy 2.7.1 of the CCRCMP provides the regional direction for implementing this policy in the Curtis Coast Region. It sets out two relevant coastal management principles: ***7A*** *The values of coastal landscapes are conserved and recognised for their importance to the quality of life of both residents and visitors, as well as to the economic development and growth of Queensland.* ***7B*** *The dominance of the natural character of the coast (excluding developed urban areas) is retained, including elements of landscape and vegetation.* The regional context discussion within policy 2.7.1 recognises the importance of landscape values in the Curtis Coast Region. It states "*Incompatible development within these areas can adversely impact on their scenic landscape values, particularly in relation to the coastal islands, Mt Larcom and the coastal ranges and remote natural areas such as The Narrows"* and goes on to further state that *"The Gladstone Region is identified to be of 'High Scenic Management Priority' with Curtis Island and the Capricorn Group being of Level 1 Scenic Quality."* ***Relevance to Arrow LNG Plant LVIA:*** Infrastructure associated with the project falls within designated scenic coastal landscapes. These are illustrated on the extract of the CCRCMP in **Figure 5**. Map No. 3 of the CCRCMP shows that the EIS study area is divided into a number of Key Coastal Sites (KCS). The LNG plant is located in KCS 1 (Curtis Island), the mainland tunnel launch shaft, tunnel spoil disposal area and Launch Site 1 are located in KCS 7 (Calliope River/Flying Fox Creek) and the feed gas pipeline crosses KCS 6 (Gladstone Harbour). TWAF 7 lies within 'Gladstone City' and is not considered to be a KCS. TWAF8 lies within/adjacent to KCS 5: Targinie Remnant Vegetation. Map 4.1 of the CCRCMP identifies that the LNG plant falls within Coastal Locality 3.2 Curtis Island (south west). In undertaking the LVIA it is necessary to fully consider the impacts of the project on the Key Coastal Landscapes identified in the CCRCMP including the landscape features and associated management measures. The key landscape features requiring assessment are: • Islands and offshore features: Curtis Island. • Estuaries and inlets: The Narrows. • Coastal wetlands: Curtis Island and The Narrows.

State Planning Designation, Policy and Guidelines	
Designation / Policy	**Relevance to landscape and visual values and the project**
	• Riverine corridors and creeks: creeks including Calliope River, Targinie Creek and Auckland Creek • Coastal mountain ranges: Curtis Island Strike Ridge and Mount Larcom. The LVIA considers issues with due regard to Chapter 3 of the CCRCMP, which sets out the desired coastal outcomes, description, significant resources and their values and associated coastal management issues; and Schedule 1 of the CCRCMP that contains measures to guide the appropriate design and location of development so that it is compatible with scenic coastal landscapes.
National Forestry Policy and State Forestry Policy (see **Figure 4**))	***Landscape and Visual Values****:* Queensland is a signatory to the *National Forest Policy Statement 1992*, which provides for ecologically sustainable management of native forests. The State Policy for vegetation management has been prepared in accordance with Section 10 of the *Vegetation Management Act 1999* and aims to "*conserve and enhance networks and corridors of vegetation*". Where clearing of vegetation is permitted, the policy recommends developments to provide a "*vegetation management offset... that ensures the extent of vegetation and associated environmental values are maintained or exceeded*". ***Relevance to Arrow LNG Plant LVIA:*** There are no nationally listed forests in the study area. Targinie State Forest is located within the EIS study area and lies adjacent to the potential TWAF 8 so potential impacts need to be explored, although no infrastructure directly affects it.
Queensland Nature Conservation Act 1992: Cape Capricorn Conservation Park	***Landscape and Visual Values:*** Conservation Parks are designated under the *Queensland Nature Conservation Act 1992* which is primarily utilised to protect areas for the conservation of nature with only indirect relevance to landscape and visual amenity. ***Relevance to Arrow LNG Plant LVIA:*** The Cape Capricorn Conservation Park is located in the north-east corner of Curtis Island. Due to the distance (some 30 km from the LNG Plant) and indirect relevance of this designation is not considered further.
Gladstone State Development Area July 2008, Queensland State Government **Curtis Island Industrial Precinct and Environmental Management Precinct** July 2008 Queensland State Government (see **Figure 6**)	***Landscape and Visual Values:*** The purpose of the Gladstone State Development Area (GSDA) as shown on **Figure 6** is to secure and protect a large area of suitable land with ready access to a deep water port for large scale industrial development under the direction of The Gladstone Economic and Industry Development Board. The GSDA comprises land north and west of Gladstone, including the Curtis Island Industrial Precinct, the purpose of which is to provide for LNG processing operations (including liquefaction and storage), associated infrastructure facilities including transport linkages to wharf facilities, transport infrastructure, and potentially forestry or extractive industry. The GSDA (July 2008) requires that developments at Curtis Island "…*have regard to the physical characteristics of the land when considering the location of the industrial development* [and] *provide for the physical separation of significant industrial and infrastructure activities within the Curtis Island Industry Precinct from the adjoining Environmental Management Precinct."* The purpose of the Environmental Management Precinct is primarily "…*to protect and maintain areas of high ecological significance."* ***Relevance to Arrow LNG Plant LVIA:*** With the exception of the proposed TWAF 7 and TWAF 8 sites the project falls within the GSDA and is broadly consistent with the intents of this zone. Whilst further assessment is not required through the LVIA process, this policy needs to be considered as a context to other state legislation discussed above since the Queensland Government has made the GSDA in the knowledge of legislation regarding the landscape and environmental qualities of the area that precedes the date of the GSDA; effectively sanctioning developments of this kind with their associated landscape and visual consequences.
State Planning Policy (SPP) 1/92	***Landscape and Visual Values***: This state planning policy aims to protect Good Quality Agricultural Land (GQAL) as a major economic resource for the region. However,

State Planning Designation, Policy and Guidelines	
Designation / Policy	**Relevance to landscape and visual values and the project**
Development and Conservation of Good Quality Agricultural Land	indirectly it may also result in the preservation of rural landscapes. ***Relevance to Arrow LNG Plant LVIA:*** Only a small area of land within the EIS study area (associated with TWAF 8) is classified as GQAL. As the prime purpose of the GQAL designation is not associated directly or indirectly with the preservation of landscape or visual amenity this assessment does not consider the impacts on GQAL further.



Source of Figure: Map 10 Areas of State Significance - Scenic Coastal Landscapes (Curtis Coast Regional Coastal Management Plan)	AECOM		Arrow Energy Arrow LNG Plant	arrowenergy	Extract of CCRCMP 'Areas of State Significance - Scenic Coastal Landscapes'	Figure No: 5



	AECOM		Arrow Energy Arrow LNG Plant	arrowenergy	Gladstone State Development Area (GSDA) Precincts Map

Figure No: 6

2.4 Local Legislative Context

The project falls entirely within Gladstone Regional Council area. This is a newly formed council, created from the amalgamation of three council areas: Gladstone City, Miriam Vale Shire and Calliope Shire. Gladstone Regional Council is in the process of preparing a new planning scheme to replace the three existing planning schemes that applied to the former jurisdictions. Until planning policy has been developed and adopted, the local planning schemes for the three previous council areas remain relevant. None of the EIS study area falls within Miriam Vale Shire. The EIS study area falls between the former Gladstone City and Calliope Shire Council areas as shown on **Figure 7** with associated land use zoning. These plans are also summarised in **Table 5** below.

Table 5 Summary of local legislative context relevant to landscape and visual amenity

Local Planning Designation, Policy and Guidelines	
Designation / Policy	**Relevance to landscape and visual values and the project**
Gladstone Regional Council	
Calliope Shire Planning Scheme 2007	***Landscape and Visual Values:*** Most of the EIS study area falls within the Calliope Shire jurisdiction. However the GSDA in effect supersedes development controls applied by Calliope Shire Planning Scheme across much of the study area with the exception of TWAF8 which is currently zoned Rural. ***Relevance to Arrow LNG Plant LVIA:*** The project is within areas which development is now governed by the GSDA, with the exception of TWAF 8.
Gladstone City Council Planning Scheme: December 2006	***Landscape and Visual Values:*** Part of the EIS study area falls within Gladstone's City Council Planning jurisdiction, in particular TWAF 7 which is zoned as 'Open Space'. This is considered further in the land use and planning assessment (Coffey Environments, 2011). The mainland tunnel launch site and tunnel spoil disposal site is zoned rural, however falls within the Yarwun Precinct of the GSDA. The development controls in the GSDA override Gladstone's City Council's planning scheme. ***Relevance to Arrow LNG Plant LVIA:*** The project is mostly within areas which development is now governed by the GSDA with the exception of the TWAF 7 site.

2.5 Summary Legislative Context

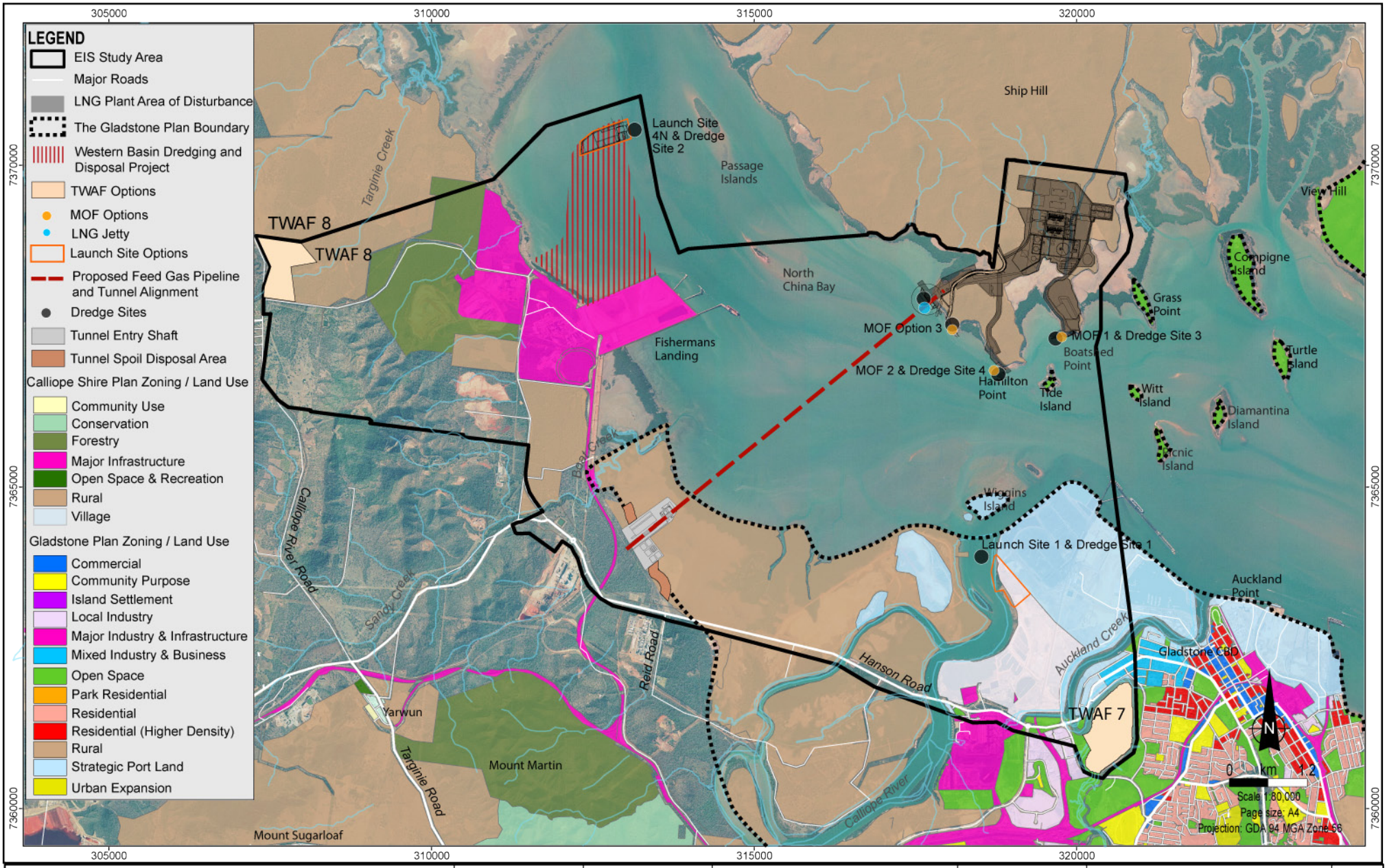
Based on the assessment above, Table 6 below, summarises the key aspects of the legislative and planning context that require consideration in the LVIA.

Table 6 Summary table of designated landscapes requiring assessment

Landscape receptor	**Relevance to Arrow LNG Plant LVIA**	**Assessed in LVIA?**
International Legislation		
Great Barrier Reef World Heritage Area (GBRWHA)	The project lies within the GBRWHA. Visual values are a key element of GBRWHA designation. The impact of the project on these values will need to be ascertained.	Yes
Great Barrier Reef World Marine Park (GBR Marine Park)	The project lies approximately 8 km due west of the GBR Marine Park. The designation does not directly apply. However, indirect impacts on visitors using the marine park do need to be considered in the LVIA for completeness.	Yes
National Legislation		
Australian Heritage Commission Register of the National Estate:		

Landscape receptor	Relevance to Arrow LNG Plant LVIA	Assessed in LVIA?
Curtis Island	The registered area of Curtis Island lies approximately 13 km which is considered too far from the project site for its values to be affected.	No
Balaclava Island	The registered area of Balaclava Island lies approximately 34 km from the project site which is considered too far for its values to be affected.	No
The Narrows	The registered area of The Narrows lies approximately 7 km from the project site and close to associated project elements (such as launch sites) The impact of the project on the visual values for which The Narrows was designated requires further assessment.	Yes
Garden Island	The registered area of Garden Island Conservation Park lies approximately 2.5 km from the project site. The impact of the project on the visual values relating to the recreational use of Garden Island requires further assessment.	Yes
Mount Larcom Range	The 'indicative' registered area of Mount Larcom (i.e., that area proposed but not yet fully registered) lies approximately 13.5 km from but within the potential viewshed of the project site. The impact of the project on the visual and recreational values for which Mount Larcom was designated requires further assessment.	Yes
Nature Conservation Act 1992: Curtis Island National Park	The prime focus of this area is nature conservation. The protected area of Curtis Island lies approximately 8 km from the project site which, due to intervening landform, is considered too far for its values to be affected. Therefore, the impact of the project on landscape and visual values of this area does not need to be considered further.	No
State Legislation		
Curtis Coast Regional Coastal Management Plan (2003):	This document designates coastal landscapes and features of scenic value. The LNG project affects the following elements: The LNG plant: KCS 1 (Curtis Island), Mainland tunnel launch shaft, tunnel spoil disposal area and Launch Site 1: KCS 7 (Calliope River/Flying Fox Creek); feed gas pipeline: KCS 6 (Gladstone Harbour). In undertaking the LVIA it is necessary to fully consider the impacts of the project on the Key Coastal Landscapes with potential to be affected. i.e: The key landscape features requiring assessment are: • Islands and offshore features: Curtis Island. • Estuaries and inlets: The Narrows. • Coastal wetlands: Curtis Island and The Narrows. • Riverine corridors and creeks: creeks including Calliope River, Targinie Creek and Auckland Creek • Coastal mountain ranges: Curtis Island Strike Ridge and Mount Larcom.	Yes
Vegetation Management Act 1999 State Forestry Policy: *Targinie State Forest*	TWAF 8 lies adjacent to Targinie State Forest. Indirect impacts, including the effects of the project on State Forest visitors needs further consideration.	Yes
Queensland Nature Conservation Act 1992: Cape Capricorn Conservation Park	This is designated primarily for nature conservation and is considered too far (approximately 30 km) from the project for there to be meaningful impacts on visitors.	No

Landscape receptor	Relevance to Arrow LNG Plant LVIA	Assessed in LVIA?
Gladstone State Development Area July 2008, Queensland State Government	With the exception of the TWAF sites, the project falls within the GSDA. This designation for large scale industrial development is relevant as it demonstrates the State governments general acceptance of landscape and visual impacts in the vicinity and provides a context against which other landscape and visual impacts should be considered.	No
State Planning Policy (SPP) 1/92 Development and Conservation of Good Quality Agricultural Land	The GQAL designation applies to an area of TWAF 8. It may indirectly result in rural landscape preservation but as this is not the prime intention of the policy this is not considered further. .	No
Local Planning Legislation		
Calliope Shire Planning Scheme, 2007	With the exception of TWAF 8 (zoned Rural) the project lies within (and is superseded by) the GSDA.	No
Gladstone City Council Planning Scheme, 2006	With the exception of TWAF 7 (zoned Open Space) the project lies within (and is superseded by) the GSDA.	No



Source of Figure: Gladstone Plan and Calliope Shire Plan

AECOM

Arrow Energy

Arrow LNG Plant

arrowenergy

Land Use Plan

Figure No: 7

3.0 Study Method

This method applies to the landscape and visual amenity impact assessment (LVIA) for the project.

3.1 Key references

There are currently no accepted national or state level guidelines for LVIA in Australia. Therefore, the approach to this LVIA has been developed with reference to accepted guidelines from elsewhere, primarily:

- The Landscape Institute and the Institute of Environmental Management and Assessment, UK (2002) *Guidelines for Landscape and Visual Impact Assessment, Second Edition*.

Other relevant guidance notes and documentation include:

- *Visual Landscape Planning in Western Australia; a manual for evaluation, assessment, siting and design* (2007) Western Australian Planning Commission.
- The Landscape Institute, UK (2009) Landscape Institute Advice Note 01/09: *Use of photography and photomontage in landscape and visual assessment.*
- Scottish Natural Heritage and the Countryside Agency, UK (2006) *Topic Paper Six: Techniques and Criteria for Judging Capacity and Sensitivity.*
- Scottish Natural Heritage (2006) *Visual Representation of Windfarms: Good Practice Guidance*.
- The Institution of Lighting Engineers (ILE) (2005), *Guidance Notes for Reduction of Obstructive Lighting:* UK, The Institution of Lighting Engineers.

3.2 Types of impacts

The method is applicable to the assessment of both the short term impacts during the construction of the project and the long term impacts during operation (25 year minimum project life) and the likely impacts following decommissioning. The assessment of residual impact is made assuming that all mitigation measures have been fully integrated into the detailed design, including landscaping. This impact assessment does not make additional recommendations on the siting of specific components of the project, as the current conceptual design mitigates the impacts as far as possible as discussed in **Section 6.1**.

3.3 Assessment limitations

The following limitations associated with this assessment have been identified:

- The LVIA process aims to be objective and describe factually any anticipated changes to landscape resources, views and visual amenity. Potential changes as a result of the project have been defined however the significance of these changes requires qualitative judgements to be made. The conclusions to this assessment combine objective measurement and professional interpretation, which are therefore, in part subjective.
- At the time of the assessment, the detailed lighting scheme had not been developed, however conceptual lighting requirements had been determined.
- The description and understanding of the project is based on the project description available at the time of assessment, and therefore the end form may change to some degree from that described and illustrated. This point is particularly pertinent to the production of the photomontages. There is an element of judgement inherent in the representation of changes shown in a photomontage. While the data sources are largely factual, the finished image is ultimately what the modeller believes to be a fair and reasonable imitation of a photograph of the completed proposal taken in similar conditions. Should the project be approved and constructed, the eventual development may differ from that illustrated. Furthermore the image only truly represents the appearance of the development as it would have appeared at the time of day the image was taken. The perceptibility of the changes and the visual character of elements of the scheme will undoubtedly be different under different weather or lighting conditions.
- The cumulative assessment considers those projects, whose proposals are publicly available as of April 2011. At the time of review, the cumulative assessment situation may be different from that stated within this document, as planning decisions eventuate. Furthermore, the cumulative impact proposal descriptions

considered in this document are based on the description available at the time of the assessment and the eventual end form may change somewhat from that described and illustrated here on in.

- The assessment considers an “assumed” project baseline as opposed to the current project baseline situation. The assumed project baseline, considers the two other LNG projects on Curtis Island as real projects given they have been approved and passed the financial investment decision, but at the time of assessment were not fully built, although some construction activity has commenced. These two projects are Queensland Curtis LNG (QCLNG) and Gladstone LNG Project (GLNG) and are defined in **Figure 2**.
- Rio Tinto’s Yarwun Alumina Refinery Expansion Project is also considered as part of the baseline assessment, although due to its distance, does not meaningfully influence the baseline assessment.
- The assessment considers the “worst case” scenario option of the LNG plant only. Refer to **Section 5.1** for details on selection of worst case option.
- This assessment considers surface level impacts on the landscape resource, views and visual amenity only, and does not comment on related topic areas which are being covered by other technical consultants, including:
    - Impacts on ecology and soils. Therefore, this assessment does not consider impacts which may result in long term impacts to soil structure and associated land cover and ecology.
    - Impacts of lighting of the LNG plants on the navigation of vessels in Gladstone Harbour.
    - Impacts of increased vehicular movements at night.
    - Impacts of lighting on ecology and fauna habitats.

3.4 Key Steps

The process diagram (**Figure 8**) illustrates the key steps undertaken in the LVIA.

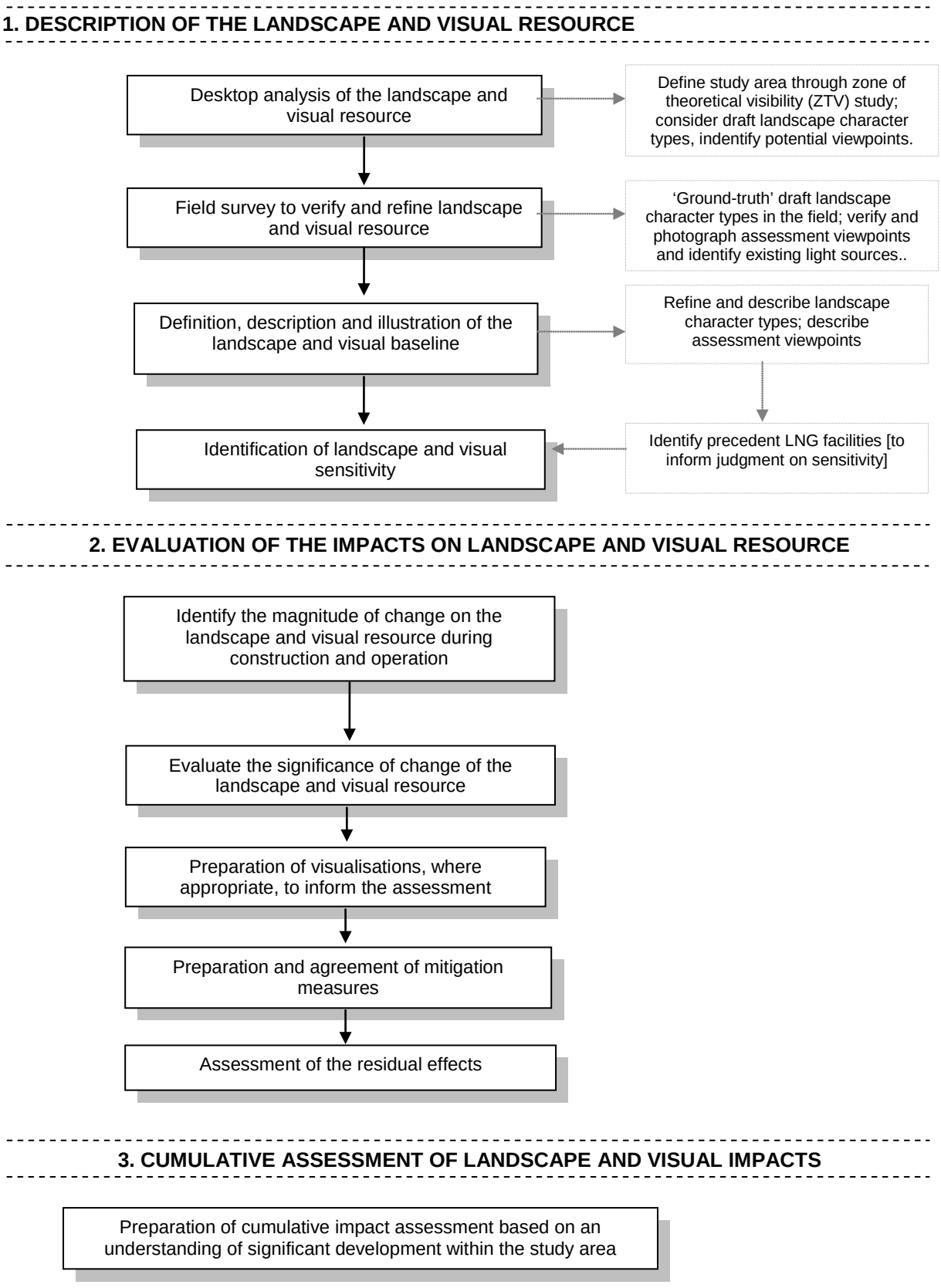


Figure 8 Landscape and Visual Assessment Process Diagram

3.5 Description of landscape and visual resource

3.5.1 Desktop analysis of the landscape and visual resource

The first task in the LVIA involved gathering existing data and other information within and adjacent to the study area. Key information sources include:

- Legislation and planning schemes from relevant local councils (see **Section 2.0**).
- Digital aerial photography.
- Cadastral data (showing roads and all major features, built areas, etc.).
- Hydrology/riparian corridors.
- Land use.
- Geology and soils.
- Vegetation (including Queensland Regional Ecosystem Mapping).
- Existing infrastructure e.g., transmission lines.
- Important cultural heritage features.
- Available landscape and visual impact assessments prepared for previously assessed projects in the locality. In particular a review of the available LVIAs conducted for other LNG facilities proposed on Curtis Island, such as Gladstone LNG Project (Santos Limited) and Queensland Curtis LNG Project (Queensland Gas Company Limited).

Using this information, a preliminary desktop analysis was undertaken to determine the study area for the LVIA (the LVIA study area). This area extends beyond the EIS study area to consider the wider landscape with potential to fall within the viewshed zone of theoretical visibility (ZTV) of the project. Within this area the landscape and visual resource was analysed and used to inform the baseline assessment. This included analysis of the underlying landscape (e.g., geology, soils, topographical structure), landcover (e.g., vegetation, land use, settlement pattern etc.), landscape value (e.g., reflected in scenic routes/trails and landscape designations including national parks and conservation reserves), and desk-based site analysis (e.g., identification of recognised panoramas and views, key landmarks, and local peaks).

Where appropriate, Geographic Information Systems (GIS) analysis was undertaken to assist the assessment e.g., preparation of digital elevation models (DEM) and landform analysis. Following this, draft landscape character types were created which formed the basis of field verification. Additionally, a number of plans assessing the likely ZTV of various aspects of the proposal were undertaken. The results of this analyses combined with a review of the viewpoints identified in the other Curtis Island LNG project assessments, generated a provisional list of viewpoints. These viewpoints were subsequently verified in the field work.

3.5.2 Survey to verify and refine understanding of the landscape and visual resource

Field visits were carried out in March 2010 and April 2011 by three landscape planners / architects (registered members of the Australian Institute of Landscape Architects) and experienced in landscape and visual impact. The purpose of the assessment was to ground truth the findings of the desktop assessment and take photographs to (a) portray landscape character; (b) refine the viewpoint assessment and selection of viewpoints; and, (c) provide data for the production of photographic simulations and visualisations. The field visits focused on those aspects of the landscape with potential to be of the greatest sensitivity to the proposals, and on gaining an appreciation of those aspects of the proposals most likely to affect landscape and/or visual values.

Records were made in the form of global positioning system (GPS) point data, field notes and photographs.

3.5.3 Definition, description and illustration of the landscape baseline

Landscape character assessment is a tool for identifying what makes one place different from another. It identifies what makes a place distinctive, without necessarily assigning a value to it. This approach has been used to establish a baseline audit of the current character of the landscape and to provide a framework for measuring the impact of the proposals.

Broad ‘landscape character types’ have been defined and provide a framework for describing an area systematically, ensuring judgements can be made based on knowledge of what is distinctive so that changes can respect local character, where possible. An understanding of landscape character can be particularly helpful in

informing the siting of new elements in the landscape and assist with identifying which types of mitigation may assist in integrating the project in the landscape.

The baseline landscape character assessment involved mapping and describing broad landscape character types based on the desk-based study, field surveys and liaising with specialists within the project team for more information. Each character type considers:

- Landscape elements that contribute to defining character e.g., pasture, crops, drainage channels, river/creek corridors, bushland, mature bushland corridors alongside roads, cultural plantings (e.g., planting along property entrance drives) etc.
- Landscape character attributes (including scale, grain and perceptual characteristics such as the sense of remoteness, tranquillity and/or its perceived rural character).
- Landscape value (e.g., landscapes designated for their scenic or landscape importance or valued recreational function).

The baseline assessment also considers factors which have influenced landscape change in the past and those that are likely to do so in the future e.g., recreational demands, changing agricultural practices, development pressures.

3.5.4 Definition, description and illustration of the visual baseline

The visual baseline is assessed and described in terms of views from selected representative viewpoints within the study area. It is considered that likely sensitive receptors (viewers) who would potentially experience views from these locations would include:

- Residents living on Curtis Island (i.e., at South End) or other islands near Curtis Island and in Gladstone near the projects infrastructure components.
- People working in and around Port Curtis, in Gladstone and in isolated rural properties near one of the potential TWAF sites.
- Tourists passing through the LVIA study area by vehicle or using recreational trails (e.g., to Mount Larcom).
- Recreational users of Port Curtis, lookouts such as Auckland Point, local parks such as Spinnaker Park and Targinie State Forest.
- Travellers using major and minor roads within the study area, including motorists on the Bruce Highway, Gladstone–Mt Larcom Road and Port Curtis Way etc.

3.5.5 Zone of Theoretical Visibility (ZTV) Assessment

A ZTV maps the area within which a development may have an influence or effect upon views and visual amenity. It is often used as a tool to select representative viewpoints for more detailed assessment. ESRI ArcGIS (v9.3) software has been used to model the ZTV of the proposals. A Digital Elevation Model (DEM) was produced using 10 m contour resolution from the Client (Coffey Environments via Queensland DERM). The DEM has a cell size of 10x10m; this translates to the model having a unique Z height for every 10x10 m unit on the ground within the study area.

The ZTV assessments were run off this DEM. Each ZTV prepared has two Z heights assigned to elevate the expected viewing level above this DEM. The viewpoint location either a point (e.g., the emergency flare stack) or polyline have the Z Height set at the expected height of the object, i.e., the emergency flare stack was set at 110 m. The remainder of the viewing area is set at 1.8 m (average height of a person). The software used then digitally determines the likely extent over which the feature would be visible.

In interpreting the ZTV, the following issues must be considered:

- The ZTV is only accurate to the resolution of the DEM, in this case this resolution is 10x10m. This translated to every 10x10 m cell on the ground giving a binary value of seeing the object or not seeing the object.
- The ZTV does not take into account intervening vegetation, buildings or minor changes in topography, such as road cuttings. As it only uses the landform it is a worst case scenario of potential visual impact.

Two ZTV's have been created, which are presented in **Section 5.3**: These comprise:

- A ZTV of the selected "worst Case" LNG plant option, excluding the emergency flare stack. This ZTV is of the most visible components of the LNG plant as outlined in **Section 5.1**of this report. It includes the construction camp on Boatshed Point, four LNG trains with associated stacks, the LNG pipe racks, the LNG

storage tanks, one of the two MOF options (at Boatshed Point as this is considered potentially to be more prominent and therefore represents the worst case). The ZTV has excluded the two TWAF options, mainland passenger terminal, the feed gas pipeline, mainland tunnel launch shaft and spoil disposal area and dredging, since the impacts of these will be more localised and ZTV modelling is unlikely to be sensitive enough to assist in determining the extent of their visual impact.

- A ZTV of the LNG plant Emergency Flare stack only. This is the highest component on the site (110 m) and represents the greatest extent of potential visibility.

3.5.6 Selection of representative viewpoints

Viewpoints were selected in a variety of landscape types to represent a range of views and types of viewers likely to be affected by the project. The location of each viewpoint was recorded on site using a hand-held GPS. These are described in **Section 4.5**.

Photographs were taken by AECOM (in March 2010 and April 2011) with a digital single lens reflex (SLR) camera and 35 mm digital lens set to the equivalent of a 50 mm focal length lens on a 35 mm film camera, and were used to feed into the visualisation process. Photo stitching software and Adobe Photoshop were used to piece together the adjoining images.

3.5.7 Definition and Description of the Lighting Baseline

The assessment of landscape and visual impacts associated with the lighting of the LNG plant uses a similar approach as the main LVIA assessment. To determine the current level of lighting within the study area, a field assessment during non daylight hours was conducted. This determined the principal sources of light in the wider study area.

3.6 Evaluation of the impacts on landscape and visual resource

3.6.1 Identification of landscape and visual sensitivity

This step involved classification of the sensitivity of the landscape and viewers (sensitive receptors) to the development.

The sensitivity of a landscape is judged based on the extent to which it can accept change of a particular type and scale without adverse effects on its character. Sensitivity varies according to the type of development and the nature of the landscape, including:

- Its inherent landscape value (its condition, perceptual qualities, cultural importance, and any specific values that may apply e.g., landscape planning designations).
- The likely congruency of the proposed change (i.e., the extent to which the proposal may fit or be ‘visually absorbed’ into the scale, landform, land use, pattern, texture of the existing landscape).

For the purposes of this assessment, the sensitivity of the viewers at the viewpoints is considered to be dependent upon:

- The importance of the view i.e., the scenic qualities of the view, including the presence of other existing manmade elements in the view.
- The nature of the visual receptor (type and volume of sensitive receptors or viewers) experiencing the view; for example, residents and visitors to important/valued landscapes are considered to have a higher sensitivity to their visual environment than, say, visitors to non-designated areas or motorists passing through the landscape.

For continuity and consistency, the visual impacts from additional lighting are assessed using the same separate landscape and visual receptors as the daytime assessment. However, assessment of the lighting impacts on designated landscapes is not required as it is considered through the landscape character type assessment.

For the purpose of determining the sensitivity of the landscape character types to lighting, the assessment has used the following environmental zones adopted from *Guidance Notes for Reduction of Obstructive Lighting*: (2005), The Institution of Lighting Engineers UK as set out in **Table 7**, below.

Table 7 Determination of Sensitivity to Light Pollution

Environmental Zone	Examples	Sensitivity
E1: Intrinsically dark landscapes	Untouched, primarily natural and inherently remote landscapes with no artificial existing light sources. In addition the landscape is generally not impacted by sky glow, light pollution or spill from other areas.	High
E2: Low district brightness areas	Either rural landscapes, landscapes with small villages, or untouched, primarily natural landscapes which sustain some sky glow, light pollution or spill from adjacent areas in relatively close proximity or "intermittent" sources of lighting (e.g., shipping channels, with lit channel markers). However overall these areas retain a relatively dark atmosphere.	Medium
E3: Medium district brightness areas	Small town centres or rural residential areas, with standard lighting such as street lighting and that from residential properties.	Low
E4: High district brightness areas	Town/city centres or large scale industrial landscapes with high levels of night time lighting.	Negligible

For the purpose of assessing the lighting impacts on visual resource, the assessment uses the representative viewpoints from the ZVI assessment. The sensitivity of the viewers at the viewpoints has been ascribed based on the following;

- The view is easily accessible at night or is representative of views from sensitive viewer groups at night.
- The view is representative of viewers sensitive to changes in light pollution e.g., residents, campers or a popular lookout that is visited at night.
- The distance of the viewers; closer sensitive viewers (such as viewers in residential areas, in certain business and tourists) will be more susceptible to changes in light levels at night.

The judgement regarding the inherent sensitivity of the landscape and visual resource including lighting aspects has been made in the absence of any mitigation measures and/or standard operating procedures which may reduce the magnitude of the impact to present a worst case scenario. This approach ensures that the sensitivities of each landscape are fully understood so that mitigation can be proposed that addresses these concerns. Mitigation does not change the sensitivity of the landscape, only the magnitude of the resultant effect and consequent significance of the impact. The application of the approved mitigation measures is considered in the residual impact assessment (**Section 7.0**).

In this assessment, sensitivity is described as *negligible, low*, *medium* or *high* as defined and illustrated in **Table 8** (landscape impacts) and **Table 9** (visual impacts).

3.6.2 Identification of magnitude of change

This step involved prediction of the magnitude of change in the landscape or the view, resulting from the project, taking into account the current project description. This includes some measures that have already been designed into the scheme to minimise the landscape and visual impact as described in **Section 6.1.1**. It does not consider the additional mitigation measures identified in **Section6.1.2** onwards**.**

The magnitude of change affecting a landscape or visual receptor depends on the nature, scale and duration of the particular change that is expected to occur. In a landscape the magnitude of change will depend on the loss, change or addition of any feature; or any change in the backdrop to, or outlook from, a landscape that affects its character. With regard to impact on landscape character types, the magnitude assessment assumes a worst case scenario and the assessment is based upon the area of LCT which would be impacted to the greatest extent by the project. The effect on a view will depend on the extent of visibility, degree of obstruction of existing features, degree of contrast with the existing view, angle of view, duration of view and distance from the development.

Magnitude of change is described as being *low (imperceptible), medium (noticeable), high (considerable)* or *very high* (*dominant),* as defined and illustrated in **Table 8** (landscape impacts) and **Table 9** (visual impacts). It is noted that these tables are intended as a guide to the process only. The descriptions of magnitude and sensitivity are illustrative as, there is no defined boundary between levels of impacts.

With regard to lighting the following terminology has been used to define the magnitude of change (Institution of Lighting Engineers, 2002):

- **Sky Glow**, the brightening of the night sky above towns, cities and countryside.
- **Glare** the uncomfortable brightness of a light source when viewed against a dark background.
- **Light Trespass**, the spilling of light beyond the boundary of the property or area being lit.

The process for determining the magnitude of change affecting a landscape and visual receptor due to lighting is the same as that used for the daytime assessment i.e., described as being low (imperceptible), medium (noticeable), high (considerable) or very high (dominant). See and below.

3.6.3 Evaluation of significance of change

This step involved evaluation of the significance of landscape and visual impacts based on the sensitivity of the landscape or viewer to change and the magnitude of change. No established, measurable technical thresholds of significance exist for landscape and visual (The Landscape Institute and Institute of Environmental Management and Assessment, 2002). Significance is therefore determined by considering the sensitivity of the landscape or visual receptor and the magnitude of change expected as a result of the development. Professional judgement and experience are applied on a case by case basis in order to identify broad levels of significance for each receptor. Each case is assessed on its own merits as factors unique to each circumstance need to be considered. However, there are general principles which can be used as a guide to this process, which provide transparency about how judgements have been made. These are set out in the following diagram and tables.

Figure 9 Approach to Evaluating the Significance of Change

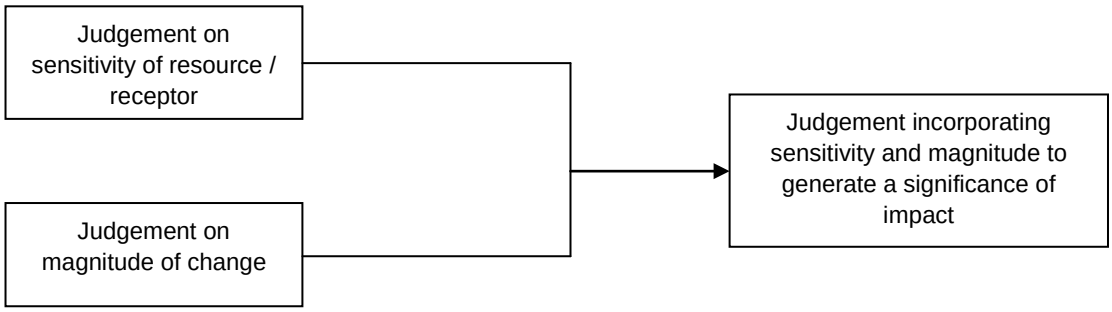


Table 8 Levels of Significance of Landscape Impacts (Landscape Character and Designated Landscapes)

			Magnitude of change in landscape caused by development			
			Very High (Dominant) change	**High (Considerable) change**	**Medium (Noticeable) change**	**Low (Barely perceptible) change #**
			A clearly evident and frequent/continuous change in landscape characteristics affecting an extensive area, which is likely to fundamentally change the character of the landscape.	A considerable change in landscape characteristics, frequent or continuous and over a wide area or a clearly evident change, but over a restricted area.	A noticeable change in landscape characteristics over a wide area or a considerable change over a restricted area, but will not fundamentally change the character of the landscape.	An imperceptible, barely or rarely perceptible change in landscape characteristics
Sensitivity of landscape to proposal	**High**	**Indicator** A landscape protected by national designation and/ or widely acknowledged for its quality and value; a landscape with distinctive character and low capacity to accommodate the type of change envisaged.	**Major***	**Moderate to major***	**Moderate**	**Minor to moderate**
	Medium	A moderately valued landscape, perhaps a regionally important landscape and / or protected by regional/state designation, or where its character, land use, pattern and scale may have some capacity to accommodate a degree of the type of change envisaged.	**Moderate to major***	**Moderate**	**Minor to moderate**	**Minor**
	Low	A landscape valued to a limited extent, perhaps a locally important landscape, or where its character, land use, pattern and scale is likely have the capacity to accommodate the type of change envisaged.	**Moderate**	**Minor to moderate**	**Minor**	**Minor to Negligible**
	Negligible	A landscape which is not valued for its scenic quality or where its character, existing land use, pattern and scale are tolerant of the type of change envisaged, and the landscape has capacity to accommodate change.	**Minor to moderate**	**Minor**	**Minor to Negligible**	**Negligible**

***** Denotes most significant impacts for consideration by decision makers

Note: If *no* changes would be perceptible a significance of **No Impact** is recorded.

Table 9 Levels of Significance of Visual Impacts

			Magnitude of change in views caused by development			
			Very High (Dominant) change	**High (Considerable) change**	**Medium (Noticeable) change**	**Low (Barely perceptible) change #**
			Major changes in view at close distances (e.g. up to around 2 km), affecting a substantial part of the view, continuously visible for a long duration, or obstructing a substantial part or important elements of view.	Clearly perceptible changes in views at intermediate distances (e.g., around 2 to 5 km), resulting in either a distinct new element in a significant part of the view, or a wider ranging, less concentrated change across a wider area.	Minor changes in views, at long distances (e.g,, between approximately 5 to 8 km) or visible for a short duration, and/or are expected to blend in with the existing view to a moderate extent.	Change which is barely visible, at a very long distance (e.g., over 8 km), or visible for a very short duration, and/or are expected to blend with the existing view.
Sensitivity of viewpoints to proposal	**High**	**Indicator**	**Major***	**Moderate to major***	**Moderate**	**Minor to moderate**
		Large numbers of viewers or those with proprietary interest and prolonged viewing opportunities such as residents and users of attractive and/ or well-used recreational facilities. Views from a regionally important location such as a scenic lookout whose interest is specifically focussed on the landscape e.g., Auckland Point.				
	Medium	Medium numbers of residents and moderate numbers of visitors with an interest in their environment e.g., visitors to State Forests, including bush walkers, horse riders, trail bikers. Larger numbers of travellers with an interest in their surroundings.	**Moderate to major***	**Moderate**	**Minor to moderate**	**Minor**
	Low	Small numbers of visitors with a passing interest in their surroundings e.g., those travelling along principal roads. Viewers whose interest is not specifically focussed on the landscape e.g., workers, commuters.	**Moderate**	**Minor to moderate**	**Minor**	**Minor to Negligible**
	Negligible	Very occasional numbers of viewers with a passing interest in their surroundings e.g., those travelling along minor roads e.g., those travelling along minor routes.	**Minor to moderate**	**Minor**	**Minor to Negligible**	**Negligible**

***** Denotes most significant impacts for consideration by decision makers # Note: If *no* changes would be perceptible a significance of **No Impact** is recorded.

Table 10 Levels of Significance of Lighting Impacts on Landscape Resource

			Magnitude of change in landscape caused by lighting of the development			
			Very High (Dominant) change	**High (Considerable) change**	**Medium (Noticeable) change**	**Low (Imperceptible) Change #**
			An extensive area of the landscape is anticipated to be well lit by the project. The project may generate glare or light trespass. This is generally a direct impact.	An extensive area is anticipated to be partially lit or restricted areas are anticipated to be well lit. The project may generate glare or sky glow. This may be a direct or indirect impact.	An adjacent area is anticipated to be partially lit over a wide area; however the area retains a relatively dark character. Sky glow may be generated by the development. Or an intermittent light source within the landscape area. This generally is an indirect impact.	A barely or rarely perceptible change in level of lighting within the landscape. No glare, light trespass or sky glow is anticipated from the development. The light impact is not direct and the area retains its current level of brightness.
Sensitivity of landscape character unit	**High**	**Indicator**				
		Intrinsically dark landscape	**Major**	**Moderate to major**	**Moderate**	**Minor to moderate**
	Medium	Low district brightness areas	**Moderate to major**	**Moderate**	**Minor to moderate**	**Minor**
	Low	Medium district brightness areas	**Moderate**	**Minor to moderate**	**Minor**	**Negligible**
	Negligible	High district brightness areas	**Minor to moderate**	**Minor**	**Negligible**	**Negligible**

Note: If *no* changes would be perceptible a significance of **No Impact** is recorded.

Table 11 Levels of Significance of Lighting Impacts on Visual Resource

			Magnitude of change in view caused by lighting of the development			
			Very High (Dominant) change	**High (Considerable) change**	**Medium (Noticeable) change**	**Low (Imperceptible) Change**
			Major light level changes in a view, for example at close distance (e.g. up to around 2 km), or affecting a substantial part of the view. The development may generate glare or light trespass.	Clearly perceptible level of light change, for example in views at intermediate distances (e.g., around 2 to 5 km). The development may generate glare or sky glow.	Minor level of light changes in views, for example at long distances (e.g,, between approximately 5 to 8 km) or visible for a short duration, and/or are expected to blend in with the existing view to a moderate extent. Sky glow may be generated by the development.	Change in light level which is barely visible, for example, at a very long distance (e.g., over 8 km), or visible for a very short or intermittent duration. No glare, light trespass or sky glow is anticipated from the development.
Sensitivity of viewpoint to proposed lighting	**High**	**Indicator**	**Major**	**Moderate to major**	**Moderate**	**Minor to moderate**
		Easily accessible at night, with viewers that are at typically close distances and are sensitive to changes in light level.				
	Medium	Relatively accessible at night, with viewers at typically close or moderate distances, that may be sensitive to changes in light levels.	**Moderate to major**	**Moderate**	**Minor to moderate**	**Minor**
	Low	Typically not accessed at night by viewers. If accessed, viewers are typically at moderate to longer distances and will be less sensitive to changes in light levels.	**Moderate**	**Minor to moderate**	**Minor**	**Negligible**
	Negligible	Typically not accessed at night by viewers. If accessed viewers are not sensitive to changes in light levels.	**Minor to moderate**	**Minor**	**Negligible**	**Negligible**

(These tables are a guide only)

Using these tables as a guide, a judgement is made regarding the level of significance of the impact, which is described as being *negligible, negligible to minor*, *minor, minor to moderate*, *moderate*, *moderate to major* or *major*. There is often a gradual or blurred transition between levels of significance; and where impacts lie on the borderline they may be described, for example as minor to moderate.

Impacts which are graded as being *moderate to major* or *major* are those which the LVIA team considers should be given greatest weight, relative to other levels of landscape and visual impact, in decision making. They usually concern immediate landscapes around development facilities and close views seen by sensitive viewers. *Minor to moderate* levels of impact are of progressively reducing importance. Impacts graded as *minor* also constitute

effects which warrant consideration, but the team consider these should individually carry little weight in the decision making process.

Impacts may be described as being adverse (negative) or beneficial (positive). They can be direct (i.e., directly or physically affecting a landscape resource) or indirect (i.e., physical changes elsewhere which affect the landscape character or views within adjacent or more distant areas). Impacts can be short term (i.e., those occurring during installation/construction of a development) or long term (i.e., those lasting for the life time of the project). In addition, they can be wide-spread or localised. Impacts on designated landscapes are generally assessed using the table for landscape impacts, although visual aspects may also be considered using the criteria set out in the table for assessing visual impacts.

3.6.4 Preparation of visualisations

Visualisations have been compiled to appreciate the potential visual impact of the presence of the proposed LNG plant and associated marine facilities on Curtis Island from a number of representative viewpoints. These have been created from the baseline viewpoints, using 2 dimensional (2D) AutoCAD drawings issued by Arrow Energy in combination with SketchUp and Photoshop for rendering. Only the “unmitigated project design” (i.e., does not include any mitigation) has been represented or the “worst case” scenario selected.

3.6.5 Preparation and agreement of mitigation measures

Following on from the assessment of impacts on the landscape and visual resource, a set of mitigation measures not inherent in the original project description have been developed. These measures were agreed with Arrow Energy and are to be investigated in the design development, therefore reflecting the commitment of Arrow Energy to sound environmental management techniques. These measures aim to avoid and reduce adverse impacts as far as reasonably practicable during the construction, operation and decommissioning phases of the project, including considerations of lighting impacts.

3.6.6 Identification of significance of residual impacts and management plan preparation

The residual impact assessment is an assessment of the base case project combined with the agreed mitigation measures. An assessment of the significance has been undertaken drawing together the findings of the study to reach a conclusion about the extent, duration and the remaining impacts of the development activities on landscape and visual resource, during construction/installation, operation and maintenance, and rehabilitation. This provides the assessor and reader with an indication of the effectiveness of the mitigation measures proposed, as well as indication of the residual impact associated with the project.

Finally this section identifies the construction and operational management plan inputs pertaining to managing impacts on landscape and visual amenity.

3.7 Cumulative landscape and visual impact assessment

The aim of the cumulative landscape and visual impact assessment (cumulative LVIA) presented in **Section 8.0** is to describe and assess the ways in which the project could have additional impacts when considered together with other proposed projects of a similar scale in the Gladstone region. The cumulative assessment does not consider those projects that are being constructed or approved developments that have taken a financial investment decision. These projects (i.e., QCLNG, GLNG and Yarwun Alumina Refinery Expansion Project) form part of the existing baseline situation.

Information to inform the cumulative LVIA is based on information on other similar scale projects, including other proposed LNG facilities in the study area, to the extent that information was publicly available at the time of this assessment.

The cumulative situation may change as applications are made or withdrawn. Therefore, the cumulative assessment is current as of April 2011, and any changes in the cumulative situation after this date are not incorporated in the assessment.

For clarity, the cumulative impact assessment has adopted a qualitative method similar to the main LVIA assessment; including a three step process, as follows:

- **Step One:** Identification and description of existing projects within the study area.

- **Step Two:** Project screening i.e., exclusion of projects anticipated to generate a negligible cumulative impact on landscape and visual amenity.
- **Step Three:** Assessment of cumulative landscape and visual impacts.

Principally, step three of the assessment combines the sensitivity of the receptor with the anticipated magnitude of change within or on the closest part of a landscape resource and on key viewers (using the representative viewpoints) to determine the significance of change on the landscape and visual resource.

3.7.1 Step One: Identification and description of existing projects within the LVIA study area

The projects included in the cumulative assessment are those that have been approved by the Queensland Coordinator-General or have sufficient information in the public domain (e.g., an EIS) to enable an assessment of the potential impacts. Projects included in the cumulative impact assessment have had to meet the following criteria:

1. The project is located in the Gladstone region, sufficiently close to the project for cumulative landscape and visual effects to be possible.

   The project is being assessed by one of the following:

   a) The *State Development and Public Works Organisation Act 1971* (Qld) and has been declared by the Queensland Coordinator-General as a 'project of state significance' for which the status of the EIS is either complete or, as a minimum, has an Initial Advice Statement published on the Department of Infrastructure and Planning (DIP) website.

   b) The *Environmental Protection Act 1994* (Qld) and has completed an EIS or has an Initial Advice Statement (or similar) listed on the Department of Environment and Resource Management (DERM) website.

2. The project is envisaged in statutory planning documentation.

3.7.2 Step Two: Project screening

A provisional review has been conducted to streamline the assessment process to eliminate, or scope out projects, which are anticipated to generate negligible landscape and visual impacts. The inclusion of a site is based on a judgement of whether views of the LNG plant and the development are anticipated at the same time. Factors considered are:

- A high level understanding of the proposed development.
- A review of the LNG plant ZTVs to determine an overlap of the ZTV with the developments in question (where available).
- Review of site survey information e.g., site photos.

Step 3: Assessment of cumulative landscape and visual impacts

This step determines the nature and extent of potential impacts in relation to landscape and visual values of the Gladstone region, as determined through the assessment in the main LVIA.

For continuity and consistency, the cumulative LVIA has used the same landscape and visual receptors as the project LVIA assessment. Principally, the assessment combines the sensitivity of the receptor with the anticipated magnitude of change within or on a part of a landscape resource and on key viewers to evaluate the significance of change on the landscape and visual resource. Similarly, the determination of sensitivity and magnitude of change is based on the classification presented in Section 3.6

Key Definitions

The following additional definitions have been used in the cumulative impact assessment:

- "Combined" impacts occur where a static receptor is able to view two or more developments from a standpoint/viewpoint within the receptor's arc of vision (assumed to be 120 degrees for the purpose of this assessment) at the same time.
- "Successive" impacts occur where a receptor is able to view two or more developments from a viewpoint, but must turn their head to see them.
- "Sequential" impacts occur where a receptor is moving from one area to another, for instance when a person is travelling along a road or track, and is able to see two or more developments at the same, or at different

times as they pass along the route. Sequential effects can potentially affect views from routes over a wide area.

4.0 Existing Environment

This section provides an overview of the existing environment. For clarity, the overview has been discussed in the following sections:

- Regional landscape context.
- Study area landscape context.
- LNG plant local landscape context.
- Landscape character baseline description.
- Visual baseline assessment.

4.1 Regional Landscape Context

The project is proposed in the Gladstone region and includes facilities on both Curtis Island and the mainland, in close proximity to the City of Gladstone. The EIS study area is located in the southern part of the Great Barrier Reef World Heritage Area, but lies outside the Great Barrier Reef Marine Park boundary.

The project is proposed in the northern part of the *South Eastern Queensland* bioregion. Within this bioregion, the project sits within the *Burnett - Curtis Hills and Ranges* sub-bioregion (SEQ8). This bioregion is characterised by steep granite ranges and undulating lowlands, and a mixture of vegetation types including *Eucalyptus-Lophostemon-Syncarpia,* tall open forests, eucalypt open forests, sub-tropical rainforests, *Melaleuca* wetlands, banksia low woodlands, heaths and mangrove/saltmarsh communities.

Like all landscapes, the Gladstone region has not only been shaped by natural variations in geology, soils, landform and vegetation, but the use and modification of these landscapes by people. It is a region of prolific contrasts; where heavy industry abuts distinctive natural coastal landscapes associated with Port Curtis and large scale industrial infrastructure is viewed against the dramatic backdrop of the Mount Larcom mountain ranges. These industrial landscapes also contrast with Gladstone's townscape character and the surrounding inland pastoral landscapes of Yarwun and Mount Larcom.

4.2 Study Area Landscape Context

For clarity, the description of the LVIA study area landscape context has been divided into the following sections:

- Natural Influences (e.g., landform, hydrology, vegetation).
- Human Influences (e.g., land use precincts, proposed developments either under construction or approved).

This information has informed the definition of several unique Landscape Character Types, which are described in Section 4.4.

4.2.1 Natural Influences

Landform within the LVIA study area varies considerably, including elevated granite mountain ranges which dramatically descend to alluvial coastal landscapes and seascapes of Port Curtis. Key high points in the local landscape include Mount Larcom (632 m Australian Height Datum (AHD)), Mount Scrubby (260 m AHD), Mount Sugarloaf (304 m AHD) and Ship Hill (173 m AHD) illustrated in **Figure 10**. The primary ridgelines in the study area traverse the landscape in a north-south direction along the Mount Larcom ranges, as indicated in **Figure 10**. Secondary ridgelines coincide with the Mount Larcom foothills (including the Mount Martin and Mount Stowe ridges and Forest Road Boat Ridge) and Ship Hill located on Curtis Island (locally known as 'Curtis Island strike ridge'). These elevated and mostly forested landscapes provide a dramatic backdrop within the study area.

The landscape between these hilly areas is dominated by the low lying alluvial coastal plains associated with Port Curtis and The Narrows seascape, including a series of small islands located off south Curtis Island defined in **Figure 10**.

Key mainland watercourses in the LVIA and EIS study area include Calliope River, Auckland Creek and its tributaries, Sandy Creek, Boat Creek, Targinie Creek and Mosquito Creek; which all drain into Port Curtis. Key watercourses on Curtis Island include Graham Creek, Enfield Creek and a number of small ephemeral watercourses (all of which lie outside of the study area beyond the extents of **Figure 10**).

On the mainland, a large amount of the natural vegetation has been removed and replaced with the Gladstone townscape and surrounding pastoral landscapes of Yarwun and Mount Larcom. Natural, predominantly untouched areas of vegetation such as native eucalyptus woodlands and open eucalypt forest are confined to higher and steep ground and associated with some waterway corridors.

On the southern part of Curtis Island (south of Graham Creek), small areas have been cleared for agricultural purposes and South End settlement. However, the remainder of the island is predominantly covered by native eucalyptus woodlands, open eucalypt forest and extensive patches of dry rainforest. Inland vegetation generally consists of heath, grassland and stunted paperbark woodland, whilst the island fringe and foreshore include intertidal wetlands (e.g., mangrove mudflats).

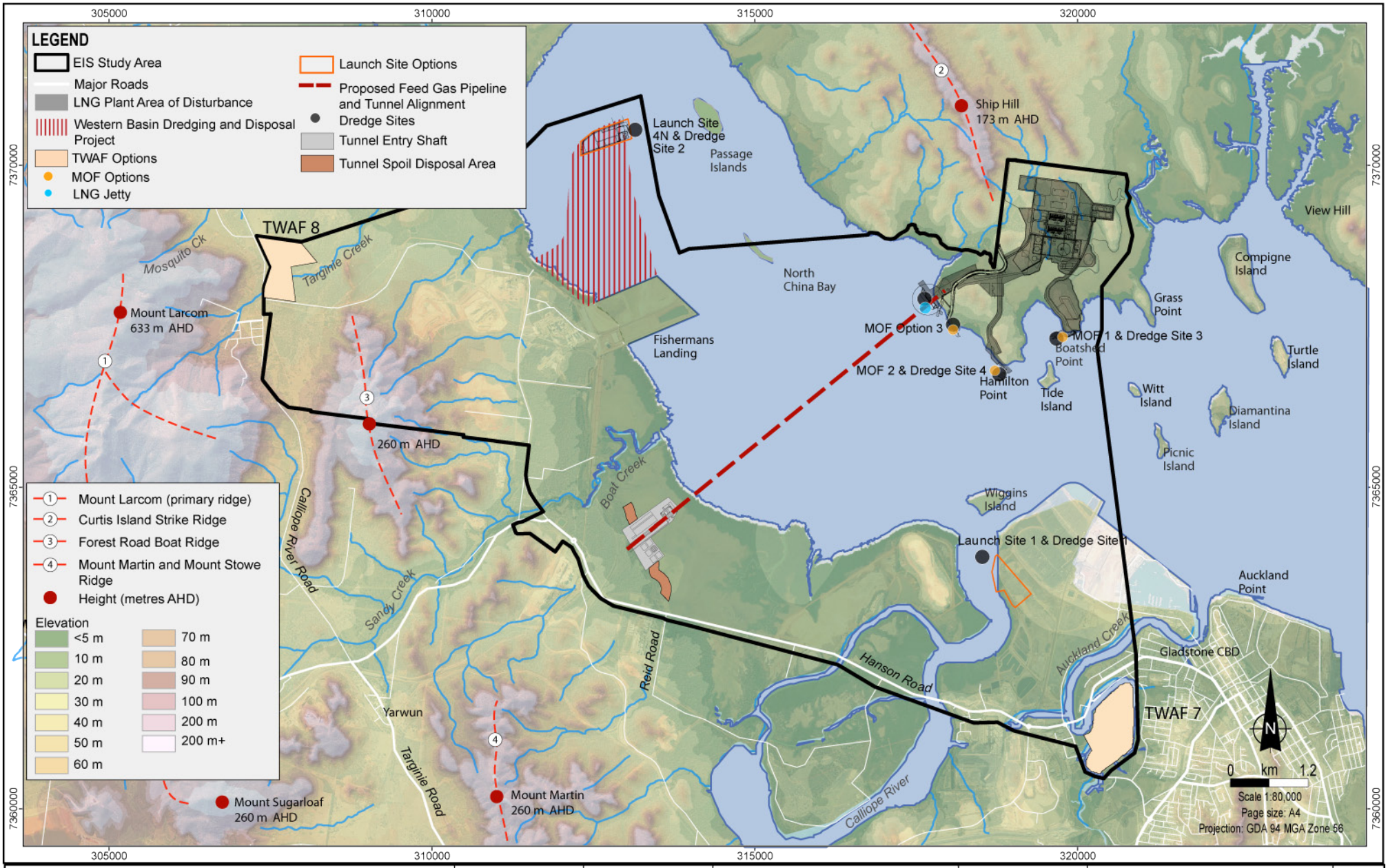
4.2.1 Human Influences

Gladstone established as a penal colony circa 1847 and settlement later grew around its port (at Auckland Point) and the railway, which linked the Port of Gladstone with Brisbane. Population growth and associated settlement pattern was slow during the early-mid 20th century, mainly servicing the region's cattle industry, including the live export industry. The township grew rapidly during the 1960s, when the Port of Gladstone was used for the export of coal from the Moura coal fields. This growth continued between 1970-1990 due to the attraction of major processing industries and export facilities, including the development of a major power station (Queensland's largest coal-fired power station), Clinton coal facility (later redeveloped as RG Tanna Coal Terminal) and the building of the Boyne Aluminium Smelter (1982). This scale and type of development, as well as additional State investment in major infrastructure corridors (e.g., road, rail, gas, water pipelines) has continued to influence the townscape character of Gladstone, which functions as Queensland's largest multi commodity port and major hub of the LNG industry, power generation and distribution, and mineral refineries, including extensive large-scale development (existing and proposed) at Curtis Island and the mainland (northwest of Gladstone City).

The Gladstone State Development Area (GSDA), comprising approximately 29,000 hectares, was declared in 1993, which attracts large industry to the region, with a focus on the LNG industry. The majority of the project is located in the GSDA, with the exception of some key mainland activities i.e., the two TWAF sites as described in **Table 4**. The purpose and development outcomes prescribed by the GSDA designation are described in the Legislative Context and Standards Section (see **Section 2.0**).

The development outcomes of the GSDA would generate large scale changes to the landscape and visual context in the study area over the next forty years. Large tracts of the relatively small scale rural landscape would potentially change to an extensive large scale, industrial landscape (including light, medium, heavy and high impact industries) in the GSDA precincts, illustrated in **Figure 6** and described below:

- ***Aldoga, Clinton, Targinie, Yarwun Precincts***: The landscape and visual context of these areas would change to predominantly heavy industry precincts, containing predominantly large scale, large plant footprint industrial development. Some precincts may also provide for the management of waste from industry. Examples of the industries include: bulk stores, heavy industry and high impact industry. Clinton, Yarwun and Targinie may also contain port and maritime related activities and industries.
- ***Curtis Island Industry Precinct:*** The existing landscape and visual context of this precinct is anticipated to change to an industrial landscape, used for LNG facilities, processing operations (including liquefaction and storage) and wharf facilities.
- ***The Corridor Area Buffer and Materials Transportation & Services Corridor Precincts:*** The transportation and services corridor would provide materials, products, wastes and services by pipe or conveyor and compatible infrastructure services. The corridor area buffer would provide for physical separation between the materials transportation and services corridor and adjacent land uses. It would be an agricultural area, where sensitive land uses such as dwellings would be discouraged.
- ***Stuart Oil Shale Reserve Preservation Area:*** This area would be further developed into an industrial landscape.
- ***Kangaroo Island and Curtis Island Environmental Management Precincts:*** These areas would principally remain intact as they are intended to provide areas for open space to retain remnant vegetation, wetlands, waterways and areas of ecological significance.



AECOM		Arrow Energy Arrow LNG Plant	arrowenergy	Landform: Topography, Waterways and Ridgelines

Figure No: 10

4.3 LNG Plant Local Landscape Context

4.3.1 Existing Landscape Features and Character

The project is located over a variety of landscapes including existing natural landscapes on Curtis Island and a variety of mainland land uses, including open space, rural, strategic port and major industry and infrastructure. With the exception of the TWAF site options and Launch Site 4N most of the project lies within the GSDA. Within the GSDA it is anticipated that, in the near future, large scale industrial land use would occur that would change the remaining areas of rural or natural landscape characteristics to a landscape characterised by heavy and high impact industrial development. The implementation of the GSDA is likely to also indirectly affect those landscapes lying outside its boundary, as large scale industry is likely to be visible from adjoining area, including the sites of TWAF 7 and TWAF 8.

LNG plant with associated marine infrastructure and construction camp: The proposed site for the LNG plant is located on flat,-gently undulating lowland coastal landscapes (approximately 0-48 m AHD), at the southern end of Curtis Island
The LNG plant proposed on Curtis Island is located within the "Curtis Island Industry Precinct" of the GSDA, which is intended to create land use for LNG processing operations. The vegetation on Curtis Island where the LNG plant is proposed consists of mainly open forest of *Corymbia citriodora* and *Eucalyptus crebra* species with patches of *Eucalyptus tereticornis*. The foreshore area consists of mangrove shrub and low closed forest on clay pans, with isolated patches of saltpan. A small proportion of the proposed plant sites also contain cleared land formerly used for farming, which appears to have high levels of weed cover and is subject to varying degrees of natural regeneration (refer to Flora Report (Ecosure, 2011) for further detail on vegetation types).

Mainland Marine Infrastructure including tunnel launch: The two options for the mainland launch site are located adjacent to the existing RG Tanna export coal terminal near the mouth of the Calliope River (Launch 1) and the northern end of the proposed reclamation area for the Fishermans Landing Northern Expansion Project (Launch 4N). Launch 1 is currently mudflats with native marine vegetation (mangroves) and falls within the Clinton precinct of the GSDA, which includes for port and maritime related activities. The proposed mainland tunnel launch site and tunnel spoil disposal area is located on the mainland, adjacent to Rio Tinto's Yarwun alumina refinery. The feed gas pipeline is connected to the LNG plant via a tunnel under Port Curtis.

TWAF Sites: The two potential sites for the temporary workers accommodation facility (TWAF) are located on the mainland. The TWAF site options include:

TWAF7: a former Gladstone Power Station ash pond site which occupies an 'island' formed by a natural meander in Auckland Creek. This area is disturbed and degraded owing to its former use and currently appears largely cleared/grassy. However, significant belts of remnant and regenerating riverside and coastal vegetation including mangroves occur at the fringes which buffer and limit views into the site.

TWAF8: this area includes a former pastoral grazing lot in the vicinity of Targinie which includes patches of cleared land with a grassy character but with some vegetation regeneration. Other parts of the site are significantly vegetated with mature bushland (eucalypts). The site also includes a small creek. It is located adjacent to Targinie Precinct of the GSDA (from which it is excluded) and also borders Targinie State Forest.

4.3.2 Baseline Landscape Context

The landscape baseline has considered developments which have been approved or are under construction. This comprises three major projects: Queensland Curtis LNG Project, Gladstone LNG Project and Yarwun Alumina Refinery Expansion Project. These projects are defined in **Figure 2** and described in Table (descriptions based on publicly available EIS documentation).

Table 12 Summary Table of Approved Projects

Project	Developer	Project Description
Gladstone Liquefied Natural Gas (GLNG project)	Santos Limited and Petroliam Nasional Berhad (PETRONAS)	The project involves the construction of a 435 km gas pipeline from the Surat and Bowen Basins, to Gladstone, and a gas liquefaction and export facility on Curtis Island, with a maximum capacity of up to 10 Mtpa, located immediately north, north west of the Arrow LNG Plant.
Queensland Curtis Liquefied Natural Gas	Queensland Gas Company	This project entails the further development of gas fields in south central Queensland, a 450 km high pressure gas pipeline from the

(Queensland Curtis LNG Project)	Limited, a BG group company	gas fields to Gladstone in central Queensland and an LNG plant on Curtis Island, with a maximum capacity of up to 12 Mtpa. The LNG plant on Curtis Island is north, north west of the Arrow LNG Plant and sites adjacent to the GLNG.
Yarwun Alumina Refinery Expansion Project	Rio Tinto	Stage two of Alumina Production Facility at the Yarwun Precinct with the inclusion of a gas-fired cogeneration facility, involves the expansion of the Yarwun Alumina refinery, up to 4 Mtpa. The refinery is located approximately 12 km from the Arrow LNG Plant.

4.4 Landscape Baseline Assessment

The key indicators of landscape resource within the study area are designated landscapes and landscape character types.

4.4.1 Designated Landscapes Baseline Assessment

The designated landscapes have been introduced in **Section 2.0**. These are areas of land or particular landscape elements that are valued and protected due to their character or quality (including visual characteristics). **Table 13** explains the sensitivity of these landscapes. Only those landscapes identified in **Section 2.0** that were identified as being relevant to landscape or visual amenity evaluation are included (e.g., the area of Curtis Island included on the Register of the National Estate was deemed to be located too far from the project to be affected).

Table 13 Sensitivity Rating of Designated Landscapes

Landscape receptor		Sensitivity to Change
Great Barrier Reef World Heritage Area (GBRWHA)		**High**: The GBRWHA is an internationally recognised and protected landscape recognised for a range of criteria including *"...areas of exceptional natural beauty and aesthetic importance..."*
Great Barrier Reef World Marine Park (GBR Marine Park)		High: The GBR Marine Park is a commonwealth protected landscape protected by an act that seeks to maintain *"...public enjoyment and appreciation..."*
Australian Heritage Commission Register of the National Estate:	*The Narrows*	**High**: The Narrows is a nationally protected landscape which is recognised *as "...an uncommon passage landscape and one of only five narrow tidal passages separating large continental islands from the mainland in Australia"*
	Garden Island Conservation Park	**Medium**: Whilst Garden Island is a nationally protected area landscape values are not the key reason for its protection, although it is used by recreational users who would maintain an interest in landscape quality.
	Mount Larcom Range	**Medium**: The Mount Larcom Range is not fully registered. However it is considered regionally important on account of its nomination for inclusion on the register and its recognised importance *"...as a scenic backdrop to the city of Gladstone...*".
Curtis Coast Regional Coastal Management Plan (2003)	*Islands and Offshore Features: Curtis Island*	**Medium**: The CCRCMP highlights features of state (as opposed to national) significance and states that incompatible development can "....*adversely impact on their scenic natural values..."* It is considered that these landscapes have low capacity to accommodate the type of development change envisaged.
	Coastal Wetlands: Curtis Island and The Narrows	**Medium**: Rationale as for Islands and Offshore Features
	Estuaries and Inlets: The Narrows Estuary	**Medium**: Rationale as for Islands and Offshore Features. In addition it is noted that The Narrows is considered in the CCRCMP to be a *"...remote natural area...".*
	Riverine Creeks and Corridors:	**Medium**: Rationale as for Islands and Offshore Features

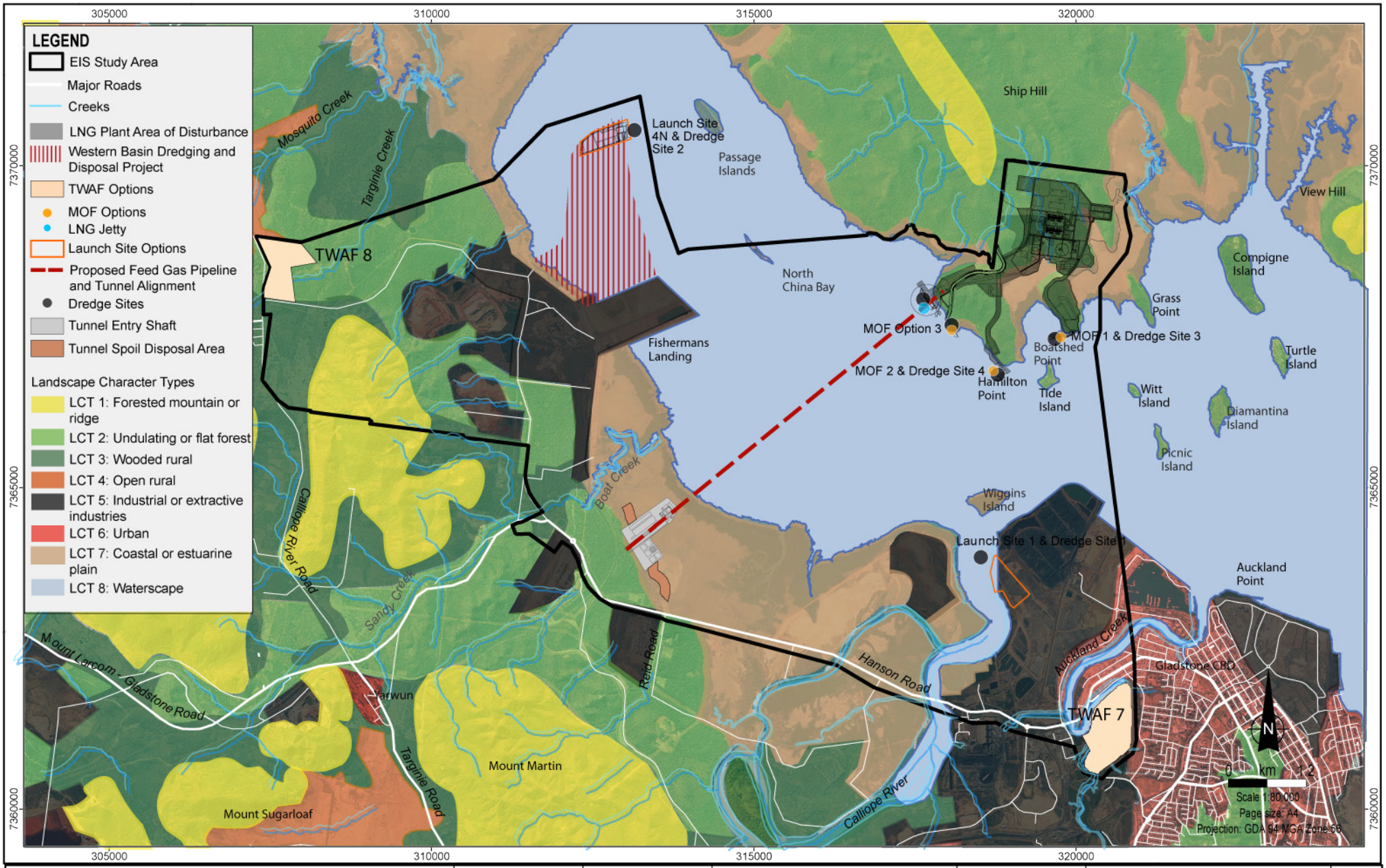
Landscape receptor		Sensitivity to Change
	Calliope River, Auckland Creek, Targinie Creek and Creek on Curtis Island	
	Coastal Mountain Ranges: Curtis Island Strike Ridge and Mount Larcom Range	**Medium**: Rationale as for Islands and Offshore Features
Vegetation Management Act 1999 State Forestry Policy	*Targinie State Forest*	**Low**: A landscape valued at the state level, but not primarily for its landscape values, although may be used by recreational users.

4.4.2 Landscape Character Baseline Assessment

Based on an understanding of the natural and cultural processes that have shaped the Gladstone landscape, the following eight Landscape Character Types (LCTs) have been identified within the study area, which are defined in **Figure 11** and described below**:**

- LCT 1: Forested mountain or ridge.
- LCT 2: Undulating or flat forest.
- LCT 3: Wooded rural.
- LCT 4: Open rural.
- LCT 5: Industrial or extractive industries.
- LCT 6: Urban.
- LCT 7: Coastal or estuarine plain.
- LCT 8: Waterscape.

The sensitivity to change of each of these Landscape Character Types are described in **Table 14** .



	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Landscape Character Types Figure No: 11

4.4.3 LCT 1: Forested Mountain or Ridge

Location

On the mainland the primary forested mountainous ridge system is the Mount Larcom Range. It includes Mount Larcom, Mount Sugarloaf and Scrubby Mountain running on a south, south east to north, north west orientation. In addition there are a number of elevated secondary ridges which have maintained their forested character. These are:

- Curtis Island Strike Ridge system (includes Ship Hill).
- Ridge between Forest Road and Boat Creek Road.
- Mount Martin and Mount Stowe Ridge

The EIS study area is located close to the edge of LCT 1 on Curtis Island where it adjoins Ship Hill (part of the strike ridge system on Curtis Island). Refer to **Figure 11** for locations. An area of LCT 1 is also located on the mainland approximately 1 km to the south-east of TWAF8.

Key characteristics

- Elevated topography – typically above 100 m AHD.
- Includes very steep slopes i.e., greater than 30% grade.
- Some incised valley features where waterways drain the elevated areas.
- Generally covered by Eucalyptus woodland or forest, but micro climates offered by varying higher topography or watercourses allows for other vegetation.
- Generally enclosed, however where vegetation does not occur e.g., peak of Mount Larcom, 360 degree views are achieved.
- Some distinctive outcrops of rock forming distinct peaks i.e., Mount Larcom.
- Highly visible landscape type within the study area providing a natural backdrop to many views.
- Inherently natural areas devoid of light at night.
- Considered to have high scenic qualities.

This LCT is very distinct and highly visible from areas within and outside the study area. The highest parts of the study area are in this LCT, reaching up to 632 m AHD. The scenic qualities of this landscape type are recognised in the Curtis Coast Regional Coastal Management Plan (CCRCMP), which describes the "*landform contrast and naturalness*" of Mount Larcom Range and Curtis Island strike ridge systems as "*providing... major contributors to scenic quality*". A CCRCMP desired coastal outcome pertinent to this assessment is that "*the landscape values of coastal ranges and their contribution to the landscape values of the surrounding areas are maintained*".

Figure 12 illustrates the typical character of LCT 1

Pressures Currently Acting on the Landscape

Lower lying areas of this LCT may radically change throughout the study area, between now and approximately 2040, with the onset of the large scale industrial development in Targinie, Aldoga and Yarwun Precincts, associated with the GSDA. If/as this takes place, it is anticipated that large areas of this LCT could change to LCT 5: Industrial or extractive industries. The area of LCT 1 falling within the study area lies in the Targinie Precinct.

Figure 12 Typical image of LCT 1

Photo: AECOM

4.4.4 LCT 2: Undulating or Flat Forest

Location

Large areas of this landscape type currently occur throughout the study area. The largest continuous tracts of this type occur on Curtis Island and in the west of the study area associated with lower lying areas between the coastal plain and the elevated landscapes of LCT 1 and LCT 3.

This is the predominant landscape type in the vicinity of the proposed LNG plant. It is also the dominant LCT in the vicinity of TWAF 8.

Key characteristics

- Lower topography – generally below 100 m AHD, with less pronounced gradients than LCT 1.
- Generally covered by Eucalyptus woodland or forest with other types of vegetation around the waterways.
- Enclosed character with views curtailed by vegetation.
- Provides a distinct visual contrast between open rural, industrial and urban landscapes.
- Inherently natural areas which are generally devoid of light at night, albeit those within the urban landscape or near industrial areas may be subject to light pollution in the form of sky glow and glare.
- Though it is not a key landscape recognised in the CCRCMP, it is considered to have locally important scenic visual qualities.

This LCT is similar to LCT 1; however it is on lower, less visually prominent topography. Areas nearer urban conglomerations and infrastructure are generally less intact due to and clearance for access tracks. Examples of this include the area around Round Hill Lookout in Gladstone.

Figure 13 illustrates the typical character of LCT 2

Pressures Currently Acting on the Landscape Large tracts of this landscape type located in the west of the EIS study area are anticipated to radically change between now and approximately 2040, with the onset of the large

scale industrial development in Targinie, Aldoga, Yarwun and Curtis Island Precincts. If / as this takes place, it is anticipated that large areas of this LCT could change from their current character type to LCT 5: Industrial or extractive industries.

Figure 13 Typical Image of LCT 2

Photo: AECOM

4.4.5 LCT 3: Wooded Rural

Location

The rural landscape has been divided into two types: wooded rural landscapes (LCT 3) and open rural landscapes (LCT 4). Boundaries between these two areas (LCT 3 and LCT 4) are transitional, gradual and liable to changes in land use and hence, the boundary line shown is illustrative.

There is little of this landscape type within the study area. It is principally found south of TWAF 8,and in the wider LVIA study area associated with the foothills of the Mount Larcom range including:

- Urban fringe locations.
- Transitional areas from forested ridgelines to flatter open rural landscape types.
- Former grazing sites that are now regenerating.

A small area of the LNG plant on Curtis Island, is considered to be this type i.e., that part of the project area that was formerly grazing land but is now regenerating.

Key characteristics

- Lower topography but including some more elevated ridgelines that have been grazed
- Generally less pronounced gradients than LCT 1.
- Generally used for lighter cattle grazing activities, though there are some areas of fruit production e.g., mangos.
- Remaining woodland is typically remnant Eucalyptus woodland or forest.
- Retains a partially enclosed character.
- Settlement comprises scattered individual farmstead properties.
- Fence lines/property boundaries can be tracts of woodland or in some cases permanent or ephemeral streams.

- May contain artificial light sources from the farmsteads, though it retains a relatively dark character. Areas near urban landscape or industrial areas may be subject to light pollution in the form of sky glow and glare.
- Though it is not a key landscape recognised in the CCRCMP, it is considered to have locally important scenic visual qualities.

This LCT functions as a transitional landscape between either LCT 1 or LCT 2 and LCT 4.

Figure 14 illustrates the typical character of LCT 3

Pressures Currently Acting on the Landscape Large tracts of this landscape type are set to radically change throughout the EIS study area between now and approximately 2040, with the onset of the large scale industrial development in Targinie, Aldoga and Yarwun Precincts. As this takes place, it is anticipated that large areas of LCT, could change to LCT 5: Industrial or extractive industries.

Figure 14 Typical image of LCT 3

Photo: AECOM

4.4.6 LCT 4: Open Rural

Location

This LCT is located in two discrete locations within the wider LVIA study area; north of the township of Targinnie and south of Yarwun. Only a very small area lies within the project study area. This is located in the north of the TWAF8 site.

Key characteristics

- Lower topography – generally below 100 m AHD, with less pronounced undulations than LCT 3.
- Gradients generally very gentle.
- Typically areas are located in flat floodplains and may contain waterway corridors.
- Generally used for heavier cattle grazing activities.
- Little remaining woodland, tending to be confined to field, road and property boundaries.
- Despite some tree cover, this landscape type retains an inherently open character.
- Settlement is scattered individual farmstead properties.
- May contain artificial light sources from the farmsteads, though it retains a relatively dark character. Areas nearer urban landscape or industrial areas may be subject to light pollution in the form of sky glow and glare.

- Though it is not a key landscape recognised in the CCRCMP, it is considered to have locally important scenic visual qualities.

Figure 15 illustrates the typical character of LCT 4

Pressures Currently Acting on the Landscape Large tracts of this landscape type may potentially radically change throughout the EIS study area between now and approximately 2040, with the onset of the heavy industrial development in Targinie, Aldoga and Yarwun Precincts. If this takes place, it is anticipated that large areas of this LCT, could change from their current character type to LCT 5: Industrial or extractive industries.

Figure 15 Typical image of LCT 4

Photo: AECOM

4.4.7 LCT 5: Industrial / Extractive

Location

For the purposes of this assessment the industrial and extractive landscape types have been reviewed together, given the similarly dominating effects these land use types have on the landscape character.

The largest areas of industrial or extractive activities within the EIS study area are located in the area between Auckland Creek and the Calliope River to the west of Gladstone central business district (CBD) and at Fishermans Landing (Clinker Wharf). In the LVIA study area this landscape type also occurs near Auckland Point and in smaller dispersed areas including around Aldoga and off the Mount Larcom/Gladstone Road. Typically, the export-related industrial activities are located in coastal locations, whilst processing-related industrial and extractive activities are located in both coastal and inland locations, either near water or good access roads e.g., Rio Tinto Alumina refinery and the Cement works off Reid Road.

TWAF 7 and launch site 1 are located in this LCT and Launch Site 4N would effectively form part of an extension to this LCT north of Fishermans Landing.

Key characteristics

- Processing and export related industrial activities are typically sited on reclaimed estuarine / coastal areas which have flat and low lying topography, whilst extractive industries currently occur in inland undulating landscapes.
- The industrial activities are generally highly visible and provide distinctive features and ‘landmarks’ in the study area. They contain large- scale industrial structures, including some elevated stacks, emitting gas waste.

- The extractive industry activities are generally screened from the majority of the study area, with the exception of very elevated viewing locations such as Mount Larcom Range.
- All extractive or industrial areas generally have minimal vegetation.
- Many of the large scale, heavy industrial activities contain a high level of artificial light sources which can produce sky glow, light trespass and glare light pollution if sited in the wrong locations near sensitive receptors or receivers.
- Non-scenic visual qualities.

This LCT is very distinct. There is marked contrast between different types of industrial and extractive industries but they all subjugate natural landscape character attributes and dominate the landscape where they are sited. A key difference, pertinent to this assessment between the extractive landscapes and industrial landscapes is that the extractive activities are generally hidden from public views, whilst in comparison the industrial activities contain elevated infrastructure which are highly visible (both in the day and at night).

Figure 16 illustrates the typical character of LCT 5

Pressures Currently Acting on the Landscape

The industrial landscape type is likely to substantially increase in extent and intensity throughout the study area, between now and approximately 2040, with the onset of the heavy industrial development associated with the GSDA. If/as this takes place, it is anticipated that larger areas of this LCT will occur across the study area.

Figure 16 Typical image of LCT 5

Photo: AECOM

4.4.8 LCT 6: Urban

Location

The largest urban centre in the LVIA study area is Gladstone. Throughout the remainder of the study area settlement is confined to isolated farmsteads located in rural landscapes (LCT 3 and LCT 4).

Key characteristics

- Typically low-rise development, though some mixed-use development is increasing density and height predominantly within Gladstone CBD.
- Complex, but with areas of higher scenic qualities e.g., local parklands.
- Generally enclosed character.

- Mixture of land uses ranging from lighter industry, residential suburbs and recreational areas.
- Gladstone CBD is set out on grid system, whilst newer predominantly residential development to the south is more informal or organic in layout.
- Native vegetation has largely been cleared, with some isolated patches of remnant vegetation confined to open space on higher ground or along waterways. Within residential areas and open spaces more formal planting has occurred.
- Gladstone CBD and some residential areas (in elevated locations or immediately adjacent to the industrial area) afford views to Mount Larcom, Curtis Island, adjacent industrial activities and the water of Port Curtis which are key to Gladstone's identity and visual character.
- Though it is not a key landscape recognised in the CCRCMP, parts of the urban area are considered to have locally important scenic visual qualities.

Figure 17 illustrates the typical character of LCT 6

Pressures Currently Acting on the Landscape This landscape type may increase throughout the EIS study area (between now and 2040) to support the industrial development associated with the GSDA. It is assumed that this would be concentrated within the three largest mainland precincts: Yarwun, Targinie and Aldoga, but principally away from high impact and heavy industries.

Figure 17 Typical image of LCT 6

Photo: AECOM

4.4.9 LCT 7: Coastal or Estuarine Plain

Location

This LCT is central to the EIS study area and provides a transition between the waterscape of Port Curtis, The Narrows, the mainland and islands. To the east of study area, this LCT has largely been modified to LCT 5 (industrial) and LCT 6 (Urban).

Currently there are two distinct areas of this LCT within the project study area:

- In the intertidal zone on the southern flank of Curtis Island, from Hamilton Point to South End.
- Covering an extensive area, stretching north of Calliope River to Fishermans Landing and northwards towards The Narrows.

Launch Site 4N and the mainland tunnel launch shaft and tunnel spoil disposal area are located within this LCT.

Key characteristics

- Flat, low lying topography.
- Natural landscape.
- Relatively uniform and uncluttered landscape.
- Tidal mudflats (open) or mangroves between 3 to 5 m high (enclosed).
- Varies in extent and can form wide or very narrow coastal edges.
- Some areas nearer existing industrial or urban development (LCT 5 and LCT 7) have been degraded by indirect activities e.g., areas south of Fishermans' Landing.
- Generally devoid of light at night, however those immediately adjacent or near to industrial areas may be subject to light pollution in the form of sky glow, light trespass and glare.

Considered to have a high scenic quality. Despite the relatively uniform character of this LCT, the contrast between the mudflats and mangrove areas at a local scale results in views enclosed by mangroves, with some wide, expansive and long distance views across mud flats.

Areas of the tidal mudflats north of Calliope River and south of Fishermans Landing and around Gladstone have been impacted by man's activities and have a derelict unkempt appearance. However the scenic qualities of this landscape type and the habitats it supports are recognised in the CCRCMP. A desired coastal outcome states "*coastal wetlands contribute significantly to scenic quality in terms of vegetation, wildlife and naturalness*".

Figure 18 illustrates the typical character of LCT 7

Pressures Currently Acting on the Landscape Some areas of this landscape may be subject to major change between now and 2040, associated with three GSDA precincts: Clinton, Yarwun and Targinie. Much of the fringing mangrove vegetation associated with this LCT lies outside of the GSDA; however significant changes will occur within Yarwun Precinct, south of Fisherman's landing in the vicinity of the mainland tunnel launch shaft. The development of Curtis Island Industry Precinct would also significantly affect the character of the remnant LCT 7 along the western side of Curtis Island associated with the approved GLNG and QCLNG projects.

Figure 18 Typical image of LCT 7

Photo: AECOM

4.4.10 LCT 8: Waterscape

Current Locations

This LCT occupies a wide band through the centre of the project study area. There are three distinct areas of this LCT within the project study area:

- Port Curtis;

- Calliope River (lower reaches).; and
- Auckland Creek (lower reaches).

The Narrows and Graham Creek, located north of the project study area are also LCT 8.

Calliope River and Auckland Creek have been identified as waterscape landscapes, as they are sufficiently large to be experienced as a distinct landscape type. In contrast, the smaller waterways and tributaries are subsumed within and viewed as elements within other landscape character types. All of the marine infrastructure associated with the project is located in or immediately adjacent to this LCT. This includes MOF options, MOF1, MOF2 and MOF3, launch site 1 and launch site 4N. The feed gas pipeline also crosses beneath Port Curtis in this LCT.

Key characteristics

- Flat and open, but visually enclosed by adjacent estuarine or coastal landscape types, Curtis Island and Mount Larcom range.
- Inherently natural.
- Relatively uniform.
- Varies in extent, from relatively narrow e.g., Calliope River to very wide expanse of water at Port Curtis.
- Some of this LCT character has been reclaimed and changed LCT 5 i.e., Clinton Coal Wharf, Clinker Wharf and Fishermans Landing.
- A number of small islands are located on the southern edge of Curtis Island. These areas contain intermittent sources of artificial light with flashing channel markers and boat movement at night, however they are generally devoid of light. Some areas near industrial sites are subject to light pollution in the form of sky glow, light trespass and glare.
- Considered to have an inherently high scenic quality, heavily adversely influenced by borrowed character from highly visible adjacent LCT's which include, LCT 5 and LCT 1.

Currently the Port Curtis, Auckland Creek and Calliope River waterscapes are heavily influenced by adjacent industrial land uses. From the southern entrance to The Narrows industrial facilities can be clearly discerned; however they do not dominate the natural landscape, due to the broad scale of the waterscape and dominance of the Mount Larcom Ranges as a scenic backdrop.

Figure 19 illustrates the typical character of LCT 8

Pressures Currently Acting on the Landscape

There are a number of direct changes anticipated to impact this landscape type associated with the GSDA. These changes may include the proposed wharf development along Curtis Island Industry Precinct, Yarwun Precinct and Clinton Precinct in line with the Port of Gladstone 50 year Plan. Given the flat and open character of the area, views from this LCT are easily afforded of adjacent land uses. The onset of industrial development associated with the GSDA could generate an indirect impact on this LCT as many activities are anticipated to be visible. Of particular significance will be the construction of the approved LNG export facilities in the Curtis Island Industry Precinct (QCLNG and GLNG).

Figure 19 Typical image of LCT 8

Photo: AECOM

4.4.11 Landscape Character Type Sensitivity Assessment

Based on the assessment presented above the sensitivity of each of these landscape types to the type of change envisaged by the project is presented in **Table 14**.

Table 14 Sensitivity Rating of Landscape Character Types

(Assessed in accordance with parameters established in Table 8)

Landscape Character Type	Sensitivity to Change
Landscape Receptor	
LCT 1: Forested Mountain Ridge	**High**: This LCT is highly valued for its landscape character and scenic qualities. Areas of LCT 1 falling within the LVIA study area, including the Mount Larcom Range and Curtis Island strike ridge, are referred to in landscape designations and policy including the CCRCMP. The key attributes of this landscape type give it an inherently low capacity to accommodate the type of development anticipated. Elevated topography increases the prominence and potential viewshed of any large scale developments proposed. Sloping landform increases the likelihood of the requirement to undertake extensive ground modification (cut and fill) which would cause noticeable modification to natural levels. Removal of valued landscape attributes, particularly mature forest trees and vegetation, is also an inevitable consequence of large scale development in this LCT. Currently there is no precedent of large scale industry being constructed within this LCT, although within the study area, nearby areas of LCT 5 are often skylined against forested ridges.
LCT 2: Undulating or Flat Forest	**Medium:** This LCT is a relatively common landscape of the study area, and is valued at the local level for landscape and scenic attributes. The low lying and forested attributes limit the potential for longer distance views which give this landscape some ability to accommodate the type of change envisaged. However, the loss of mature trees and vegetation arising from this scale of development would result in the loss of the most important defining characteristics of this LCT.
LCT 3: Wooded Rural	**Medium**: This LCT is valued at the local level. It is a relatively common landscape type in the LVIA study area, although there are few areas on Curtis Island. The type of

	development envisaged would result in the loss of characteristic elements, particularly areas of mature vegetation. However, the presence of trees provides some capacity to provide screening that can help integrate large scale development into the landscape. Overall, it is considered that this LCT has limited capacity to accommodate large scale industrial development, so has a medium sensitivity to change.
LCT 4: Open rural	**Medium**: This LCT is valued at the local level for its landscape and scenic qualities. However, it has little capacity to accommodate the type of change anticipated due to its open character and the current absence of similar developments across this LCT.
LCT 5: Industrial / Extractive Industries	**Negligible**: This LCT occurs extensively throughout the LVIA study area and is not valued for its scenic qualities. The project would be of similar character to the existing LCT 5 and, therefore, has a high capacity to accommodate change.
LCT 6: Urban	**Low**: In isolation, this LCT would be sensitive to new large, scale industrial development; however the existing urban landscape is already heavily influenced by large scale industrial activities. There are few locations within the city, where views of adjacent industrial activities cannot be obtained. This somewhat lowers this LCT's inherent sensitivity to the type of change envisaged.
LCT 7: Coastal or Estuarine Plain	**High**: These coastal salt pans and mangroves are distinctive landscapes and are also recognised for their high scenic qualities in the CCRMCP. The coastal and estuarine plains are open and flat allowing long distance views, which limit the capacity of this landscape to absorb the type of change envisaged by the project without significant change. Potential for loss of characteristic valued landscape elements such as mangroves also emphasizes the sensitivity of this landscape to change.
LCT 8: Waterscape	**Medium**: This is a regionally important landscape, which is valued for its scenic qualities. In isolation, this open LCT would be highly sensitive to new, large-scale industrial development; however the existing waterscape in the EIS study area is already heavily influenced by large scale industrial activities and few views from or of Port Curtis, do not include adjacent industrial activities. This somewhat lowers its sensitivity to change associated with this type of development.

4.5 Visual Baseline Assessment

The visual baseline is described in terms of views from selected representative viewpoints within the study area, which respond to publicly accessible locations in settlements, work places, recreational features, recognised vantage points, tourist trails and roads.

4.5.1 Sensitive Receptors

Sensitive receptors for the visual assessment are considered to be any persons who are anticipated to obtain views of any component or activity associated with the project, including, for example, the movement of construction traffic. However, it is not possible to identify and describe every person or group likely to be affected. Therefore, the desktop review and field assessment has determined the key sensitive receptors in the LVIA study area who are anticipated to obtain views of and /or be most affected by the project. The identified receptors include:

- Tourists, workers and residents being ferried from Gladstone to Heron Island, Lady Musgrave Island, uninhabited coral cays and South End. This includes those on the main shipping channel and recreational users of vessels on Port Curtis.
- Recreational users of Gladstone Marina and Spinnaker Park (4.7 km south, south east of the LNG plant).
- Recreational users of prominent lookouts such as Auckland Hill / Point, Radar Hill and Round Hill. These three locations provide wide, panoramic, bird's-eye views of Gladstone city, harbour and islands, including Curtis Island.
- Recreational users of Mount Larcom. The footpath provides a challenging trek up to the peak (approximately 4 hours), where uninterrupted 360-degree views of the Gladstone area, rural lands, the islands and Port Curtis harbour are achieved. Glimpsed views of these surrounding key features are also provided, through breaks in the vegetation all the way along the trail. On a clear day views of the sea reef islands to the east and Rockhampton to the north can be obtained. A large number of school children are known to undertake this walk, as well as tourists.

- Users of Gladstone CBD (shoppers, businesspeople etc.).
- Residents living in properties on the north side of Round Hill, particularly those whose properties are orientated in a northerly direction.
- Residents and recreational users of Port Curtis Islands; based on the presence of buildings identified by aerial photography it is considered that the following islands are inhabited: Tide island – two residences; Witt Island – one residence; Turtle Island – one residence; and Compigne Island – one residence and Quoin Island – several residences (mostly located on the eastern side of the island). It has been assumed that there are currently no residents living on Garden Island, Picnic Island, or Diamantina Island.
- Residents at South End and around Farmers Point on Facing Island.
- Motorists and travellers on major and minor roads throughout the LVIA study area and beyond, including Gladstone-Mt Larcom Road Forest Road, Calliope River Road, Targinie Road and residential streets in Gladstone.

It is noted that Auckland Point, Radar Hill, Round Hill and the Mount Larcom summit provide panoramic views which are 'known' prominent elevated locations or lookouts within the LVIA study area and are referred to in Gladstone tourist literature.

Other visual sensitive receptors considered in the assessment but who are predicted not to view the proposed project include: visitors to the Art Gallery or Museum located on Goondoon Street; visitors to Tondoon Botanic Gardens; recreational users of Barney Point Beach; visitors to Cape Capricorn Conservation Park; and visitors to Curtis Island National Park. This designated area covers the north eastern end of Curtis Island, and at its closest point is approximately 13 km north of the LNG plant. The majority of visitors are attracted to the eastern coastline, lengthy beaches, interrupted by headlands overlooking the Coral Sea. The northern and eastern part of this part of the national park are the most visited localities and are not anticipated to obtain views of the project.

4.5.2 Representative Viewpoints

Based on the fieldwork and ZTV assessment (described fully in section 5.3) the following 15 locations were selected to assist illustration of the visual impact of the project. The location of these viewpoints is illustrated on **Figure 23**.

1) View from Auckland Point.
2) View from Spinnaker Park.
3) View from Gladstone CBD: junction of Goondoon and Yarroon Streets.
4) View from Round Hill Lookout.
5) View from South End.
6) View from Port Curtis by Turtle Island.
7) View from Port Curtis by Witt Island.
8) View from Port Curtis by Tide Island.
9) View from the South End Ferry Service and the Main Shipping Channel.
10) View from Port Curtis Shipping Channel looking east.
11) View from Laird Point on Curtis Island.
12) View from Mount Larcom Summit.
13) View from Reid Road and Gladstone–Mount Larcom Road intersection.
14) View from Flinders Street
15) View from Calliope River–Targinie Road

For ease of cross-referencing and understanding the sensitivity levels associated with each of these viewpoints are presented alongside the view descriptions and viewpoint photographs in **Section 5.3.**

4.6 Lighting Baseline Assessment

In order to understand the likely impacts of lighting associated with the project on landscape and visual values it was necessary to first undertake a qualitative assessment to determine existing light sources. The following key sources of artificial light associated with industrial activities were identified during a night time field assessment in the study area. These are also illustrated on Existing Light Sources **Figure 20**:

1) Clinton Coal terminal and wharf (also known as RG Tanna Export Coal terminal): combination of large scale elevated white flood type lighting at regular spacing and lower level orange street lighting. Wharf cranes are also lit.
2) Auckland Point Wharves: low level bright white lighting associated with the silos.
3) Barney Point Wharf and coal terminal: white bright low level lighting.
4) Queensland Alumina Plant: numerous, low level, scattered orange lights – similar to Rio Tinto Aluminium Facility.
5) NRG Power Station: low level orange street light and red lighting of three cooling towers.
6) Rio Tinto Aluminium Smelter Factory: numerous, low level, scattered orange lights – similar to Queensland Aluminium Facility.
7) Clinker Wharf and Cement Australia at Fishermans Landing: numerous scattered orange lighting and wharf crane are also lit.
8) Gladstone Shipping Channel: intermittent red, blue and white flashing lights from the channel markers and anticipated light from freight movement in the water.

In addition a number of other key, however less prominent light sources on the mainland and Curtis Island were identified:

9) Gladstone CBD: Light sources principally concentrated in the CBD and orange street lighting along major road corridors. There is also incidental lighting from residential areas.
10) South End: Some incidental lighting from residential areas.
11) Very low level of residential light from some of the islands including Tide island, Witt Island, Turtle Island, Quoin Island and Compigne Island.

Currently there are no light sources on the LNG plant site on Curtis Island. However even though the rural and natural landscape site itself does not emit artificial light sources and is considered to be intrinsically dark, it is considered to be an Environmental Zone E2: Low district brightness areas in accordance with the lighting assessment methodology criteria described previously. This is because the existing industrial/export facilities located nearby are well lit and influence the baseline lighting level of the LNG plant site. In particular the highly lit Clinton Coal terminal lies only 4 km south of the LNG plant. Other light sources nearby include the Gladstone channel, less than 2 km away, which has “intermittent” channel marker lights and boat freight movement

The mainland components of the project are also affected by existing lighting. The mainland tunnel launch site is located in an area that is currently affected by lighting from the Rio Tinto Aluminium Smelter Factory as well as lighting from Fisherman’s Landing.

TWAF7 is located close to both urban and industrial areas of Gladstone and is considered to be affected by sky glow

TWAF 8 is located in a more rural landscape with little existing lighting, with the exception of lighting from homesteads in Targinnie. However, it is noted that the GSDA precinct and the Targinie Precinct immediately adjoins this site which will have significant implications for the future lighting situation in this area.

Table 15 below, presents the sensitivity rating of landscape character types and **Table 16** presents the sensitivity of viewpoints to lighting. It is noted that no separate assessment of lighting impact/sensitivity on designated landscapes has been undertaken as this can be adequately explored through the landscape type assessment.

Table 15 Light Sensitivity Rating of Landscape Character Types

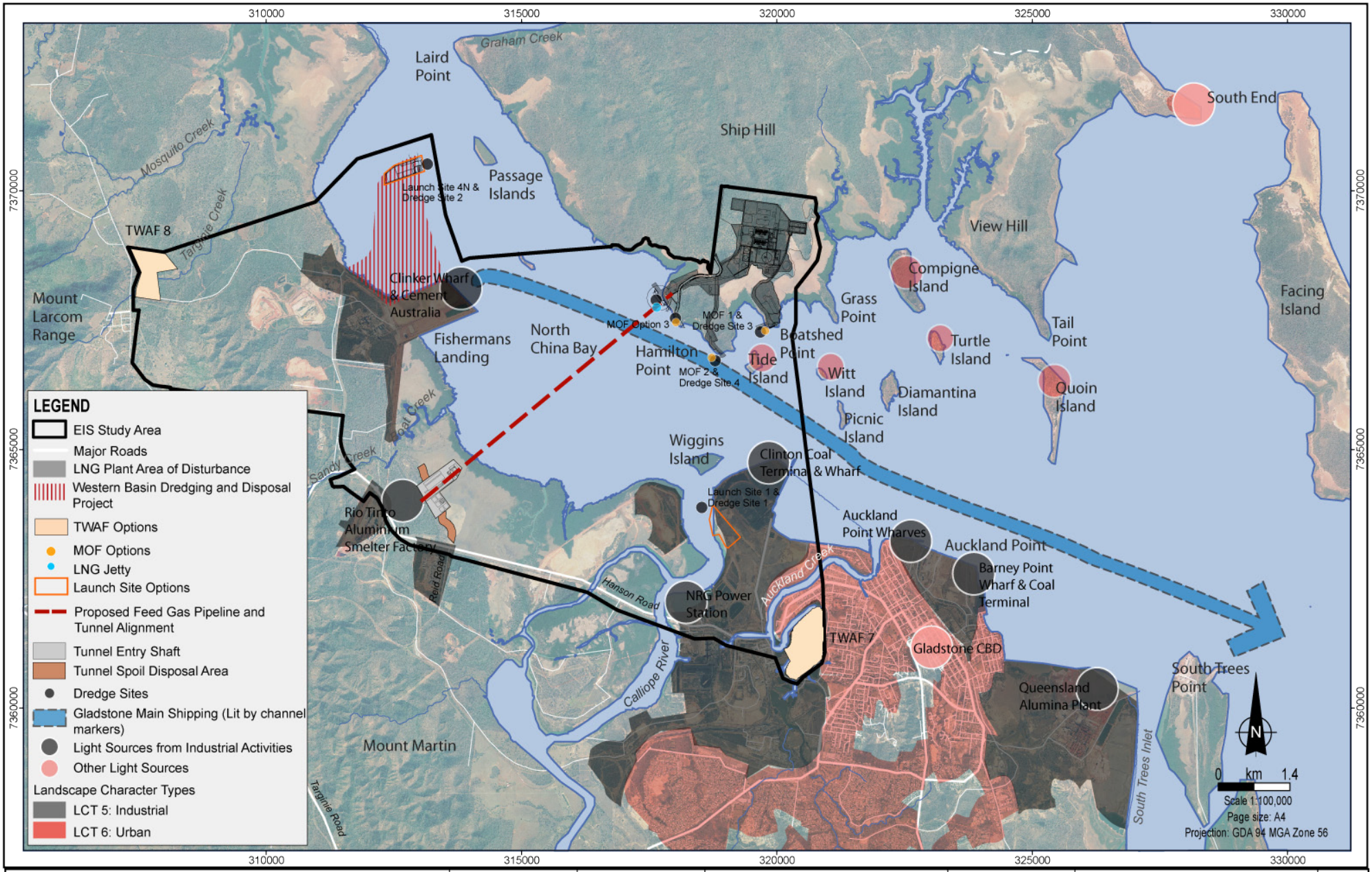
Sensitivity of Landscape Character Types	
Landscape Receptor	**Sensitivity to Light Change**
LCT 1: Forested	**Medium:** This LCT is considered to be a Zone E2: Low district brightness area. Whilst

Sensitivity of Landscape Character Types	
Landscape Receptor	**Sensitivity to Light Change**
Mountain or Ridge	the landscape is primarily an untouched, natural and relatively dark landscape, currently this LCT sustains some light pollution from adjacent areas in relatively close proximity (e.g., Clinton and Clinker Wharfs) and "intermittent" sources of lighting (e.g., shipping channels, with lit channel markers).
LCT 2: Undulating or Flat Forest	**Medium:** This LCT is considered to be a Zone E2 Low district brightness area. Whilst the landscape is primarily an untouched, natural and relatively dark landscape, currently this some light pollution is sustained from adjacent areas in relatively close proximity (e.g., Rio Tinto Aluminium Smelter, Clinton and Clinker Wharfs) and "intermittent" sources of lighting (e.g., shipping channels, with lit channel markers).
LCT 3: Wooded Rural	**Medium:** This LCT is considered to be a Zone E2 low district brightness area. Whilst the landscape is primarily an untouched, natural and relatively dark landscape, currently this some light pollution is sustained from adjacent areas in relatively close proximity (e.g., Rio Tinto Aluminium Smelter and the industrial and residential areas of Gladstone).
LCT 4: Open Rural	**Medium:** This LCT is considered to be a Zone E2 low district brightness area. Whilst the landscape is primarily an untouched, natural and relatively dark landscape, currently this some light pollution is sustained from adjacent areas in relatively close proximity (e.g., Rio Tinto Aluminium Smelter, the industrial and residential areas of Gladstone and/or intermittent lighting sources such as shipping channels.
LCT 5: Industrial / Extractive Industries	**Negligible**: These areas are considered Zone E4 high district brightness areas due to the presence of large scale industrial facilities with twenty-four hours a day lighting, including extensive floodlighting.
LCT 6: Urban	**Low**: The Gladstone CBD and residential suburbs are considered to be Zone E3 medium district brightness area due to the presence of standard street lighting and light spill from houses and commercial properties
LCT 7: Coastal / Estuarine Plain	**Medium:** These areas are considered to be Zone E2: low brightness. They are relatively dark but do sustain some light spill from intermittent sources (e.g., associated with the shipping channel) and from nearby industrial facilities (e.g., around Fishermans Landing).
LCT 8: Waterscape	**Medium:** These areas are considered to be Zone E2: low brightness. They are relatively dark and much of this area is an untouched, natural and relatively dark landscape. However it currently it sustains some light pollution from adjacent areas in relatively close proximity (i.e., Clinton and Clinker Wharfs) and "intermittent" sources of lighting i.e., shipping channels with lit channel markers (Zone E2).

Table 16 Light Sensitivity Rating of Viewpoints

Sensitivity of Viewpoints	
Visual Receptor	**Sensitivity to Light Change**
1. From Auckland Point	**Medium**: A popular lookout at an intermediate distance from the site (4.8 km approximately), that is easily accessed at night. The sensitivity to night time impacts is lower than during the day since fewer viewers would be present. Also the view already contains a substantial level of light in the foreground associated with Auckland Point Wharves and Clinton Coal terminal and wharf (Zone E4 high brightness district).
2.From Spinnaker Park	**Medium:** A popular park at an intermediate distance from the site (4.7 km approximately), that may be accessed at night. The sensitivity to night time impacts is lower than during the day since fewer viewers would be present. Some of the view already contains a substantial level of light in the foreground associated with Auckland Point Wharves and Clinton Coal terminal and wharf (Zone E4 high brightness district).
3.From Gladstone CBD	**Medium**: A transient viewing location at an intermediate to longer distance (approximately 5 km), that is accessible at night and likely to still be visited by

	numerous visitors accessing restaurants and bars. This view already contains a substantial level of light in close proximity (Zone E3 medium brightness district) and further away associated with Clinton Coal terminal (Zone E4 high brightness district.
4.From Round Hill Lookout	**Medium**: A popular lookout at some distance from the site that is easily accessed at night. The sensitivity to night time impacts is lower than during the day since fewer viewers would be present. Also the view already contains a substantial level of light in associated with the industrial and urban land uses around Gladstone (Zone E3 and E4).
5.From South End	**Medium**: This long distance view would be infrequently accessed at night. Some of the view already contains a substantial level of light in the background associated with industrial areas around Gladstone such as Auckland Point Wharves and Clinton Coal terminal and wharf (Zone E4 high brightness district).
6.From Port Curtis by Turtle Island	**Low**: At night this view is expected to have very few viewers and those viewers present are expected to be working or engaged in other recreational pursuits (e.g., fishing) so their focus is unlikely to be on landscape appreciation. This view experiences sky glow from industrial activity on the mainland but is considered a low level brightness district (Zone E2). There are very few residents on Turtle Island but they would have a slightly greater sensitivity to lighting impacts (**medium**).
7.From Port Curtis by Witt Island	**Low**: as per Turtle Island above. Again, individual residents may have a greater sensitivity level (medium).
8.From Port Curtis by Tide Island	**Low**: as per Turtle Island above. Again, individual residents may have a greater sensitivity level (medium).
9.From the South End Ferry Service and the Main Shipping Channel	**Low**: Typically this view would not accessed at night by recreational viewers, although would be by workers using the shipping channel (whose presence would be transient and interest is not likely to be focussed on landscape appreciation).
10.From Port Curtis Shipping Channel	**Low**: Typically this view would not accessed at night by recreational viewers, although would be by workers using the shipping channel (whose presence would be transient and interest is not likely to be focussed on landscape appreciation).
11.From Laird Point on Curtis Island	**Medium**: A popular camping spot at an intermediate - longer distance from the site (5.5 km approximately), that may be accessed at night. Some of the view already contains a substantial level of light in the foreground associated with Auckland Point Wharves and Clinton Coal terminal and wharf (Zone E4 high brightness district).
12.From Mount Larcom Summit	**Negligible**: A view at a long distance from the site (13 km approximately), that would extremely rarely be accessed at night by a very small number of adventurous recreational users. Whilst Mount Larcom is inherently dark/low brightness district (Zone E2) there are already considerable light sources in the environment associated with the industrial and urban areas.
13.From Reid Road and Gladstone - Mount Larcom Road intersection	**Negligible**: This view would be viewed by transient receptors using the roads, who are considered not to be sensitive to changes in light levels (at this distance). The view already contains a substantial level of light in the background associated with Clinker Wharf and Clinton Coal terminal and wharf (Zone E4 high brightness district).
14. From Flinders Street	**Medium**: This view would be experienced by residents of this part of the Gladstone urban area. The view already contains a substantial level of light associated with the residential area and the backdrop of the industrial area around Auckland Creek (Zone E4 high brightness district).
15. From Calliope River-Targinie Road	**Medium**: This view would be experienced by a relatively small number of travellers on the Targinie Road as well as residents (Smiths Road). The view is inherently dark low level brightness district (Zone E2).



	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Existing Light Sources	Figure No. 20

5.0 Issues and Potential Impacts

This chapter describes the key activities associated with the project that have the potential to impact on the landscape and visual resource. This is followed by the assessment to determine the likely effects that the project would have on the landscape and visual resource. For the purpose of the assessment, the potential effects on the landscape and visual resource are grouped into three categories:

1) Impacts and effects on landscape sensitive receptors (Section 5.2).
2) Impacts and effects on visual sensitive receptors (Section 5.3).
3) Impacts of lighting on the landscape and visual resource (Section 5.4).

This chapter includes the full visual impact assessment and a summary of the findings in relation to landscape impacts and lighting. For the full assessment details of these aspects refer to **Appendix 1**: Detailed Evaluation of Impacts and Effects on Sensitive Landscape Receptors and **Appendix 2**: Detailed Evaluation of Landscape and Visual Impacts of Light Sources,

The impacts considered are both direct and indirect impacts, on the identified landscape and visual values and significance prior to taking into account any additional mitigation measures considered in later sections. Construction, operation and decommissioning phases are all considered. Where there is any uncertainty the impacts are based on the 'worst case scenario' assuming the greatest impact in terms of landscape and visual impact . For example where different plant options are still being explored the assessment is based on the most visually dominant option. Of particular note in this regard is the selection of the process options There are multiple process options (for example an all electrical option, an all mechanical option etc.) However, the all mechanical option is used as the basis for this impact assessment and the associated visualisations as we deem it to be worst case as it has more high components which would have more and taller stack elements. However, where the options entail different locations/multiple sites (e.g., for MOF and TWAF) a separate commentary is provided on each option.

5.1 Key Aspects of the Project Affecting Landscape and Visual Values

For the purposes of understanding what facilities, activities and components of the LNG plant may be potentially visible or affect landscape values, the project description has been divided into the following parts:

1) Key project construction activities (See **Table 17**).
2) Key project operational components (See **Table 18)**
3) Key project decommissioning activities (See **Table 19**))

The project is planned to be developed in two phases, as a worst case this assessment considers the impacts of the entire project. The construction time line for LNG trains one and two and the jetty is five years, between 2014 and 2017. The timeframe for constructing LNG trains three and four is not known, and would commence according to market conditions, but anticipated to follow approximately five years from completion of the phase one.

It is noted that elements and activities excluded from the LVIA are the dredging in Port Curtis, disposal of dredge spoil material, and the common infrastructure corridor from Hamilton Point via north China Bay, as these are already addressed in other published EISs for GLNG and QCLNG.

For the purposes of this assessment, the key visible LNG plant components are illustrated on **Figure 2** and **Figure 3**.

5.1.1 Construction facilities and activities

Table 17 Key Project Components Likely to Affect Landscape and Visual Values during the Construction Phase

Construction Infrastructure	
Facility	**Description**
Pioneer Camp	This small pioneer construction camp, for up to 250 people, would be constructed prior to the main construction camp. For the purpose of this assessment it has been assumed it would be a small facility, principally composed of porta cabins. This will be incorporated into the Boatshed Point construction camp on Curtis Island.

Construction Infrastructure	
Facility	**Description**
Boatshed Point Construction Camp	A large construction camp for up to 2,500 personnel is required until the completion of Train two construction activities. The approximate land take is 20ha with a further 5ha for utilities. Facilities may include recreational facilities, utilities and distribution networks. Buildings may include, guesthouse, clinic, shops, emergency services, facility management building, security building or guard house, IT and communications centre, laundry, mess halls, and recreation areas. These buildings are anticipated to be single and two storey (up to approximately 8m high but designed to ensure they do not extend higher than the boatshed point ridgeline).
Temporary Workers Accommodation Facility (TWAF) Sites	A mainland TWAF may be required to house 'overflow' workers. Two locations are proposed – the former Gladstone Power Station ash pond No.7 (TWAF 7), and a former pastoral grazing lot in the vicinity of Targinnie (TWAF 8). The details of these facilities are not fully developed; however it is anticipated that these would be similar to the Boatshed Point Construction Camp with single or two storey high temporary buildings (up to approximately 8m high), laydown areas and workshops.
Concrete batching plant	A concrete batching plant will be required on the site
Materials Offloading Facility (MOF) and Personnel Transfer Jetty	This would be used to offload all plant, equipment, materials and construction personnel, during the construction phase. Alternative MOF sites are proposed on Curtis Island: MOF1 is located at Boatshed Point. MOF2 is located at South Hamilton Point. MOF3 is located on the western side of Hamilton Point at North China Bay and would be a shared facility with Santos. A passenger and light vehicle terminal at Boatshed Point is proposed.
Temporary construction roads and heavy haul road	A separate haul road option accompanies each MOF option.
Laydown areas	Laydown areas are proposed in numerous locations on Curtis Island, at the mainland TWAF sites and near the entrance of the feed gas pipeline on the mainland. These will be used to store equipment and materials prior to use. What could be seen in these areas will therefore vary throughout the construction programme.
Mainland Tunnel Launch Site and Spoil Disposal Area	The mudflats south of Fisherman's landing are the site of the mainland tunnel launch site and tunnel spoil disposal area. Infrastructure will include laydown and pipeline stringing areas, a small number of temporary buildings and tunnel construction equipment
Construction Activities	
Activity	**Description**
Vegetation clearance	Vegetation clearance would occur within the area of disturbance on Curtis Island (shown on **Figure 3**) which would include loss of a large area of Eucalypt forest. Clearance would also occur associated with the mainland TWAF sites (particularly TWAF 8) and the area around the mainland tunnel launch site. It is noted that disturbance is being restricted to the minimum envelope possible and that key stands of vegetation are being retained (e.g., to the south of Boatshed Point). This will result in the loss of natural green features and the temporary presence of exposed areas of land.
Clearing, grubbing and stripping	Topsoil, subsoil, rock and other unsuitable materials will be removed where necessary to create stable and level areas for infrastructure to be constructed. This will result in the temporary presence of exposed areas of land.

Construction Infrastructure	
Facility	**Description**
Creation of stockpiles	Stockpiles of materials cleared from site will be present in the laydown areas where they will be stored prior to reuse or disposal. This includes the tunnel spoil disposal area located near the tunnel entrance shaft.
Cut and fill activities	A large amount of soil and rock excavation required e.g., filling of up to approximately 16 m and excavation of up to approximately 35 m is required to reach the proposed platform levels required indicated in **Figure 3**. Blasting of rock substrate may be required.
Associated construction equipment	It is envisaged that some large scale and potentially tall construction equipment / machinery such as cranes, excavators, trucks, scrapers, graders, heavy bull dozers, generators and dump trucks, would be required for all construction activities (e.g., earthmoving). This could potentially be visible from both close and more distant locations. In particular, tall cranes will be required associated with the construction of the emergency flare stack and LNG tanks, Barges and ferries transporting materials and personnel will also be visible crossing Port Curtis. Typical image of an LNG plant under construciton  Source: Shell
Presence of construction crews	The presence of the construction crew may be visible from close distance sensitive viewing locations for activities on both Curtis Island and the mainland.
Dredging and Construction of feed gas pipeline	Dredging would be associated with the construction of all proposed marine infrastructure (MOF, jetty and launch site). The feed gas pipeline would be located underground and under Port Curtis. On land it would be constructed using principally an open trench and backfill method. This includes areas south of Boat Creek and from the tunnel receiving shaft on Hamilton Point to the LNG plant. In some areas horizontal directional drilling (HDD) may be used to minimise the impact. A tunnel boring machine would be used for the below-water section through Port Curtis. A pipeline construction right of way (ROW) of 40 m wide is anticipated for the mainland corridor. The spoil would be disposed of in the tunnel spoil disposal area located adjacent to the mainland tunnel launch shaft. Silt plumes may be visible associated with dredging and pipeline construction.
Temporary fencing and hoardings	At close range temporary hoardings and fencing may be visible, albeit at this range other construction elements are more likely to dominate the view.
Increased traffic movement	There may be a visually discernable increase of traffic on both land and water associated with the movement of personnel undertaking construction activities and construction materials. This particularly includes workers moving between the mainland TWAF and / or airport and launch site. In addition to the actual construction activity the transportation of LNG components and pipeline elements by vehicles is also anticipated to be visible.
Construction lighting	A number of construction activities are anticipated to take place during non-daylight hours. The primary light sources will be from the construction village, perimeter security lights and construction vehicles. In particular Boatshed Point construction camp is predicted to be a

Construction Infrastructure	
Facility	**Description**
	very visible component at night. Working hours during the construction phase are predicted to be: • LNG plant (The work will generally be conducted during the day, between 7am and 7pm, although there may be project requirements for night work such as when modules arrive on vessels, concrete pour, or other construction requirements. In addition, there is the potential for staggered shifts as per the ferry movements). • Construction of the gas pipeline: The working hours will generally be between 6am and 6pm. • Construction of the pipeline tunnel: It is anticipated there will be eight hour shift rotations over 24 hours. • Dredging: The work will be conducted over 24 hours with two to three shift rotations.

5.1.2 Key project operational components

Table 18 describes those facilities and activities associated with the operational phase of the project that are anticipated to generate landscape and/or visual impacts. Not all facilities are described – only those liable to effect impacts of significance. The LNG plant would comprise of large industrial scale elements that would be accommodated on an elevated, multi-level platform reaching a maximum height (emergency flare stack) of 110 m above the platform level. In terms of landscape impacts, these new, introduced features are unprecedented elements which contrast considerably with the existing natural landscape characteristics of Curtis Island. However, existing industrial facilities in the LVIA study area (such as the coal export terminal and aluminium refinery) are comparable in scale and character. Moreover, it is anticipated that the construction of the 'baseline' GLNG and QCLNG LNG export facilities will have considerably advanced by the time that work on the Arrow LNG Plant commences, which will change the baseline landscape conditions of Curtis Island. Project Activities anticipated to occur at the operation stage include the operation of plant, movement of carriers etc. which are considered in relation to their associated infrastructure components in the table below.

Table 18 Key Project Components Likely to Affect Landscape and Visual Values during the Operational Phase

Project Infrastructure	
Facility	**Description**
LNG plant	***Four LNG Trains*** with dimensions of up to 250 m x100 m, and up to 35 m high. They also include stacks up to 45 m high (two per train). The trains and stacks will be constructed of steel and located in the middle to the northern part of the site. Typical image of an LNG train  Photo: Shell ***LNG pipe racks:*** The main pipe tracks carrying rundown lines are located south and west of the LNG trains. These pipes carry LNG to the storage tanks, and rundown lines to LNG carriers. They would be constructed of steel and would be up to 30 m above the proposed platform level of 18.4 m AHD.

Project Infrastructure	
Facility	**Description**
	Typical image of LNG pipe racks  Photo: Shell ***Mixed Refrigerant storage tanks:*** Ethelyne 450 m^3, propane 2100 m^3.These would be constructed of concrete and are located south of the LNG trains***.*** ***Sewerage treatment plant and substation housing transformers***
LNG Storage	***LNG storage tanks:*** Up to three concrete storage tanks, each of 120,000 to 180,000 m^3 capacity, 45 m high. These may need to be painted white (reflective) for safety reasons but this will be explored further during the design development phases. The surface around the tanks would be unpaved. LNG tanks one and two are south of the LNG trains and main pipe rack. Two tanks would be constructed during the first phase with another tank added as market conditions dictate. Typical image of an LNG Storage Tank (left of picture)  Photo: Shell
Stacks	In addition to the stacks noted above: • Stacks associated with the ***power generation*** would be 25 m high (approximately 5 stacks for 4 trains). These are associated with the mechanical 'worst case' scenario as discussed above. • Stacks for the ***process compressors*** 40 to 45 m high (8 stacks). • There is one ***emergency flare*** stack of 110 m high. This is the tallest component on the site. Stacks are anticipated to be constructed of steel.
Marine Infrastructure	***Materials offloading facility (MOF):*** this facility for materials and equipment transport would include a temporary laydown, a heavy haul road and associated quarantine area. One ***LNG berth containing a jetty and mooring facilities***, for loading the LNG onto LNG carriers for export would be constructed. It would be designed to accommodate full containment membrane LNG carriers up to 217,000m^3 size. The approximate freeboard is 15 m with stacks up to 45 m tall. Anticipated traffic movements are three to five LNG carriers per week. Typical image of a full contaminment membrane LNG carrier

Project Infrastructure	
Facility	**Description**
	 Photo: Shell The ***berth*** would contain mooring dolphins and catwalks with a handrail. The loading platform would be made up of a 200 m long causeway and trestle and would have four loading arms. The ***Jetty approach*** links the loading platform at the LNG berth to the shore. It would be an open piled trestle with a fence and security gate at the waterfront. ***Personnel Transfer Jetty***: this facility to ferry workers and light vehicles would include parking space, laydown, waiting area facilities and guardhouse. ***The Approach road*** to the jetty head is assumed to be constructed of concrete, around 4.0 m wide, constructed of concrete and with associated lighting. ***Shore protection*** is anticipated to be rock armour.
Buildings and Workshops	The main building complex is located in the north east corner of the site. It contains a number of buildings including the central control room, fire fighting administration building, storage, laboratory and workshop. ***Non-plant buildings*****:** The majority of these buildings will be single storey except the administration buildings which will be two storeys. ***Plant Buildings***: All buildings would typically be up to one storey (3 to 4 m high).
Other visible LNG plant elements	***Retaining structures or slope reinforcement/protection measures*** are envisaged to support a cutting up to 29 m high. It has been assumed that this would be constructed from shotcrete (as a worst case scenario). ***Permanent Perimeter Fencing*****.** This would be a security fence up to 3 m high. The ***permanent roads*** include the main roads on the LNG plant area a patrol road on the inside of the fence and haul roads from the permanent marine infrastructure to the LNG plant.
Feed gas pipeline elements	***Pipeline Operational Right of Way*** The pipeline construction right of way on the mainland is anticipated to be 40 m wide. The visual character of the ROW shall be as per the remediation and revegetation determined in the Environmental Management Plan of the project. For the purpose of this assessment it is assumed it would be rehabilitated to fit with the existing landscape and ecological context where feasible. The presence of the pipeline on land would be marked by safety markers. **Typical image pipeline safety markers**

Project Infrastructure	
Facility	**Description**
	 Arrow Energy
Lighting	The operational, security and maintenance works will typically have eight hour shift rotations over 24 hours. The key light sources anticipated to generate visual impacts (based on lighting concepts) are: ***Operational Lighting:*** It is anticipated that the proposed LNG plant will operate twenty four hours a day (24/7) and therefore the perimeter security fence, LNG trains and all other industrial facilities will require night lighting that is bright enough to conduct work. The marine infrastructure will be lit in line with standard harbour facility requirements. The rest of the site i.e., internal access paths and roads, will be lit at street lighting level. For the purpose of the assessment the proposed lighting of the LNG plant is anticipated to be emitted from the following sources: ***Fixed /Permanent Lights:*** This lighting is to be installed as permanent infrastructure. The primary types of lighting within this category are: • **Security lighting**: Elevated, directional, flood lighting of external security fences and street lighting of jetty approach, internal roads, haul road and perimeter roads. • **Operational lighting** : Lighting of areas to facilitate operations at night, for example, in access areas and in areas where work activities are regularly undertaken e.g., access to the main administration building and around the LNG trains. • **Maritime and aviation safety lighting**: Lighting of the tallest elements of the LNG plant (such as the flare stack) may be required for aviation safety. This would potentially comprise small red lights, on the top of the structure, such as those on the NRG power station stacks. The marine infrastructure may require navigation lighting for maritime safety. ***Vehicle Mounted Lights:*** • **On land vehicles** operating within the LNG plant during non daylight hours will have headlights and occasionally hazard lights for occupational health and safety requirements. • **LNG carriers** may be lit if operating at night. The impact at night will be a very occasional, incremental impact as there are only 4 to 5 carriers movements anticipated per week, of which a number will be conducted during day light hours. ***Emergency Flare:*** One operational elevated flare stack of 110 m high is included as part of the LNG plant, to vent excess gas. A low level 'pilot' flare will be continuously present, however, should the elevated flare operate at night it will potentially generate a highly visible flame up to 20 m high (on top of the 110 m high stack). This will be a bright, flickering flame. A ZTV has been produced (illustrated in **Figure 22)**, of the stack only, and clearly illustrates the potential visual prominence

Project Infrastructure	
Facility	**Description**
	of the stack alone. **Typical image LNG lighting – An LNG Plant in Russia**  Photo: Arrow Energy Pty Ltd

Table 19 Key Project Components Likely to Affect Landscape and Visual Values during the Decommissioning Phase

Decommissioning Infrastructure	
Facility	**Description**
Laydown areas	It is assumed that laydown areas would be present for storage of facilities that have been dismantled prior to removal from site.
Construction equipment	It is envisaged that some large scale and potentially tall construction equipment / machinery such as cranes, excavators, trucks, scrapers, graders, heavy bull dozers, generators and dump trucks, would be required for all decommissioning activities. This could potentially be visible from both close and more distant locations. In particular, tall cranes will be required associated with the deconstruction of the emergency flare stack and LNG tanks,
Decommissioning Activities	
Activity	**Description**
Vegetation planting:	Planting of vegetation (tubestock, hydromulching etc.) may occur within areas from which infrastructure has been removed.
Creation of stockpiles	Stockpiles of materials cleared from site will be present in the laydown areas where they will be stored prior to reuse or disposal. This includes the tunnel spoil disposal area located near the mainland tunnel launch shaft.
Cut and fill activities	Some cut and fill activities may occur to bring the site back to natural levels. However, it is anticipated that this will depend on the amount of vegetation that has naturally established at the time of decommissioning; it may be inappropriate to remove mature vegetation to re-establish former levels.
Presence of construction crews	The presence of the crew undertaking decommissioning and rehabilitation activities may be visible from close distance sensitive viewing locations for activities on both Curtis Island and the mainland.
Increased traffic movement	There may be a temporary increase in traffic on both land and water associated with the removal of equipment from Curtis Island. After this time traffic will reduce to pre-project levels.

5.2 Impacts and effects on sensitive landscape receptors

The assessment of impacts and subsequent effects on sensitive receptors is divided into the two following sensitive landscape receptors groups:

- Designated areas (**Table 20**)
- Landscape character (LCTs) (**Table** 21).

5.2.1 Summary of landscape impact assessment

This is a summary of the landscape impact assessment of the LNG project. For full details refer to Appendix 1: Detailed Evaluation of Impacts and Effects on Sensitive Landscape Receptors.
Table 20 summarises impacts on designated landscapes and **Table 21** summarises impacts on landscape character. The magnitude assessment assumes a worst case scenario and the assessments are based upon the area of designated landscape or LCT which would be impacted to the greatest extent by the project (e.g., in considering impacts on LCT 1 Forested Mountain or Ridge, the greatest impact is anticipated to be experienced by the area of this LCT located on Curtis Island adjacent to the site and the assessment is made on this basis). The project assessment considers the current situation in each of the LCTs with the study area. The baseline assessment considers an assumed scenario, including the QCLNG and GLNG facilities. As these LNG plants are approved and are under construction the assessment against the 'baseline' is considered to be more relevant than the 'project' assessment that assumes that the Arrow LNG Plant would be introduced to an 'undeveloped' island environment. Impacts of moderate significance and above have been highlighted in these summary tables.

Table 20 Summary table of significance of impacts on designated landscapes

Landscape receptor	Sensitivity	Phase	Landscape Magnitude of Change		Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts on Designated Areas						
Great Barrier Reef World Heritage Area (GBRWHA)	High	*Construction*	**Medium**	**Low**	**Moderate**	**Minor-Moderate**
		Operation	**Medium**	**Low**	**Moderate**	**Minor-Moderate**
		Decommissioning	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
Great Barrier Reef World Marine Park (GBR Marine Park)	High	*Construction*	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
		Operation	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
		Decommissioning	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
Australian Heritage Commission Register of the National Estate:						
The Narrows	High	*Construction*	**Medium**	**Low**	**Moderate**	**Minor-Moderate**
		Operation	**Medium**	**Low**	**Moderate**	**Minor-Moderate**
		Decommissioning	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
Garden Island	Medium	*Construction*	**High**	**High**	**Moderate-Major**	**Moderate-Major**
		Operation	**Medium**	**Medium**	**Minor-Moderate**	**Minor-Moderate**

Landscape receptor	Sensitivity	Phase	Landscape Magnitude of Change		Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts on Designated Areas						
		Decommissioning	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
Mount Larcom Range	Medium	*Construction*	**No impact**	**No impact**	**No impact**	**No impact**
		Operation	**No impact**	**No impact**	**No impact**	**No impact**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
Curtis Coast Regional Coastal Management Plan (2003):						
Islands and Offshore Features: Curtis Island	Medium	*Construction*	**High**	**Medium**	**Moderate**	**Minor-Moderate**
		Operation	**High**	**Medium**	**Moderate**	**Minor-Moderate**
		Decommissioning	**Medium**	**Medium**	**Minor-Moderate**	**Minor-Moderate**
Coastal Wetlands: Curtis Island and The Narrows	Medium	*Construction*	**Medium**	**Medium**	**Minor-Moderate**	**Minor to Moderate**
		Operation	**High**	**High**	**Moderate**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**
Estuaries and Inlets: Narrows Estuary	Medium	*Construction*	**Medium**	**Low**	**Minor-Moderate**	**Minor**
		Operation	**Medium**	**Low**	**Minor-Moderate**	**Minor**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**
Riverine Creeks and Corridors: Calliope River, Auckland Creek, Targinie Creek and Creek on Curtis Island	Medium	*Construction*	**Low**	**Low**	**Minor**	**Minor**
		Operation	**Low**	**Low**	**Minor**	**Minor**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
Coastal Mountain Ranges: Curtis Island Strike Ridge	Medium	*Construction*	**High**	**Medium**	**Moderate**	**Minor-Moderate**
		Operation	**High**	**Medium**	**Moderate**.	**Minor-Moderate**
		Decommissioning	**Low**	**Low**	**Minor**.	**Minor**
Coastal Mountain Ranges: Mount Larcom Range	Medium	*Construction*	**High**	**Medium**	**Negligible**	**Negligible**
		Operation	**High**	**Medium**	**Negligible**	**Negligible**
		Decommissioning	**Low**	**Low**	**Negligible**	**Negligible**
Vegetation Management Act 1999 State Forestry Policy						
Targinie State Forest	Medium	*Construction*	**Low**	**Low**	**Minor**	**Minor**
		Operation	**No Impact**	**No impact**	**No Impact**	**No Impact**

Landscape receptor	Sensitivity	Phase	Landscape Magnitude of Change		Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts on Designated Areas						
		Decommissioning	**No Impact**	**No Impact**	**No Impact**	**No Impact**

Table 21 Summary table of significance of impacts on Landscape Character (LCTs)

Landscape receptor	Sensitivity		Landscape Magnitude of Change		Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts on Landscape Character						
LCT 1: Forested Mountain Ridge	High	*Construction*	**High**	**Medium**	**Moderate-Major**	**Moderate**
		Operation	**High**	**Medium**	**Moderate-Major**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
LCT 2: Undulating or Flat Forest	Medium	*Construction*	**Very High**	**High**	**Moderate-Major**	**Moderate**
		Operation	**Very High**	**High**	**Moderate-Major**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**
LCT 3: Wooded Rural	Medium	*Construction*	**Medium**	**Medium**	**Minor-Moderate**	**Minor-Moderate**
		Operation	**Medium**	**Medium**	**Minor-Moderate**	**Minor-Moderate**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**
LCT 4: Open Rural	Medium	*Construction*	**Low**	**Low**	**Minor**	**Minor**
		Operation	**No impact**	**No impact**	**No impact**	**No impact**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 5: Industrial / Extractive Industries	Negligible	*Construction*	**Low**	**Low**	**Negligible**	**Negligible**
		Operation	**Low**	**Low**	**Negligible**	**Negligible**
		Decommissioning	**Low**	**Low**	**Negligible**	**Negligible**
LCT 6: Urban	Low	*Construction*	**Low**	**Low**	**Negligible**	**Negligible**
		Operation	**Low**	**Low**	**Negligible**	**Negligible**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 7: Coastal or Estuarine Plain	High	*Construction*	**High**	**High**	**Moderate-Major**	**Moderate-Major**
		Operation	**High**	**High**	**Moderate-Major**	**Moderate-Major**

Landscape receptor	Sensitivity		Landscape Magnitude of Change		Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts on Landscape Character						
		Decommissioning	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
LCT 8: Waterscape	Medium	*Construction*	**High**	**Medium**	**Moderate**	**Minor-Moderate**
		Operation	**Medium**	**Medium**	**Minor-Moderate**	**Minor-Moderate**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**

Construction

For most of the designated landscapes and landscape character areas assessed the levels of impact sustained during the construction and operation phases are considered to be similar.

Designated Landscapes:

The greatest impacts during construction against the baseline scenario are anticipated to be of moderate significance. This level of impact is predicted only for the Garden Island (Register of the National Estate) due to its close proximity to the construction activities. Other landscape impacts include minor to moderate impacts predicted for the GBRWHA, the Australian Heritage Commission Register of the National Estate listed landscape of The Narrows and certain elements identified as important in the CCRCMP including Islands and Offshore Features (Curtis Island) and Coastal Mountain Ranges (Curtis Island Strike Ridge). The construction impacts identified largely relate to the significant clearance of vegetation, particularly on Curtis Island and the affect this would have on the perception of Curtis Island as a natural landscape. It is noted that against the project baseline, the significance of many of the construction impacts on designated landscapes would be marginally greater since this assumes the Arrow LNG Plant scheme would contrast with an undeveloped context, whereas in reality the construction activities would be viewed against the disturbed context associated with the approved QCLNG and GLNG plants

Landscape Character:

The greatest impacts on landscape character during the construction phase considered against the baseline are predicted on LCT 2: Undulating or Flat Forest (Major), LCT 7: Coastal or Estuarine Plain (Moderate-Major) and LCT 1: Forested Mountain Ridge (Moderate-). These character areas all sustain direct impacts resulting in the removal of vegetation or introduction of significant construction activities/plant either within or in close proximity to them.

Operation

Designated Landscapes:

The most significant designated area affected by the proposals is the GBRWHA which includes the EIS study area. Whilst this has a high sensitivity due to its international significance, the magnitude of change is considered low during operation against the baseline as there is already a high level of industrial development in the Gladstone area generally including the approved LNG plants located close to the area around the Arrow LNG Plant. Accordingly the significance of the impact on the GBRWHA is considered minor-moderate. It is considered that the QCLNG and GLNG plants will have already caused the greatest change i.e., incursion of the industrial elements into the currently largely natural landscape of Curtis Island. Furthermore, it is noted that the Curtis Island Industry Precinct which lies within the GSDA has been designated at the state level. This implies acceptance of some industrial incursion onto the landscape of the GBRWHA within the vicinity of Curtis Island. The significance of the landscape impact is marginally higher (moderate) under the project scenario i.e. were the approved LNG plants not to proceed. The study area is located outside the Great Barrier Reef Marine Park so its landscape values are only impacted to a minor-moderate level of significance.

The designated landscape that experiences the greatest significance of effect during operation is the Coastal Wetland landscapes identified in the Curtis Coast Regional Coastal Management Plan that would experience a moderate impact. The other designated landscapes would experience, at greatest, a minor-moderate impact. This includes The Narrows (Australian Heritage Commission Register of the National Estate) which would be affected by APLNG primarily and then to a lesser degree the other proponents, then by the Arrow Energy facility. From the southern part of this area significant infrastructure associated with the LNG plant and marine facilities would be visible. Other affected landscape features affected to a minor-moderate extent include features noted in the CCRCMP including Curtis Island, noted as an island and offshore feature and Curtis Island Strike Ridge noted as a Coastal Mountain Range.

Landscape Character:

The greatest impacts on landscape character considered against the baseline would be the impact of anticipated moderate-major significance on LCT 7: Coastal or Estuarine Plain that is predominantly affected by the mainland tunnel launch site and tunnel spoil disposal area and marine infrastructure. The area of LCT 1: identified as the Curtis Island Strike Ridge is affected by indirect impacts from the industrialisation of its landscape setting. In the case of Curtis Island (island / offshore features), there is currently no precedent for industrial development on Curtis Island and the change from either a wooded rural or forested landscape to the industrial landscape of the LNG plant would (even in isolation and when not considering the cumulative impact of the other LNG development on Curtis Island) fundamentally change the character of the southern part of the island. However, the relative impact of the Arrow LNG Plant would lessen when viewed against the changes brought about by the QCLNG and GLNG plants. The area of LCT 2: Undulating or flat forest located on Curtis Island is predicted to sustain direct impacts and the introduced infrastructure would contrast greatly with the inherent landscape character (moderate to major significance), although less against the baseline scenario (moderate significance). The change would be dominant, leaving little of the former landscape characteristics evident in this area. Within the area of LCT 2 affected, the forest is anticipated to be entirely cleared and the undulating and organic landform would be re-graded to regular angular forms. This specific area of this LCT associated with the LNG plant on Curtis Island would be changed to an industrial landscape (LCT 5).

All other impacts on landscape amenity of Landscape Character Types are anticipated to be of below moderate significance. Those landscape receptors located at a greater distance from the site e.g., Mount Larcom Range, are predicted to sustain a lower magnitude of change and subsequent significance rating since there would be no direct impacts on landscape character and their setting is already affected by existing industrial activities in the study area, which already industrialise the inherent character of these landscape types and features.

Decommissioning

Designated Landscapes:

At decommissioning the identified impacts on the value of designated landscapes would decline. At this stage the remaining impacts on designated landscapes would be, at greatest, of minor-moderate significance with many designated landscapes recording ‘no impact’.

Landscape Character:

At decommissioning the identified impacts on landscape character values would decline, in many cases significantly, as the affected area is returned largely to its former character. At this stage the remaining impacts on landscape character would be, at greatest, of minor-moderate significance with many landscape character types recording ‘no impact’.

Comparison against Project:

The baseline conditions associated with the approved LNG Projects lowers the magnitude of change associated with the Arrow LNG Plant from the impact that would be anticipated were this approved development not to proceed. As described above for most landscape receptors, this results in a lower level of significance for the Arrow LNG Plant when viewed against this relative landscape baseline. For example, the relative impact on the designated landscape of The Narrows varies according to the distance between the passage landscape and the proposed facility. The APLNG project is located closest and, therefore, has the greatest level of impact, with the Arrow LNG Plant located furthest from the Narrows (approximately 7 km) and having a relatively lower level of impact.

5.3 Impacts and effects on visual sensitive receptors

5.3.1 Zone of Theoretical Visibility (ZTV) Analysis

Two ZVT analyses were undertaken to form a preliminary representation of the likely visual envelope of different components of the project.

Figure 21 and **Figure 22** illustrate how the existing topography of limits the visual influence of the LNG plant. For both the 110 m high flare and the lower facilities (of which the 45 m high LNG storage tanks are predicted to be the most prominent) the computer model illustrates that the existing topography has a significant role in curtailing views. To the west and south, Mount Larcom and the Mount Martin Range represent the viewshed limit. To the north the Curtis Island Strike Ridge system curtails any potential views from the eastern side of Curtis Island. Notably, due to the significantly elevated topography in these locations there is little difference in the ZTVs generated for the highest (110m high flare) and lower LNG plant components.

It is noted that the ZTV study suggests the visual influence extends over a greater area of the southern parts of Gladstone and to South End. However, as predicted, field investigations identified that many of these publicly accessible locations identified as theoretically “visible” in the ZTV study, were in reality “not visible” due to the intervening land cover (vegetation and built form).

5.3.2 Visual Impact Assessment

Based on the ZTV analyses and subsequent field work in March 2010 and April 2011, a total of 15 representative viewpoints have been selected which illustrate potential views of the project from key sensitive viewer receptor groups. 13 are representative viewpoints of the LNG plant components and one representative viewpoint has been selected for each of the proposed TWAF sites. These are illustrated on **Figure 23**.

The selected views represent the “worst case scenario” from publicly accessible locations where the clearest views from the most sensitive viewer groups, at close, middle and long distances (maximum of which is approximately 13 km from the project area on Mount Larcom summit) of the LNG plant are anticipated. Whilst the viewpoints described are selected from publicly accessible locations, private views have also been considered in the assessment. The viewers are concentrated around Port Curtis, the elevated viewing or foreshore area of Gladstone or Mount Larcom Range. The closest sensitive viewers are to the south and west of Curtis Island and may include residents living on the cluster of southern islands (Tide, Witt etc) and water based recreational users (e.g., fishermen).

A range of impacts with visual significance ranging from minor to major were identified. The viewpoints with significance graded as being moderate to major or major are those which should be given greatest weight, relative to other levels of landscape and visual impact.

The locations identified in **Section 4.5.2** have been selected to illustrate the visual impact of the LNG plant and TWAF Sites. Night-time photographs are also included of viewpoints 1 and 2 to assist understanding the potential impacts of lighting. Artist’s impressions (visualisations) have also been produced for those viewpoints noted below.

Viewpoint 1: View from Auckland Point (1C)

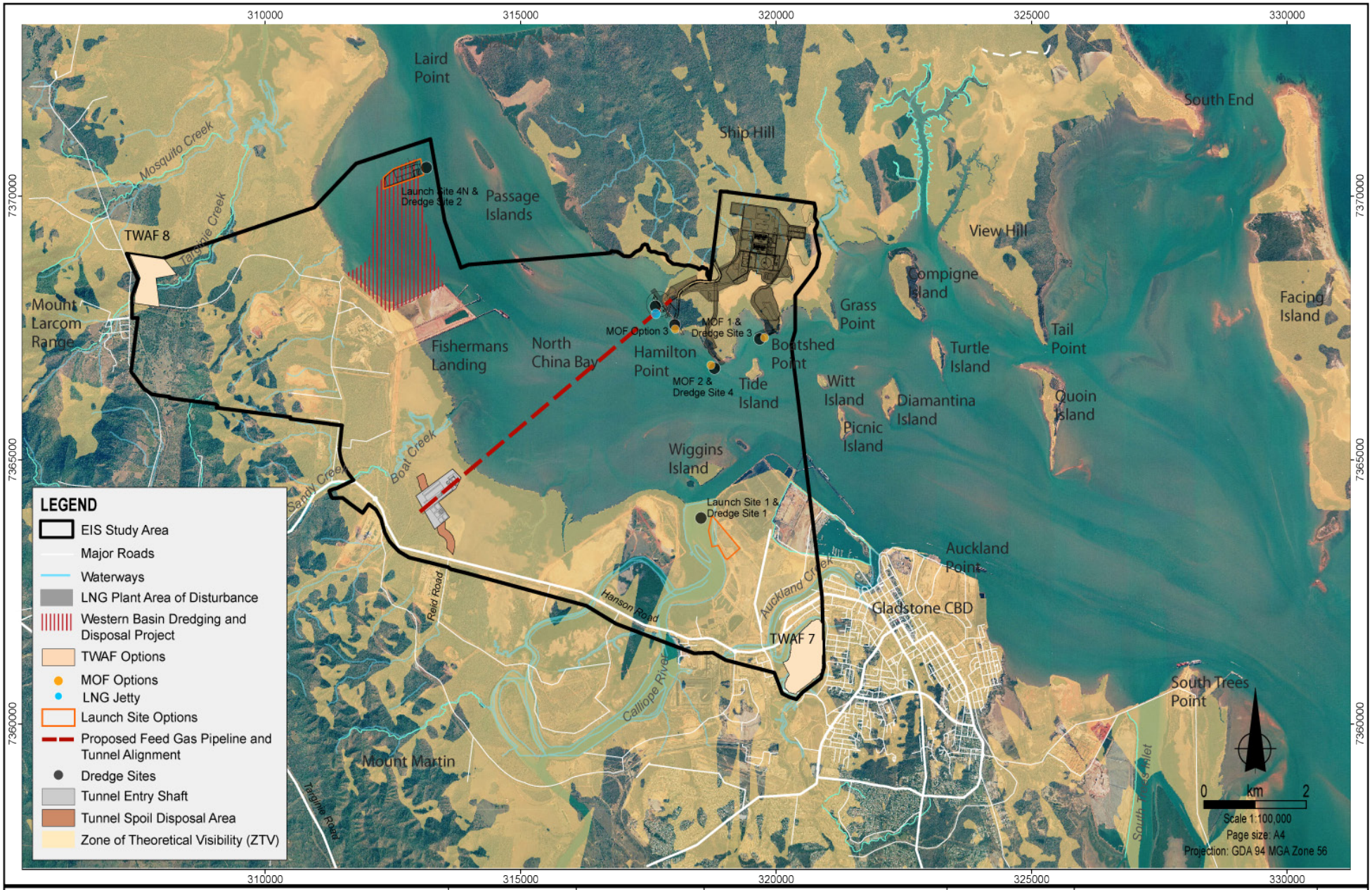
Viewpoint 4: View from Round Hill Lookout (4B)

Viewpoint 5: View from South End (5B and 5C)

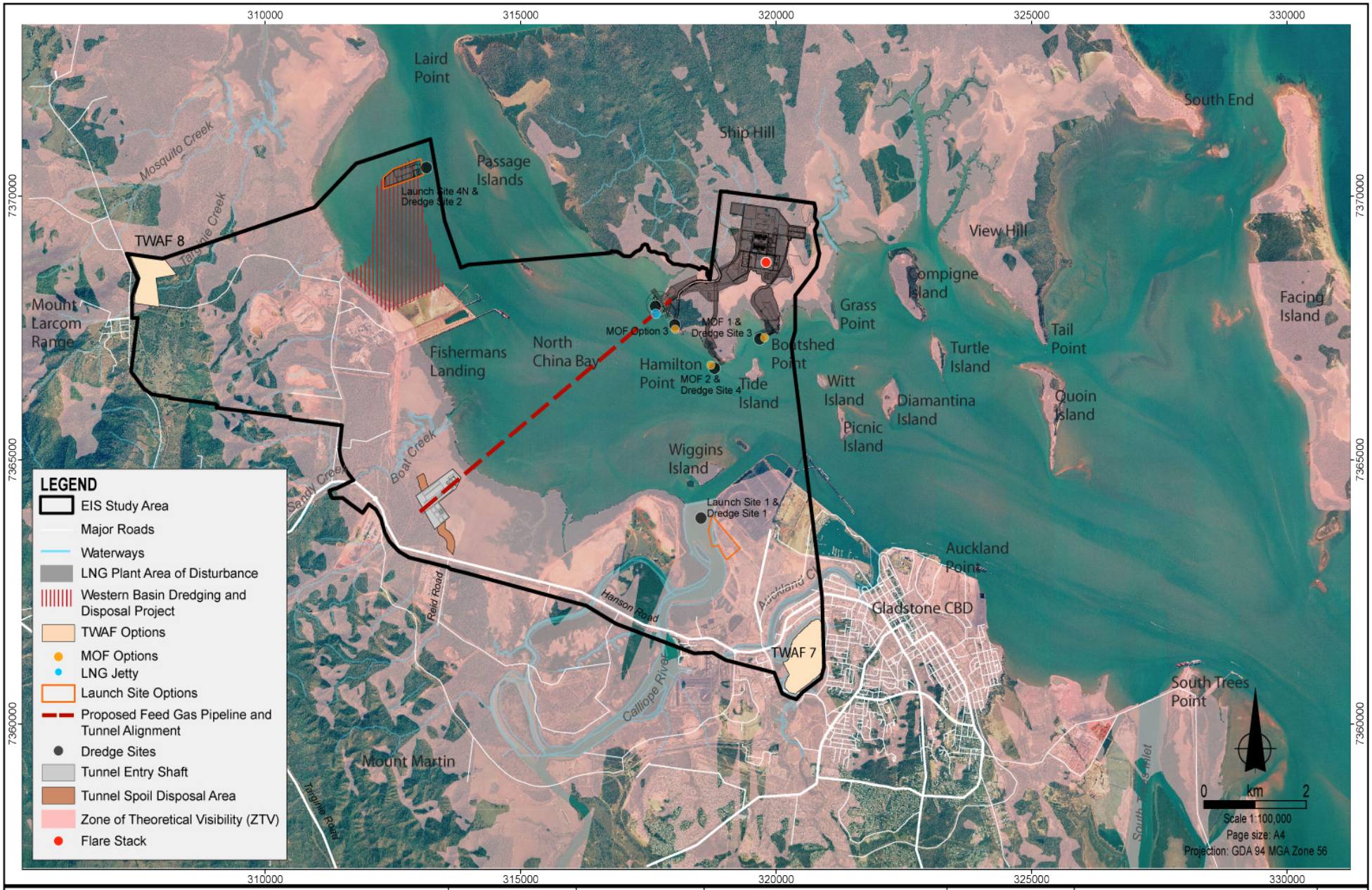
Viewpoint 7: View from Port Curtis by Witt Island (7B)

Viewpoint 8: View from Port Curtis by Tide Island (8B)

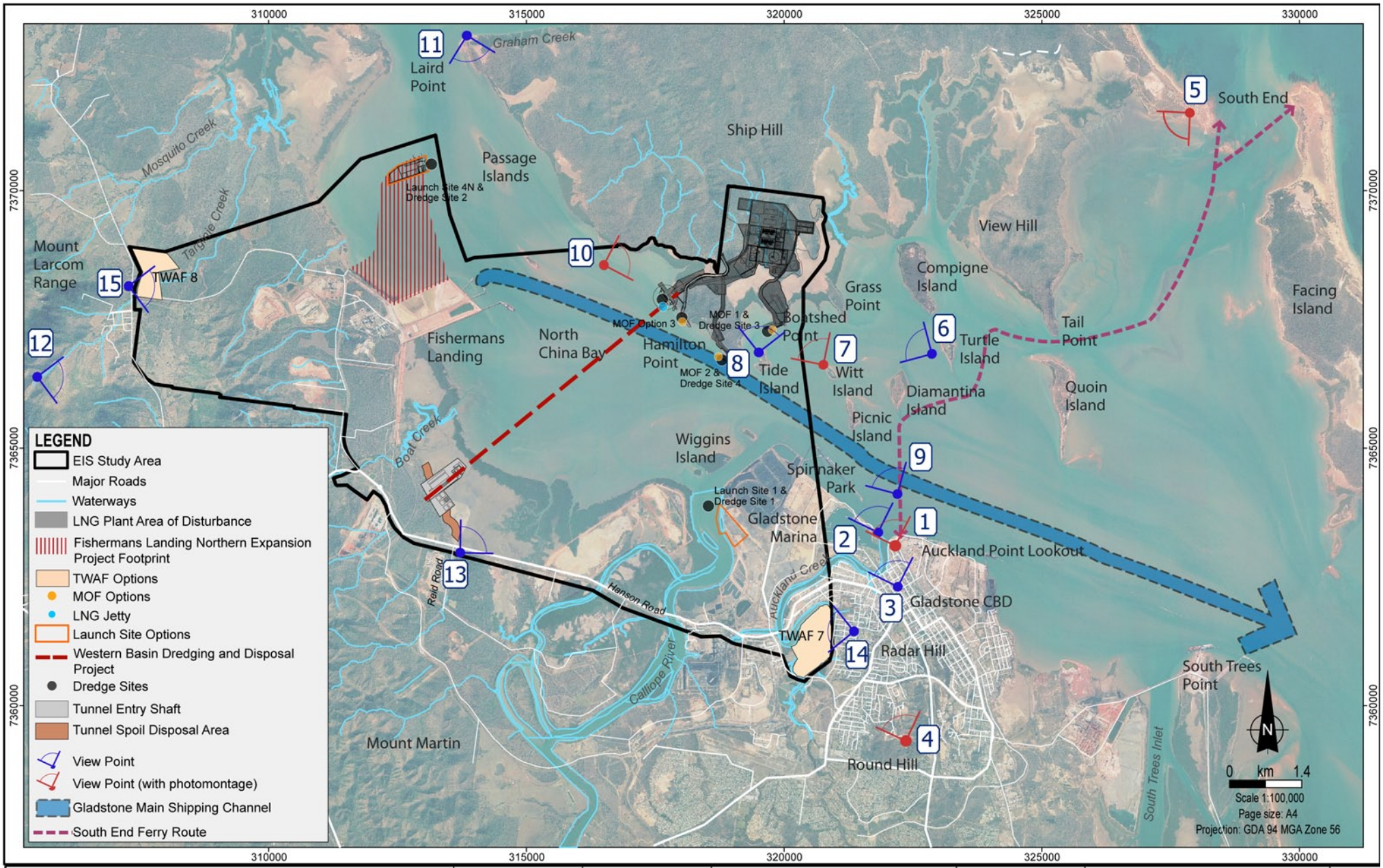
Viewpoint 10: View from the Port Curtis Shipping Channel (10B)



	AECOM		Arrow Energy	arrow energy	ZTV of LNG Plant (without emergency flare stack)	Figure No: 21
			Arrow LNG Plant			



	AECOM		Arrow Energy	arrow energy	ZTV of LNG Plant (with emergency flare stack)	Figure No: 22
			Arrow LNG Plant			



AECOM

Arrow Energy

Arrow LNG Plant

arrow energy

Representative Viewpoints Location Plan

Figure No: **23**

5.3.3 Detailed Evaluation of Impacts and Effects on Sensitive Visual Receptors

This section provides a detailed evaluation of the significance of impacts of the proposal on sensitive visual receptors, including viewpoints 1-15. Images of the existing visual situation for each viewpoint and the associated visualisation of the proposals are presented in **Figure 24** to **Figure 32** at the end of this section. The viewpoint assessment tables initially present the worst case 'project' scenario i.e., assuming that the approved QCLNG and GLNG developments were not to proceed and the landscape remained as it is at the time of the assessment. However, each viewpoint assessment concludes with the assessment of significance against the baseline scenario which anticipates the - most likely - scenario that these other LNG projects *will* proceed and, therefore, *will* change the landscape context against which the Arrow LNG Plant will be viewed.

Table 22 Detailed Evaluation of Impacts on Selected Viewpoints

Viewpoint 1: Viewpoint assessment for the view from Auckland Point	
Coordinates: 151°15'13.968"E 23°50'0.816"S ***Closest distance to the LNG plant:*** 4.8 km approximately ***Viewing direction:*** west, north and east	This viewpoint is located just north of Gladstone CBD at Auckland Hill lookout. It is one of two well-known lookouts within Gladstone and provides an impressive, panoramic view principally looking west, north and east, of over 180 degrees. Given its proximity to Gladstone CBD and the presence of a cafe, it is anticipated to be one of the most popular recreation destinations in Gladstone and, thus, to have a large number of viewers. The lookout is one of the key places of interest in Gladstone for tourists and locals referred to in Gladstone tourist literature. The view is orientated over Gladstone and Port Curtis and towards the southern end of Curtis Island. Even though it is located within the Urban LCT (LCT 6), its elevated situation allows views over a number of different types of landscape characters: LCT 1: Forested Mountain Ridge, LCT 5: Industrial or Extractive and LCT 8: Waterscape.
Existing view from Auckland Point (1A)	Refer to **Figure 24**.
Existing night-time view from Auckland Point (1B)	Refer to **Figure 24**.
Artist's impression (visualisation) (1C)	Refer to **Figure 24**.
Overall visual sensitivity	**High:** This is considered to be a view of high visual sensitivity as it is a highly used recreational lookout, which attracts large numbers of viewers with a potentially prolonged viewing opportunity and whose proprietary interest is in obtaining a view over Gladstone, Port Curtis and Curtis Island. The viewpoint is a regionally important location where user's interest is specifically focussed on the landscape. This is one of the most sensitive viewpoints within the study area.
Judgement of visual magnitude of change	From this elevated, middle to long distance, vantage point the LNG plant is anticipated to be partially visible. Though the project is visible, at this distance the small scale activities and elements (e.g., substations, site vehicles and workers) are not anticipated to be visible.
Construction phase:	**High:** Parts of the construction camp at Boatshed Point would be visible. Some of the larger construction activities are also anticipated to be visible. This would include vegetation clearance, topsoil clearance, cut and fill activities and large and/or tall construction equipment - particularly cranes which would appear skylined above Ship Hill. The initial construction and smaller scale activities are predicted to be difficult to discern at this distance. Dredging activities associated with the construction of the marine facilities would be also visible from this vantage point.

Operation phase:	**High:** Key components of the main complex anticipated to be viewed from this location would be the larger facility elements such as the LNG trains with associated stacks, the elevated pipe racks, the emergency flare stack, the main buildings complex and the LNG storage tanks. Boatshed Point passenger jetty and MOF option 1 would also be visible in the view; however the Hamilton Point water side facilities (LNG jetty and MOF options 2 and 3) are anticipated to be partially screened by a combination of the intervening islands (Tide and Witt) and the RG Tanna Coal Terminal in the foreground. Some of the coastal vegetation may assist in screening lower elements of the plant; however, the bulk of the plant is predicted to be clearly prominent in this view. These new elements would be introduced in a significant part of the view, although they are viewed partially in combination with (and indeed are screened by) other industrial facilities, which lowers the anticipated magnitude of change from very high to high**.** As the feed gas pipeline would be underground no impacts would be experienced.
Decommissioning Phase:	**Low:** Following decommissioning it is anticipated that the site would be revegetated. At this distance, the terracing would be imperceptible.
Significance of Visual Impact	
Construction phase:	**Moderate to major**
Operation phase:	**Moderate to Major**
Decommissioning phase:	**Minor to Moderate**
MOFs, Launch Sites & TWAFs	***MOFs:*** The Boatshed Point MOF (MOF1) would be evident from this vantage point.MOF Options 2 and 3 are predicted to be largely screened by the coal export facility terminal and intervening landform. However, due to the distance this has no effect on the significance of the impact. ***Launch sites:*** No mainland launch site is predicted to be visible from this vantage point. ***TWAFs:*** not applicable for this view.
Comparison against baseline	Significance during both construction and operation phase reduces to **moderate.** This is because the magnitude declines to medium during construction phase due to the presence of construction traffic across Port Curtis and the possibility of seeing taller construction elements (e.g., cranes). During operation the magnitude also changes to medium as large LNG tankers associated with the other developments would already be present and there will be a greater context of industrial development. However, it is noted that the GLNG and QCLNG have predicted in their LVIAs that the LNG plants would be visible to a negligible extent from this vantage point.

Viewpoint 2: Viewpoint assessment for the view from Spinnaker Park	
Coordinates: 151°15'2.316"E 23°49'52.332"S ***Closest distance to the LNG plant:*** 4.7 km approximately ***Viewing direction:*** northeast	This viewpoint is situated at the eastern end of Spinnaker Park, which is located in Gladstone Marina Complex, Alf O'Rouke Drive. The view is taken from the part of Spinnaker Park that is likely to be most affected by the project. Views from other more northerly and western areas of the park are principally blocked by RG Tanna Coal Terminal and Clinton Wharfs, and vegetation within the parkland. The view affords an impressive, panoramic view principally looking west, north and east of over 180 degrees. Given its proximity to the marina it is anticipated to be a popular recreational destination in Gladstone and thus have a large number of viewers. The parkland is one of nine key places of interest in Gladstone for tourists and locals referred to in Gladstone tourist literature. The view is orientated virtually north (and slightly west) over Port Curtis and towards the southern end of Curtis Island where the proposal is located. Even though it is located within the LCT 6: Urban, other landscape character types: LCT 1: Forested Mountain or Ridge, LCT 5 Industrial / Extractive and LCT 8: Waterscape feature in the viewing situation. It's noted a similar viewing situation is presented at Barney Beach. However unlike Spinnaker Park, no views of any of the LNG plant are anticipated, as they would be largely blocked the wharf at Barney Point.
Existing view from Spinnaker Park (2A)	Refer to **Figure 25**

Twighlight view from Spinnaker Park (2B)	Refer to **Figure 25**
Overall visual sensitivity	This is a view of **high** visual sensitivity as it is a popular recreational area, which attracts large numbers of viewers with a potentially prolonged viewing opportunity. Even though it is anticipated most viewers proprietary interest would not be to obtain a view over Port Curtis and Curtis Island, the landscape context and viewing experience provided at the park, is a key draw for visitors. This location provides an alternative parkland experience in an otherwise predominantly industrial landscape. The viewpoint is considered to be a regionally important location and accordingly, the viewers are considered sensitive to change.
Judgement of visual magnitude of change	From this long to middle distance vantage point, it is anticipated that the majority of the LNG plant site would be obscured by RG Tanna Coal Terminal in the foreground of the view, leaving only some eastern parts of the facility visible.
Construction phase:	**Medium:** The Boatshed Point construction camp would be visible. Some of the larger construction activities on higher ground may also be noticeable through and behind the wharf cranes e.g., vegetation clearance, topsoil clearance, cut and fill activities, and large or tall construction equipment. The initial construction and smaller scale activities would be difficult to discern. Dredging activities associated with the construction of the marine facilities would be visible from this vantage point.
Operation phase:	**Medium:** Once operating, the key, taller components of the eastern part of the main complex may be noticeable, i.e., LNG train stacks, the emergency flare stack, and the LNG storage tanks. Boatshed Point marine facilities (passenger jetty and MOF) and access are predicted to be visible. Hamilton Point water side facilities (LNG jetty and MOF options) are anticipated to be screened by the RG Tanna Coal Terminal in the foreground. The visible new elements are predicted to generate a medium change in the view, however these changes would be viewed in combination with other industrial facilities (and indeed are partially screened by them), which lowers the magnitude of change to **medium.**
Decommissioning phase:	**Low:** Following decommissioning it is anticipated that the site would be revegetated. At this distance, the remnant terracing would be imperceptible.
Significance of the visual impact	
Construction phase:	**Moderate.**
Operation phase:	**Moderate.**
Decommissioning phase:	**Minor to Moderate.**
MOFs, Launch Sites & TWAFs	***MOFs:*** The Boatshed Point MOF would be barely perceptible from this location. Hamilton Point MOFs (MOF 2 and MOF 3) would be screened by coal export facility but little discernable difference. ***Launch sites;*** No mainland launch site is predicted to be visible from this vantage point. ***TWAFs:*** not applicable for this view.
Comparison against baseline	The Arrow LNG Plant would be the dominant LNG plant from this view. The GLNG and QCLNG have predicted in their LVIAs that the LNG plants would not be visible /visible to a negligible extent from this vantage point. The operational and construction magnitude of effect remains medium so the significance remains **moderate**. Note: no visualisation has been prepared from this vantage point as the majority of the plant would be screened by existing industrial infrastructure.

Viewpoint 3: Viewpoint assessment for the view from Gladstone CBD: junction of Goondoon and Yarroon Streets	
Coordinates: 151°15'15.12"E 23°50'26.844"S	This viewpoint is located at the north-western end of Gladstone CBD and represents the "worst case scenario" for views to the project in Gladstone CBD and in elevated residential areas of Gladstone. It is obtained from a footpath at the junction of Goondoon Street and Yaroon Street. Views from other more southerly and eastern areas of the CBD are principally obstructed by the CBD buildings, the

Closest distance to the LNG plant: 5.5 km approximately ***Viewing direction:*** north	Marina and Clinton Coal Wharf of the RG Tanna Coal Terminal. The view is direct with a narrow field of view and is orientated in a virtually northerly (and very slightly westerly) direction. The view of Curtis Island and Port Curtis is interrupted by intervening built development of both LCT 5: Industrial and extractive and LCT 6: Urban, in the foreground. This view is predicted to be seen by a large number of viewers.
Existing view from Viewpoint 3	Refer to **Figure 25**.
Overall visual sensitivity	**Medium:** Even though the view is not particularly scenic or in a location where the viewer's principal interest would be the view towards Port of Curtis and Curtis Island, it is anticipated to be experienced by a large number of viewers. Furthermore, this viewpoint (and many other glimpsed views around the Gladstone urban area) provides a key visual connection between the CBD and the wider locality, providing viewers with an experience of Gladstone's "sense of place".
Judgement of visual magnitude of change	The main complex of the LNG plant is anticipated to be visible, between Hamilton Point and Boatshed Point, whilst the water-based activities around Hamilton Point (i.e., the jetty and MOF 2) are anticipated to be screened by Gladstone Marina and the RG Tanna Coal Terminal in the foreground.
Construction phase:	**Medium:** The construction camp at Boatshed Point is anticipated to be noticeable. Some of the larger construction activities would also be noticeable, i.e., vegetation clearance, topsoil stripping, cut and fill activities, and large or tall construction equipment. However the initial construction and smaller scale activities would be difficult to discern and the influence of these activities on the view is reduced by the presence of intervening industrial elements and buildings. Pipeline activities are unlikely to be discerned from here.
Operation phase:	**Medium:** Once operating, the key components of the main complex anticipated to be visible would be the larger facility elements such as the LNG trains, the pipe racks, the emergency flare stack and the LNG storage tanks, Boatshed Point MOF (MOF 1). At this angle of view, some of the coastal vegetation could assist in screening lower elements of the facility however the larger components of the facility would be visible in this view. These new elements are predicted to generate a moderate change in the view; however, these changes would be viewed in combination with other industrial facilities. These include the RG Tanna Coal export facility which provides screening to much of the LNG site and also creates an industrial context so that the new facilities would not contrast significantly with the existing view.
Decommissioning phase:	**Low:** Following decommissioning it is anticipated that the site would be revegetated. At this distance, the terracing would be imperceptible.
Significance of the visual impact	
Construction phase:	**Minor to Moderate**
Operation phase:	**Minor to moderate**.
Decommissioning phase:	**Minor**
MOFs, Launch Sites & TWAFs	***MOFs:*** The Boatshed Point MOF (MOF 1) would be visible from this view point. MOF options 2 and 3 are unlikely to be visible from this viewpoint. However, due to the distance this has no effect on the significance of the impact. ***Launch sites:*** No mainland launch site is predicted to be visible from this vantage point. ***TWAFs:*** not applicable for this view.
Comparison against baseline	GLNG and QCLNG have predicted in their LVIAs that the LNG plants would not be visible from this vantage point. Therefore the baseline would be unaffected and would remain **Minor to Moderate** during both construction and operation phase.

Viewpoint 4: Viewpoint assessment for the view from Round Hill Lookout	
Coordinates: 151°18'49.644"E 23°45'38.112"S ***Closest distance to the LNG plant:*** 8.4 km approximately ***Viewing direction:*** West, north and east	This viewpoint is located approximately 2 km south of Gladstone CBD, on a distinct knoll (at 134 m AHD), in a parkland called Round Hill Lookout. It provides an impressive view through strategically-placed breaks in the hillside vegetation. Principally views are orientated west, north and east. It is further from Gladstone CBD than its counterpart at Auckland Point and its recreational and amenity facilities are poor in comparison. However, despite this, it is anticipated to be a popular lookout point, but not one where viewers would stop for very long periods of time. The lookout is one of the places of interest in Gladstone for tourists and locals referred to in Gladstone tourist literature. This view represents the "worst case scenario" for the viewers in elevated residential areas of Gladstone, with views orientated due north. It allows a clear towards the LNG plant although is affected by vegetation growth which obscures parts of the view. Given the elevation this view affords a long distance view directly north, over LCT 6: Urban in the foreground and LCT 4: Industrial / Extractive and LCT 8: Waterscape in the middle ground . Curtis Island forms the backdrop of the view.
Existing view from Viewpoint 4 (4A)	Refer to **Figure 26**.
Artist's Impression (visualisation) from Viewpoint 4 (4B)	Refer to **Figure 26**.
Overall visual sensitivity	**High:** This is a recognised and well used recreational lookout, which attracts moderate to large numbers of viewers (though user numbers are anticipated to be less than Auckland Point). The users have a proprietary interest in obtaining a view over Gladstone, Port Curtis and Curtis Island. However, viewers are not anticipated to stay at the lookout for prolonged periods of time, given the general lack of recreational amenities (such as benches or tables). The viewpoint is a regionally important location whose users' interest is specifically focussed on the landscape.
Visual magnitude of change	The long distance from this viewpoint to the project, affords views of the entire LNG plant. At this distance smaller-scale activities and features are not anticipated to be easily distinguished.
Construction phase:	**Medium:** The construction camp at Boatshed Point would be discernable. At this long distance some of the larger construction activities are anticipated to be noticeable, i.e., vegetation clearance, topsoil stripping, cut and fill activities and large or tall construction equipment. Traffic crossing Port Curtis would also be visible.
Operation phase:	**Medium:** Once operating, the entire LNG plant would be readily noticeable, although it is anticipated that only the largest and brightest components would be visually prominent. In the main complex, these are anticipated to be the LNG storage tanks, LNG trains with associated stacks and emergency flare. At this distance the MOF at Boatshed Point is not anticipated to be a prominent element in the view. LNG tankers moored at Hamilton Point and crossing Port Curtis could be discerned. The introduced new elements would be clearly perceptible, but would be concentrated in a narrow field of the view and in the context of other industrial activities. However unlike viewpoints 1 to 3, the extension of the industrial activities across Port Curtis and on to Curtis Island is highlighted by the elevated and wide field of view and the new activities are viewed separately from the existing industrial activities. The large scale of the project combined with the relatively long distance which diminish its contribution to the overall view means that the magnitude of change is predicted to be **medium**. The operating feed gas pipeline would be underground and not visible.
Decommissioning phase:	**Low:** Following decommissioning it is anticipated that the site would be revegetated. At this distance, the terracing would be imperceptible
Significance of the visual impact	
Construction phase:	**Moderate.**

Operation phase:	**Moderate**.
Decommissioning phase:	**Minor to Moderate**.
MOFs, Launch Sites & TWAFs	***MOFs:*** The Boatshed Point MOF (MOF 1) would be visible in this view. MOF options 2 & 3 at this distance/angle would make a minor contribution to the overall view. ***Launch sites:*** No mainland launch site is predicted to be visible from this vantage point, although Launch Site 1 may be visible from other views obtained from Round Hill. ***TWAFs:*** In this view neither TWAF 7 nor 8 is visible, although TWAF7 may be discernable to a minor extent in other viewpoints at Round Hill.
Comparison against baseline	The LVIAs for the QCLNG and GLNG have predicted that these LNG plants would have a small and negligible magnitude of impact on the view, respectively. The perceived industrialisation arising from the baseline approved LNG Plants changes the visual character of Curtis Island when viewed from this vantage point from a natural island to an extension of the Gladstone development. However, the Arrow LNG Plant is anticipated to be the more prominent plant so the development remains noticeable (medium magnitude) during both construction and operation. The significance therefore remains **moderate**.

Viewpoint 5: Viewpoint assessment for the view from South End	
Coordinates: 151°18'49.644"E 23°45'38.112"S ***Closest distance to the LNG plant:*** 7.7 km approximately ***Viewing direction:*** west	This viewpoint represents the "worst case" viewing situation for users and residents at South End settlement and the camp ground, which is approximately 7 km north east from the LNG plant. The South End campground is located approximately 10 km from the LNG jetty, on the northeast side of the South End township. Even though it is not a recognised or designated lookout, the view is from a publically accessible place overlooking the Ferry Route where it is possible that people would gather. The view affords an impressive, wide, panoramic view of over 180 degrees and is orientated south west across the water and estuarine landscape types (LCT 7 and LCT 8) of Pelican Banks, towards the LNG site . In the far background of the view, the industrial landscape of Gladstone (LCT 5) and Mount Larcom (LCT 1) are visible. This view is indicative of that anticipated for residents on Facing Island and the users of Oaks campground, which is located on the north-west side of Facing Island. The campground has 35 sites located within a short stroll to the Oaks Beach.
Existing view from Viewpoint 5 (5A)	**Refer to Figure 27**
Artist's impression (visualisation) (5B and 5C)	**Refer to Figure 27** for two artist's impressions: illustrating the effects of intervening landform on screening of the facility and what is likely to actually be visible.
Overall visual sensitivity	**High**: Despite the informal and local nature of the viewpoint, this is a location of high visual sensitivity, because some of the users would have an interest specifically focused on the landscape. This location is anticipated to be well used by informal recreation users, including those camping at South End, but would only attract low numbers of viewers, given the relatively inaccessible nature of the viewing location. However, the users are anticipated to have a proprietary interest in obtaining a view the estuarine and waterway landscapes of Pelican Banks and may stay in this locality for prolonged periods of time.
Visual magnitude of change	

Construction phase:	**Low:** Construction activities are not anticipated to be discerned from here except for short term periods (e.g., to construct emergency flare). Even though the ZTVs (see Section 4.0) illustrate that views from South End would be obtained, it is predicted that most day time views of the LNG plant from the jetty would be screened by a combination of land cover and landform i.e., View Hill (121 m AHD) and Quoin Island.
Operation phase:	**Low**: Limited views from South End settlement are predicted. Whilst landform and vegetation curtail most views of the LNG facilities, glimpsed views of some infrastructure components would be possible locally where a 'saddle' of lower topography exists. Possible views of the upper component of the emergency flare stack would be barely perceptible due to the long distance from the LNG plant i.e., over 10 km. which reduces the scale of the lowers the proportion of change in the view. From some, highly limited locations there is also a minor possibility that the uppermost parts of the LNG tank may be visible. The main potential impact for this viewpoint from this viewpoint is the impact of lighting.
Decommissioning phase:	**No impact:** Following decommissioning no discernable change would be experienced from this vantage point.
Significance of the visual impact	
Construction phase:	**Minor-moderate.**
Operation phase:	**Minor – moderate.**
Decommissioning phase:	**No impact.**
MOFs, Launch Sites & TWAFs	***MOFs*** There is no discernable difference between MOF1, 2 or 3 at this distance due to the effects of intervening landform and vegetation which screen views. ***Launch sites:*** no discernable difference at this distance combined with the effects of intervening landform. ***TWAFs***: not applicable to this view.
Comparison against baseline	No effect as these projects would not be visible - significance of visual impact remains **minor-moderate** during both construction and operation.

Viewpoint 6: Viewpoint assessment for the view from Port Curtis near Turtle Island	
Coordinates: 151°15'41.046"E 23°47'51.162"S ***Closest distance to the LNG plant:*** 2.7 km approximately ***Viewing direction:*** west to northwest	This viewpoint is from Port Curtis waterway (LCT 8), immediately adjacent to Turtle Island, and provides a clear, open and wide panoramic view of Curtis Island and the cluster of adjacent islands. It has been included to illustrate the visual impact of the LNG plant as viewed from the residence at Turtle Island and recreational users of Port Curtis in the vicinity of the project. The southern flanks of Coastal Estuarine Landscape (LCT 7) and Forested Mountain / Ridge (LCT 1) of Curtis island, including Grass Point and Boatshed Point and Witt Island are in the middle ground of this view. Hamilton Point is principally hidden by Tide Island. Mount Larcom provides a distinct elevated backdrop to the viewing situation, whilst the industrial landscape of Gladstone (LCT 5) is difficult to discern at this distance. The view provides a middle distance view of the LNG plant and a close to middle distance view of Boatshed Point.
Existing view from Viewpoint 6	Refer to **Figure 28**
Overall visual sensitivity	**Medium**: This is a difficult location to access and is anticipated to be viewed by only a small number of sensitive viewers. There is believed to be one residence on Turtle Island orientated north-east. Recreational users of Port Curtis would also be in this location (though this location lies outside the main shipping and ferry channels). However, despite the low viewer numbers, given the fact that viewers in this location may have an interest specifically focused on landscape appreciation, it is

	considered to be of medium sensitivity.
Judgement of visual magnitude of change	
Construction phase:	**High:** The greatest visual impact is anticipated to be generated by the construction camp and associated personnel transfer jetty and MOF on Boatshed Point. These elements are predicted to be clearly visible resulting in a considerable change to views obtained from this location. Most other construction activities are not anticipated to be viewed, except the upper parts of tall construction equipment e.g., cranes.
Operation phase:	**High:** Once operating some of the eastern components of the LNG plant are anticipated to be viewed from this vantage point. It is predicted that most of the lower components and activities of the LNG plant would be obstructed by Garden Island, however considerable change to the view will arise as a result of the taller elements such as the stacks on the LNG trains, the emergency flare stack and the LNG storage tanks would be seen above the intervening vegetation and landform. Views of the water side facilities at Hamilton Point (MOF and LNG jetty) are not predicted since they are located on the western edge where they would be obscured by the Point and Witt and Tide Islands whereas the facilities at Boatshed Point are likely to be partially visible. The single private view obtained from the property on Turtle Island is anticipated to be marginally greater than that described above. From elevated parts of the island there is potential for additional areas of the main LNG plant complex to be visible. However views of the water side facilities at Hamilton Point are not predicted.
Decommissioning phase:	**Low:** Following decommissioning it is anticipated that the site would be revegetated. At this distance, the remaining terracing is anticipated to be imperceptible.
Significance of the visual impact	
Construction phase:	**Moderate.**
Operation phase:	**Moderate**.
Decommissioning phase	**Minor.**
MOFs, Launch Sites & TWAFs	***MOFs:*** The Boatshed Point MOF (MOF 1) would have visual impact from this angle. The South Hamilton Point MOF 2 and MOF 3 would be screened by intervening landform. ***Launch sites:*** mainland launch sites are not visible from this viewpoint. ***TWAF Options:*** not applicable to this view.
Comparison against baseline	**Moderate**: The magnitude of impact associated with the baseline approved LNG Projects of QCLNG & GLNG were noted in the LVIAs prepared for these schemes to be negligible/small, associated with the visibility of stacks. Views of these projects would lead to a slight reduction in the extent to which the project contrasts with the existing view. However, as the Arrow LNG plant would be the most dominant industrial element in this view, the magnitude and significance against the baseline are considered not to change. Note: a visualisation was not prepared for this vantage point since it would show similar features to Viewpoint 7 and 8 which are located closer to the LNG plant.

Viewpoint 7: Viewpoint assessment for the view from Port Curtis by Witt Island	
Coordinates: 151°14'27.792"E 23°48'2.688"S ***Closest distance to the LNG plant:***	This viewpoint is from Port Curtis (LCT 8) provides a clear, open and wide panoramic view of the south side of Curtis Island and Tide Island. It has been included to illustrate the visual impact of the LNG plant for the resident at Witt Island; noting that there are a number of buildings on Witt Island but the main housesite appears to be located in the centre of the island but with the main jetty located on the north-west of the island closest to the Arrow LNG Plant site. This viewpoint is also indicative of the view anticipated to be achieved for users of Picnic Island, Garden island and

1 km approximately ***Viewing direction:*** northwest	Diamantina Island. It is one of the closest viewing locations of the LNG plant accessible by water. The southern flanks of Coastal/Estuarine Plain LCT (LCT 7) and Curtis Island Strike Ridge (LCT 1) of Curtis Island are clearly visible at this close location. Boatshed Point promontory is closest to the viewpoint, in the fore to middle ground of the view, whilst Grass Point and Tide Island are located further back in the middle ground of this view. Hamilton Point is principally hidden by Tide Island. Mount Larcom provides a distinct elevated backdrop to the west of this view, whilst the industrial landscape of Gladstone (LCT 5) is generally not perceptible from here.
Existing view Viewpoint 7 (7A)	Refer to **Figure 28**
Visualisation from Viewpoint 7 (7B)	Refer to **Figure 28**
Overall visual sensitivity	**Medium:** This location is anticipated to viewed by only a small number of sensitive viewers who have access to a boat, including residents living on Witt Island and recreational users of the water in this location (though this location lies slightly north of the main shipping and ferry channels). This viewpoint is also representative of views from Garden Island (it is the closest selected viewpoint to this location). Garden Island is a Conservation Park and has a beach on the eastern side, which is occasionally visited by recreational users. However, it is a relatively difficult viewpoint to access and will only be available to few.
Judgement of visual magnitude of change	
Construction phase:	**Very high:** The greatest visual impact on the view during construction is anticipated to be generated by the construction camp and the associated MOF (MOF 1) and personnel transfer jetty at Boatshed Point. At this close distance the construction camp is likely to break the horizon in the view, elevating its visual prominence. Other construction activities that would be viewed, include clearance of vegetation, terracing activities and the upper parts of tall construction equipment. These activities would be a dominant element of the view as they contrast with the existing natural landscape.
Operation phase:	**Very high:** Once operating, the upper components of the eastern side of the main LNG plant are predicted to be visible. The lower components and western components of the export facility are predicted to be obstructed by Boatshed Point. The taller elements such as the stacks on the LNG trains and gas turbine generators, the emergency flare and the LNG storage tanks would be clearly seen above the intervening landform and vegetation, dominating the view. However, views of the MOF and LNG Jetty at Hamilton Point are not predicted due to the influences of intervening landform. The view from the property on Witt Island is anticipated to experience similar impacts to those described above. From elevated parts of the island there is potential for additional areas of the main LNG plant to be visible.
Decommissioning phase:	**Medium**: The terracing (modified landform) would still be visible following decommissioning.
Significance of the visual impact	
Construction phase:	**Moderate to Major.**
Operation phase:	**Moderate to Major.**
Decommissioning phase:	**Minor to Moderate.**
MOFs, Launch Sites & TWAFs	***MOFs:*** Boatshed Point (MOF1) would be visible from this vantage point. The South Hamilton MOF and Hamilton Point MOF options (MOF 2 and MOF 3) would not be visible. ***Launch sites:*** mainland launch sites are not visible from this viewpoint. ***TWAF options:*** not applicable from this vantage point.

Comparison against baseline	Stacks and buildings associated with the approved LNG plants are predicted to be visible from this viewpoint. This is reflected in the medium significance given to this viewpoint in the QCLNG LVIA. Against this baseline, the contrast in the view during both construction and operations is anticipated to reduce to high. This results in a significance assessment of **moderate**.

Viewpoint 8: Viewpoint assessment for the view from Port Curtis by Tide Island	
Coordinates: 151°13'41.382"E 23°47'59.868"S ***Closest distance to the LNG plant:*** 0.7 km approximately ***Viewing direction:*** Due north	This viewpoint is obtained from Port Curtis waterway (LCT 8), west of Tide Island and provides a clear, open and wide panoramic view of the south side of Curtis Island including Hamilton Point and Boatshed Point. It has been included to illustrate the visual impact of the LNG plant for the residents at Tide Island and is located close to the main shipping channel. It is one of the closest viewing locations of the LNG plant. The southern flanks of Coastal /Estuarine landscape (LCT 7), Undulating or Flat Forest (LCT 2) and Forested / Mountain Ridge (LCT 1) of Curtis Island are clearly visible from this close location. The western side of Boatshed Point and eastern side of Hamilton Point frame the western and eastern sides of the fore to middle ground of this view, whilst Grass Point is hidden from the view.
Existing view from Viewpoint 8 (8A)	Refer to **Figure 29**
Visualisation from Viewpoint 8 (8B)	Refer to **Figure 29**
Overall visual sensitivity	**Medium**: This location is anticipated to be viewed by only a small number of sensitive viewers with access to a boat, including the residents on Tide Island and recreational users of the water in this location (though this location is also located close to the main shipping and ferry channels). It is a relatively difficult viewpoint to access and would only be available to few. However, viewers in this location are likely to have an interest specifically focused on landscape appreciation.
Visual magnitude of change	
Construction phase:	**Very high:** Dominant, clear views of the activities at the main LNG plant complex at ground level are predicted. As in the case of viewpoints six and seven, the greatest visual impact is anticipated to be generated by the proposed construction camp on Boatshed Point (and the associated personnel transfer jetty and MOF 1), which would be viewed breaking the horizon in very close proximity to this vantage point. The mangrove vegetation located in the foreground of the view may partially assist in screening some of the lower components; however, given the close distance of this vantage point, all construction activities / components could potentially be viewed. It is predicted that the security fence and the workers (who are predicted to be wearing high visibility clothing), may also be discernable at this close distance.
Operation phase:	**Very high**: The operation of the LNG plant is anticipated to affect a substantial part of this view, representing a major view at close range The effect is magnified because the change is from a view that is inherently natural in character to one that is very industrial. The main complex of the LNG plant is anticipated to be highly prominent and a dominant element of the view from this vantage point. Views of the water side facilities at Hamilton Point (MOF and LNG jetty) are not predicted. Vantages from higher ground on Tide Island may provide clearer views of the main LNG plant to be visible. The pipeline construction would not be viewed, with the possible exception of a small area by Hamilton Point.
Decommissioning phase:	**Medium**: The terracing (modified landform) would still be noticeable following decommissioning.
Significance of the visual impact	
Construction phase:	**Moderate to Major.**

Operation phase:	**Moderate to Major** due to the high degree of sensitivity combined with a very high magnitude of change.
Decommissioning phase:	**Moderate.**
MOFs, Launch Sites & TWAFs	***MOFs:*** Boatshed Point MOF (MOF 1) is prominent from this vantage point. The Hamilton Point MOF 2 and MOF 3 would be hidden by intervening landform and vegetation. ***Launch sites:*** mainland launch sites are not visible from this viewpoint. ***TWAF options:*** not applicable from this vantage point.
Comparison against baseline:	Stacks and buildings associated with the approved LNG plants are predicted to be visible from this viewpoint. This is reflected in the medium significance given to this viewpoint in the QCLNG LVIA. Against this baseline, the contrast in the view during both construction and operations is anticipated to reduce to high. This results in a significance assessment of **moderate.**

Viewpoint 9: Viewpoint assessment for the view from South End Ferry Service and the Main Shipping Channel	
Coordinates: 151°15'15.954"E 23°49'27.39"S ***Closest distance to the LNG plant:*** 3.9 km approximately ***Viewing direction:*** North	This viewpoint is from Port Curtis waterway (LCT 8), close to the main shipping channel, and to the route of the South End ferry service. It has been included to illustrate the impact for users of the shipping channel (both recreational and commercial) and South End Ferry Service. It is considered to be representative of the worst case scenario for views obtained by users of the ferry service. Once the ferry has passed Turtle Island the views obtained towards the LNG plant would be interrupted by intervening islands and would be at a further distance. This middle to longer distance view provides a clear, open and wide panoramic view of the south side of Curtis Island (including Ship Hill) and Picnic Island. It indicates the landscape character of the distinctive bushland ridgelines (LCT 1) of Curtis Island. Picnic and Diamantina islands are in the middle ground of the view. Picnic Island principally obstructs views of Tide Island and Hamilton Point, whilst Boatshed Point and Grass Point promontories are visible in between behind the two islands.
Existing view from Viewpoint 9	Refer to **Figure 29**.
Overall visual sensitivity	**Medium:** Of all the representative Port Curtis waterway viewing locations, this is one that would potentially have larger numbers of viewers. The viewers may include residents and recreational users of the South End Ferry Service, recreational users of Port Curtis, as well as commercial operators in the main shipping channel. South End Ferry operates five days a week, providing passenger and cargo transport once a day from Gladstone to South End Wharf on Curtis Island and Farmer's Point on Facing Island. Given the close proximity of this viewpoint to the industrial landscape of Gladstone (LCT 5), that views towards the proposals are transient and that many of the viewers would not be in this location with an interest specifically focused on landscape appreciation, it is considered to be of medium sensitivity.
Visual magnitude of change	This viewpoint is oriented in a similar direction to viewpoint 1, from Auckland Point. However, as this vantage point is not elevated there is more potential for the LNG plant to be screened by the intervening coastal vegetation.
Construction phase:	**High:** The Boatshed Point construction camp is predicted to be visible. Some of the construction activities are also anticipated to be visible, i.e., vegetation clearance, topsoil clearance, cut and fill activities and large or tall construction equipment. The initial construction and smaller scale activities are predicted to be difficult to discern. Overall, the effect of the construction activities would result in a considerable change in the view.

Operation phase:	**High:** Once operating, the key components of the LNG plant anticipated to be viewed would be the larger facility elements such as the LNG storage tanks, LNG trains, the emergency flare stack and the main buildings complex. Boatshed Point MOF 1 and personnel transfer jetty would be visible in the view; and it is also considered that the South Hamilton Point MOF 2 and LNG jetty would be visible, although these would be partially screened by intervening landform and the intervening islands (Tide and Witt) in the foreground. It is anticipated that views of these facilities would not be continuous for the ferry route from Gladstone Marina to Turtle Island as they would be partially screened by Witt, Tide, Picnic and Diamantina Islands. During the operation phase, the introduced and unprecedented new island elements would intrude upon a considerable part of the view, introducing distinct new elements into the landscape. The operating feed gas pipeline would be underground and not visible.
Decommissioning phase:	**Low:** Following decommissioning it is anticipated that the site would be revegetated. At this distance, the remaining terracing is anticipated to be barely perceptible.
Significance of the visual impact	
Construction phase:	**Moderate.**
Operation phase:	**Moderate.**
Decommissioning phase:	**Minor.**
MOFs, Launch Sites & TWAFs	***MOF options:*** Boatshed Point MOF option (MOF1) is marginally more prominent from this vantage point. The orientation of the South Hamilton Point MOF (MOF 2) and intervening landform of Hamilton Point would partially restrict views. ***Launch sites:*** mainland launch sites are not visible from this viewpoint. ***TWAF options:*** not applicable to this vantage point.
Comparison against baseline	**Moderate**: The taller stacks associated with other LNG plants in the baseline scheme are anticipated to be visible from this viewpoint. However, the QCLNG LVIA assesses the significance of the impact on the view from a view in the vicinity of this vantage point to be negligible. Accordingly, due to the prominence of the Arrow LNG Plant in this view relative to baseline facilities the magnitude of impact at both operation and construction phase remains high so the significance is unaffected.

Viewpoint 10: Viewpoint assessment for the view close to the Port Curtis Shipping Channel	
Coordinates: 151°11'57.348"E 23°46'58.914"S ***Closest distance to the LNG plant:*** 3 km approximately ***Viewing direction:*** southeast	This viewpoint is located within Port Curtis waterway (LCT 8), north-west of Hamilton Point and north China Bay close to South Passage Island and the main shipping channel. The viewpoint has a clear, open and wide panoramic view of the south-western side of Curtis Island and North China Bay. It is one of the closest viewing locations to the waterside facilities of the LNG plant and is located adjacent to the GLNG site. The viewpoint has been selected to illustrate views to the west of Curtis Island and is also representative of views from the shipping channel. The viewpoint illustrates both the Coastal/ Estuarine landscape (LCT 7) and Forested / Mountain ridge (LCT 1) of Curtis Island.
Existing view from Viewpoint 10 (10A)	Refer to **Figure 30**
Visualisation from Viewpoint 10 (10B)	Refer to **Figure 30**
Overall visual sensitivity	**Medium:** This viewpoint would potentially be experienced by a low to moderate number of viewers The viewers may include occasional recreational users of the Port Curtis, as well as commercial operators in the main shipping channel. Given the close proximity of this viewpoint to the industrial and urban landscapes of Gladstone (LCT 5 and LCT 5) and that many of the viewers in this location would not have their interest specifically focused on landscape appreciation (as they will be working).

Visual magnitude of change	
Construction phase:	**Very high**: The Boatshed Point construction camp is not anticipated to be visible However, the different activities and elements of the construction Period are anticipated to be a dominant part of the view. Although industrial activities influence the character of views obtained in other directions from this vantage point, the view in this direction is principally of a "natural" forested landscape (LCT 2) and waterscape (LCT 8). The change from this natural landscape to an industrial landscape would be considerable given the close proximity to this viewpoint. From this vantage point, construction activities associated with the construction of the feed gas pipeline and tunnel across Port Curtis may be visible at a close distance. Impacts associated with construction traffic crossing Port Curtis would also be evident.
Operation phase:	**Very high**: The most prominent components of the LNG plant in this view are anticipated to be the LNG storage tanks which break the skyline above the forested landscape. The waterside facilities in North China Bay and around Hamilton Point (i.e., the jetty and MOF 3, shore protection and the haul road) may also be visible including moored LNG tankers. Furthermore, there is potential for views of the upper components of the western parts of the main complex, particularly the emergency flare stack.
Decommissioning phase:	**Low:** Following decommissioning it is anticipated that the site would be revegetated. At this distance, the remaining terracing is anticipated to be barely perceptible.
Significance of the visual impact	
Construction phase:	**Moderate to Major.**
Operation phase:	**Moderate to Major.**
Decommissioning phase:	**Minor.**
MOFs, Launch Sites & TWAFs	***MOFs:*** The Hamilton Point MOFs (MOF 2 and MOF 3) would be visible from this location. The Boatshed Point MOF (MOF 1) would be obscured by intervening landform. ***Launch sites:*** Launch site 4N and associated traffic movements are likely to be seen from this vantage point looking in a north west direction. Potential views of Launch Site 1 would be curtailed by Wiggins Island, although traffic movements would be seen. ***TWAF options:*** not applicable to this vantage point.
Comparison against baseline	From this vantage point the GLNG plant would be a dominant element. The QCLNG plant, would also be visible looking from this vantage point looking in a more northerly and north-westerly direction. A similar viewpoint in the QCLNG LVIA is judged to have an impact of large significance. Against this baseline the contrast in the view would reduce because the Arrow LNG Plant construction and operation would take place against an industrialised backdrop. Therefore the magnitude of the effect reduces to medium (noticeable) as the scheme would 'blend with the existing view' The significance also decreases to **moderate**.

Viewpoint 11: Viewpoint assessment for the view from Laird Point on Curtis Island	
Coordinates: 151°10'21.03"E 23°44'39.594"S ***Closest distance to the LNG plant:*** 5.9 km approximately ***Viewing direction:*** South	This viewpoint is from Laird Point, on Curtis Island. The viewpoint is located within the LVIA study area and has been selected as it is a popular camping area and is located at the southern entrance to The Narrows. The view is a clear, open and wide panoramic view of the western side of Curtis Island, Port Curtis and the southern entrance to The Narrows. The Mount Larcom range is clearly visible, providing an attractive and distinctive backdrop to the viewing situation. The view also illustrates the influence that the existing industrial activities at Fishermans Landing have on landscape character. The viewpoint has been selected to illustrate the impact on recreational users in and around Curtis Island, The Narrows and Grahams Creek. It is noted that this viewpoint lies within the Australian Heritage Commission Register of the National Estate registered landscape of The Narrows. The viewpoint illustrates the influence of the existing industrial activities on the character of the

	waterscape (LCT 8), Coastal / Estuarine plain landscape (LCT 7) and Forested / Mountain Ridge (LCT 1) LCT's.
Existing view from Viewpoint 11	Refer to **Figure 30**
Overall Visual sensitivity	**High:** This is a relatively remote location and is anticipated to be accessed by a small number of sensitive viewers, camping in this locality. It is a relatively difficult viewpoint to access and would only be available to few, with access to a private boat. However, given the likelihood that some viewers may be in this location with an interest specifically focused on landscape appreciation associated with the heritage values of The Narrows, it is considered to be of **high** sensitivity.
Visual magnitude of change	
Construction phase:	**Medium**: From this vantage point, most construction activities would be screened by the effects of intervening landform and vegetation, including the construction camp at Boatshed Point. It is possible that construction traffic crossing Port Curtis would be visible, particularly if Launch Site 4N is selected.
Operation phase:	**Medium**: At this distance and angle of view, it is predicted that most components of the LNG plant, would not be visible, with the possible exception of the upper part of the emergency flare stack which would be noticeable against this natural context. LNG tankers accessing Hamilton Point would also be visible. Even though industrial activities influence the character of other parts of the view (looking towards the mainland), the view is principally of a "natural" forested landscape (LCT 2) and waterscape (LCT 8).
Decommissioning phase:	**No impact**: Following decommissioning, any remaining landform modification would not be perceptible from this vantage point.
Significance of the visual impact	
Construction phase:	**Moderate.**
Operation phase:	**Moderate.**
Decommissioning phase:	**No impact.**
MOFs, Launch Sites & TWAFs	***MOFs:*** None of the MOF options 1, 2 or 3 are anticipated to be visible from this location. ***Launch sites:*** Launch site 4N lies close to this vantage point and associated traffic movements are likely to be seen from this vantage point looking in a south-westerly direction. Potential views of Launch site 1 would be curtailed by Wiggins Island and the effects of distance, although traffic movements would be seen. ***TWAFs:*** not applicable to this viewpoint.
Comparison against baseline	No specific assessment has been undertaken from this viewpoint in the LVIAs prepared for the QCLNG or GLNG plants. From this vantage point it is anticipated that the QCLNG and GLNG sites would be prominent. The Fishermans Landing Northern Expansion would also be visible. This industrialised context reduces the magnitude of the change of the Arrow LNG Plant against the baseline to medium during both construction and operation phases. Accordingly the significance of the impact reduces to **minor-moderate** as the change would blend into the existing infrastructure.

Viewpoint 12: Viewpoint assessment for the view from Mount Larcom Summit	
Coordinates: 151°5'9.42"E 23°48'17.616"S ***Closest distance to the LNG plant:*** 13km	This viewpoint is from the highest point within the LVIA study area at over 550 m AHD. It affords an impressive 360 degree view, encompassing the entire study area, and subsequently all landscape character types. Views of the LNG plant on Curtis Island are obtained in an easterly direction from this viewpoint (Viewpoint 12A). The viewpoint has been selected to represent the worst case view from elevated locations in the Mount Larcom range (landscape character type – LCT 1) The majority of views from the remainder of the trail are blocked by tree cover; glimpsed views of Mount Larcom and the wider area are

approximately ***Viewing direction:*** West, north and east	allowed intermittently providing the viewer with a good appreciation of the wider landscape.
Existing view from Viewpoint 12A looking east	**Refer to Figure 31**
Existing view from Viewpoint 12B looking north	**Refer to Figure 31**
Existing view from Viewpoint 12C looking west	Refer to **Figure 31**
Overall visual sensitivity	**High:** This is a remote location, which is relatively difficult to access due to the strenuous nature of the climb. However, it is a recognised trail and lookout in the local area that is mentioned in Gladstone tourist literature. It is visited by small to moderate numbers of both tourists and locals, including school groups. The viewers who reach the summit are those with a high proprietary interest, specifically focused on landscape appreciation and may have a prolonged viewing time.
Visual magnitude of change	This long distance affords views of the entire LNG plant, including the area of the pipeline crossing Port Curtis. At this distance the large scale activities and components are predicted to be visible whereas smaller scale activities are unlikely to be discerned.
Construction phase:	**High**: During the construction phase, the construction camp is anticipated to be visible, as well as the larger construction activities such as vegetation and topsoil clearance, cut and fill activities and large or tall construction equipment. Although the changes would result in a change to a relatively narrow field of view, the change would appear considerable since it would change the perception of the visual character of Curtis Island as a natural landscape.
Operation phase:	**High:** Once operating, even though the entire LNG plant would be visible, it is anticipated that the largest and brightest components would be the most prominent elements. In the main complex, these are anticipated to comprise the LNG trains, emergency flare stack, main buildings complex and the LNG storage tanks. These new elements would be clearly perceptible, however primarily concentrated in a small part of the view and in the context of other industrial activities. The extension of the industrial activities across Port Curtis and on to Curtis Island is highlighted due to the elevated location of the view and the new activities are viewed separately from the existing industrial activities. As the feed gas pipeline would be ground, it would not be seen from here.
Decommissioning phase:	**No impact**: Following decommissioning, any remaining landform modification would not be perceptible from this distant vantage point.
Significance of the visual impact	
Construction phase:	**Moderate to major.**
Operation phase:	**Moderate to major.**
Decommissioning phase:	**No impact.**

MOFs, Launch Sites & TWAFs	***MOFs:*** There is potential for all of the MOF options to be visible from this vantage point. However, at this distance these facilities are unlikely to be clearly discerned with the naked eye. ***Launch Sites:*** Launch site 4N lies in the centre of this vantage point, at the tip of the Fishermans Landing Northern Expansion project. This launch site and associated traffic movements are likely to be visible looking in a north-easterly direction. Launch Site 1 and traffic crossing Port Curtis from here could also be seen, located on the Calliope River to the east (right hand side of viewpoint). ***TWAFs:*** TWAF 8 would be visible in this view, located to the north (left) of the cleared land associated with Targinnie. From this vantage point the TWAF site appears to be dense forest and its clearance would be noticeable. This would not result in a considerable change as it would appear to relate to the existing farmed landscape of Targinnie.
Comparison against baseline	The Mount Larcom viewpoint was not assessed in the QCLNG or GLNG LVIAs. It is considered that the existence of these baseline approved LNG Projects in this view would cause the magnitude of change to appear considerably less during both construction and operation phases. The magnitude would reduce to medium (noticeable) as the Arrow LNG Plant would contrast less with the industrialised character of Curtis Island in the. Even though this is a long distance view, the large scale of the baseline projects, and the Western Basin dredging and disposal area at Fisherman's Landing would be more prominent in the view than the Arrow LNG Plant elements. This reduces the significance of the impact to **moderate**.

Viewpoint 13: View from Reid Road and Gladstone - Mount Larcom Road intersection	
Coordinates: 151°10'14.232"E 23°49'59.484"S ***Closest distance to the LNG plant:*** 5.7 km approximately ***Viewing direction:*** North-east	This viewpoint is located at the junction of Reid Road and Gladstone–Mount Larcom Road intersection. The viewpoint has been selected to represent the worst case view from Gladstone–Mount Larcom Road and has been selected in preference to other potentially representative views (e.g., the Calliope River crossing) because this view also encompasses the mainland tunnel launch site and tunnel spoil disposal area. This viewpoint is located within LCT 7: Coastal or Estuarine Plain. Views of the LNG plant on Curtis Island are in a north easterly direction from the viewpoint (to the right of view) whilst views of the mainland tunnel launch site and tunnel spoil disposal area are in a north-westerly direction (to the left).
Existing view from Viewpoint 13	Refer to **Figure 32**
Overall visual sensitivity	**Low:** This is transient viewing location, which would principally be experienced by road users. It is anticipated that there would be very few viewers on foot in this location. Given the view is obtained from the main road into and out of Gladstone, from the north and at the entrance to the Cement Works off Reid Road, relatively high numbers of viewers are anticipated to obtain this view. However, when considering the type of viewer in this location, they would not have a proprietary interest, specifically focused on landscape appreciation and would have a short viewing time.
Visual magnitude of change	
Construction phase:	**High:** The most prominent construction components of the LNG project are anticipated to be activities associated with the Tunnel Entrance, including spoil disposal mounds and laydown. Construction activities on the mainland, particularly associated with the South Hamilton Point MOF are also anticipated to be viewed. The main visible construction activities would be those across the mudflats at a close distance, which could affect a substantial part of the view.

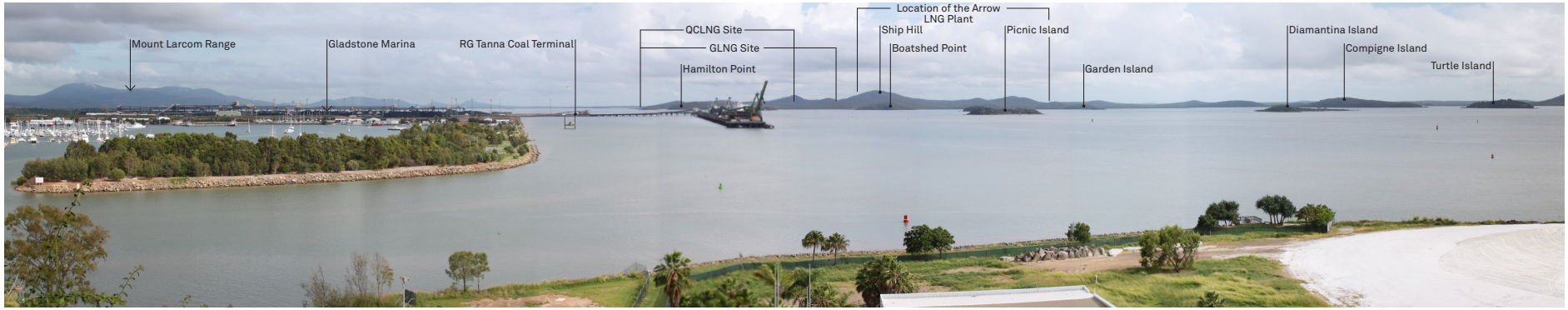
Operation phase:	**Medium:** The operating feed gas pipeline would be underground and, therefore, not visible. There will, however, be some remaining facilities and elements associated with the tunnel entrance including a mainline valve and the spoil disposal mounds. The right of way of the feed gas pipeline across the tidal flats would be barely perceptible. Views of the main LNG plant would be largely curtailed by the effects of landform, vegetation and distance. However, larger components such as the emergency flare stack and LNG tanks are likely to be visible. This viewing situation is currently influenced by the existing industrial development (including presence of large storage tanks in the view) which affects the perception of change, particularly as most views from this location would be obtained by people in moving vehicles.
Decommissioning phase:	**Low**: Following decommissioning, the landform modification associated with the spoil mounds may still be barely perceptible.
Significance of the visual impact	
Construction phase:	**Minor to Moderate.**
Operation phase:	**Minor.**
Decommissioning phase:	**Minor – Negligible.**
MOFs, Launch Sites & TWAFs	***MOFs*:** The Hamilton Point South MOF (MOF 2) would be marginally more prominent from here, but at this distance and with to the effects of intervening landform and vegetation this difference is unlikely to be significant. ***Launch sites:*** No launch sites are visible from this location. ***TWAFs:*** No TWAF sites are visible in this view.
Comparison against baseline	The QCLNG and GLNG plants would appear prominent in this view, as recognised in the GLNG LVIA assessment which affords this view a medium visual impact significance. During construction, the impacts of the Arrow LNG Plant construction on the mudflats would be the dominant element; therefore the baseline does not reduce the magnitude of effect and the significance remains **minor to moderate**. However, during operation the QCLNG and GLNG will have significantly intensified the industrial character so the magnitude of change will reduce to low. This changes the impact significance to **minor to negligible**. It is also noted that this viewpoint is located in the Yarwun Precinct of the Gladstone State Development Area and, thus, it is anticipated that the viewers' outlook in the foreground and northern part of the view would substantially change in the coming years, as this area is developed into a major industrial precinct.

Viewpoint 14: View from Flinders Street near Forest Road Intersection	
Coordinates: 151°14'44.556"E 23°50'53.886"S ***Closest distance to the LNG plant:*** n/a –views represent TWAF7 ***Viewing direction:*** West	This viewpoint is located at in a residential area west of Gladstone Hospital, in Flinders Street. This elevated vantage point offers expansive westerly views over Auckland Creek, towards the industrial precinct north of Gladstone Airport, including Gladstone power station. The Mount Larcom mountain ranges provide a forested backdrop to this view. Due to the flat low, lying nature of the landscape surrounding Auckland Creek and Calliope River, this is one of the few close range vantage points in Gladstone which offers comprehensive views over the former Gladstone power station ash pond site (where TWAF 7 is proposed).
Existing view from Viewpoint 14	Refer to **Figure 32**
Overall Visual Sensitivity	**Medium:** Views from this point would generally be experienced by a moderate number of local residents and visitors to this residential precinct.
Visual Magnitude of Change	

Construction Phase	**High**: From this elevated vantage point, TWAF 7 (located approximately 1 km west of this viewpoint) is anticipated to be highly visible in the foreground of this view, located on the former ash pond site between Gladstone Power Station and Auckland Creek. TWAF 7 would only be there during the construction phase and is anticipated to be highly visible from this viewpoint. Key visible aspects are preparation activities(including vegetation clearance, stripping and stockpiling of topsoil, general earthworks and the associated presence of construction equipment, and construction crews), presence of the TWAF buildings and movement of workers vehicles to and from the TWAF 7 site. TWAF7 would be highly visible from this viewpoint. Although the sensitivity of this view is reduced by the precedent of extensive urban and industrial development, the introduction of the TWAF would be an obvious new feature in this view.
Operation Phase	**No impact:** During the operation phase it is anticipated that the TWAF would be removed and the site restored to an appropriate condition.
Decommissioning Phase	**No impact**
Significance of the Visual Impact	
Construction Phase	**Moderate**
Operation Phase	**No impact**
Decommissioning Phase	**No impact**
MOFs, Launch Sites & TWAFs	***MOFs MOF 1, 2 & 3** are* not visible from this vantage point ***Launch sites: Launch sites 1 and 4N** are not visible from* this vantage point ***TWAFs:*** This vantage point overlooksTWAF7. There is no intervisibility with TWAF8 from this location. Whilst it would be visible due to the elevated location of the residential areas, TWAF7 would visually relate to the urban context of Gladstone in this view with precedent infrastructure already present.
Comparison against baseline	Not applicable as the proposals are not relevant to the foreground of this view. Therefore significance is not affected.

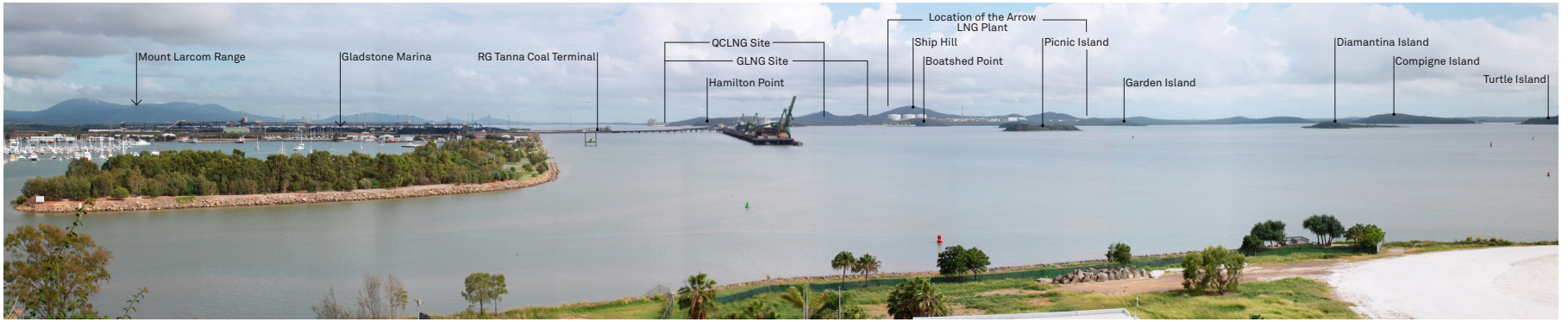
Viewpoint 15: View from Calliope River-Targinie Road	
Coordinates: 151°6'34.122"E 23°47'14.724"S ***Closest distance to the LNG plant:*** n/a –views represent TWAF7 ***Viewing direction:*** West	This viewpoint is located at Calliope River–Targinie Road, north of the Forest Road turn off close to the rural community of Targinnie. It lies adjacent to Targinie State Forest within LCT 5 Undulating or Flat Forest. The landscape comprises a quiet rural character, including a mixture of pastoral grazing land (not currently used by stock) and vegetation, with mature eucalypt forest and regrowth. An area of LCT 4 Open Rural lies to the north beyond the viewpoint. From this flat low-lying vantage point, the presence of vegetation provides visual enclosure.
Existing view from Viewpoint 15	Refer to **Figure 32**
Overall visual sensitivity	**Medium:** Views from this point would generally be experienced by people travelling along Calliope River-Targinie Road, including a small number of residents living in the local Targinnie area and visitors to Targinie State Forest.
Visual Magnitude of Change	

Construction phase:	**High**: The TWAF 8 is anticipated to be highly visible from this viewpoint. Key visible aspects are preparation activities(including vegetation clearance, stripping and stockpiling of topsoil, general earthworks, laydown areas adjacent to Forest Road and the associated presence of construction equipment, and construction crews), presence of the TWAF buildings and movement of workers vehicles along quiet rural roads to and from the TWAF site.
Operation phase:	**Medium:** During the operation phase it is anticipated that the TWAF would be removed and the site restored to an appropriate condition. However, the loss of mature vegetation is still likely to be evident in this phase as vegetation re-establishes.
Decommissioning phase:	**No impact**
Significance of the Visual Impact	
Construction phase:	**Moderate**
Operation phase:	**Minor to Moderate**
MOFs, Launch Sites & TWAFs	***MOFs*** MOF 1, 2 & 3 are not visible from this vantage point ***Launch sites:*** Launch sites 1 and 4N are not visible from this vantage point ***TWAFs:***This vantage point overlooksTWAF8. There is no intervisibility with TWAF7 from this location. TWAF8 has potential to result in the removal of trees and the introduction of unprecedented infrastructure in a rural landscape.
Comparison against baseline	Not applicable as the proposals are not relevant to the foreground of this view. Therefore significance is not affected.



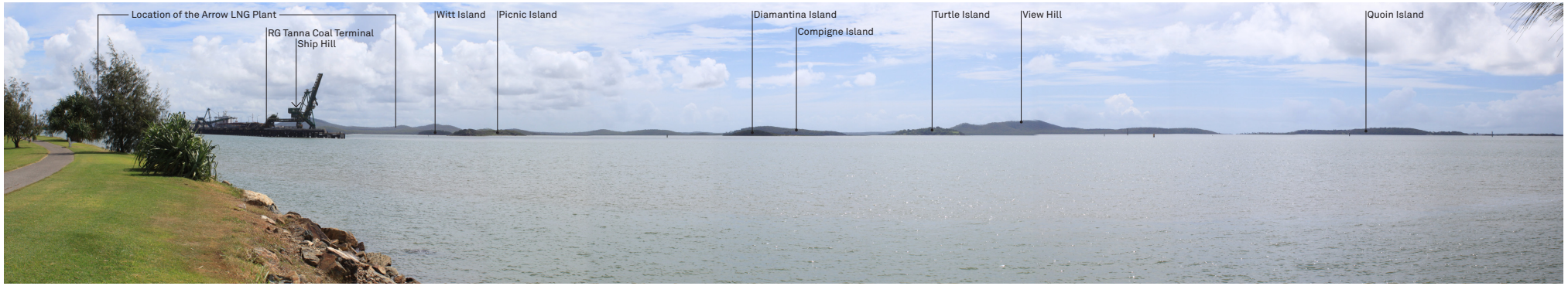
Viewpoint 1a: View from Auckland Point

Viewpoint 1b: Night time view from Auckland Point



Viewpoint 1c : Artist impression (visualisation) - showing potential view from Auckland Point

	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoint 1	Figure No: 24



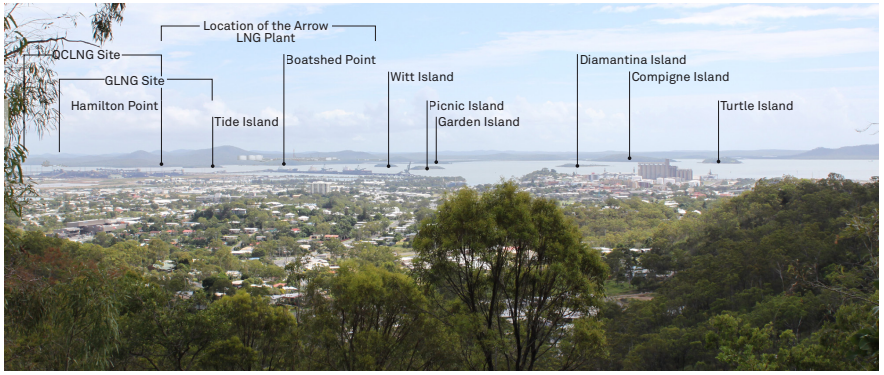
Viewpoint 2a: View from Spinnaker Park

Viewpoint 2b: Twilight view from Spinnaker Park

Viewpoint 3: View from Gladstone CBD: junction of Goondoon Street and Yarroon Street

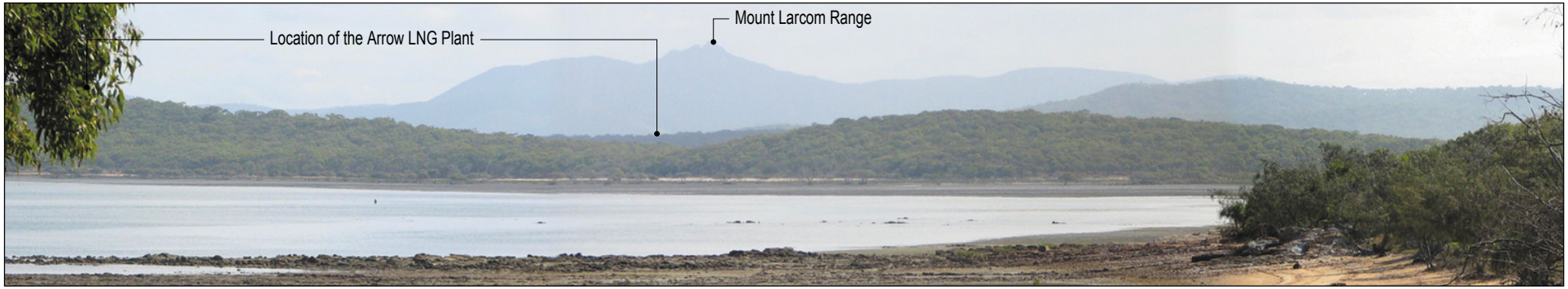
	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoints 2 - 3	Figure No: 25

Viewpoint 4a: View from Round Hill Lookout

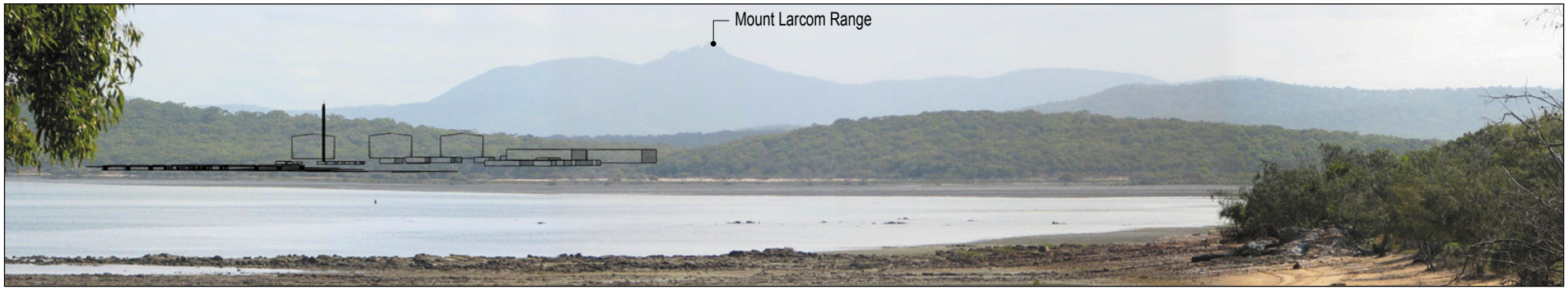


Viewpoint 4b: Artist Impression (Visualisation) showing potential view from Round Hill Lookout

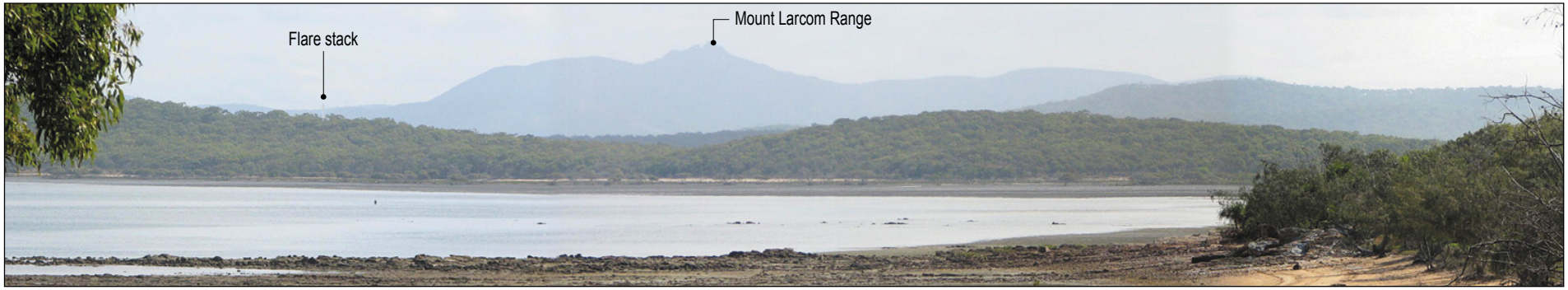
	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoint 4	Figure No: 26



Viewpoint 5a: View from South End



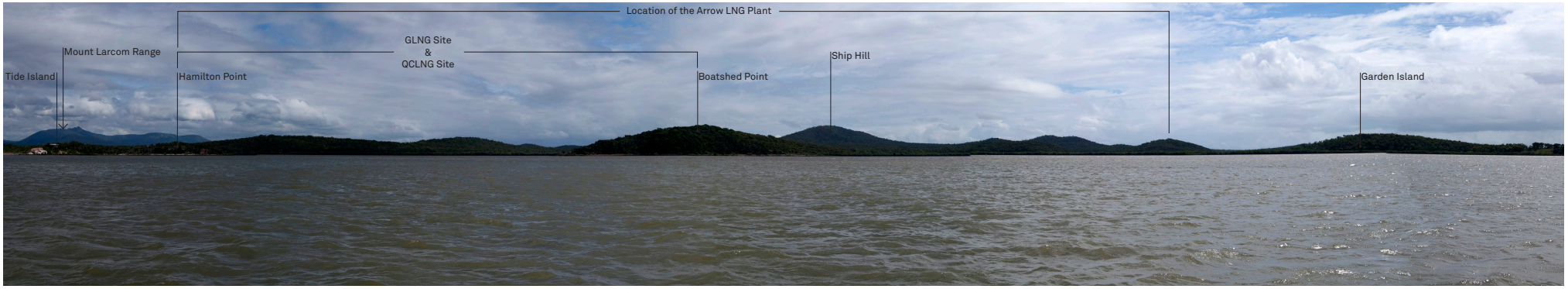
Viewpoint 5b: Simulation of site massing behind ridgeline



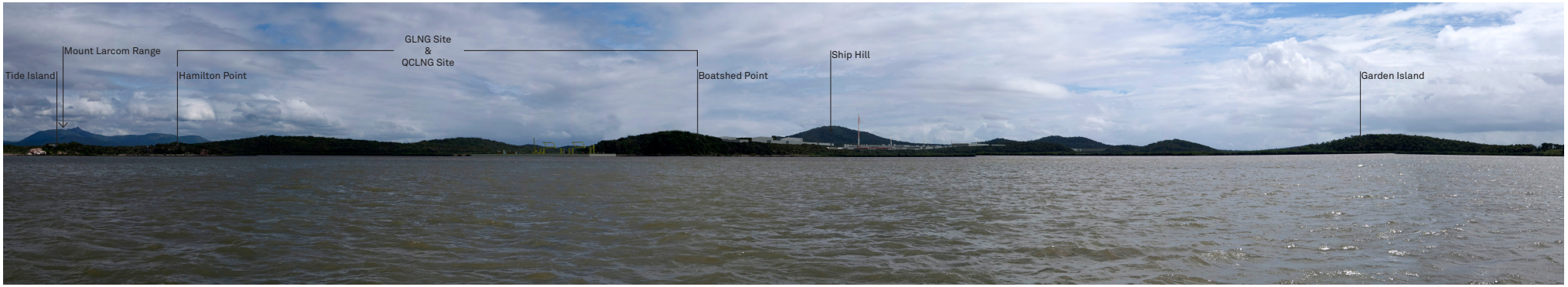
Viewpoint 5c: Artist impression (visualisation) showing potential view from South End

	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoint 5	Figure No: 27

Viewpoint 6: Day time view from Port Curtis by Turtle Island



Viewpoint 7a: View from Port Curtis by Witt Island

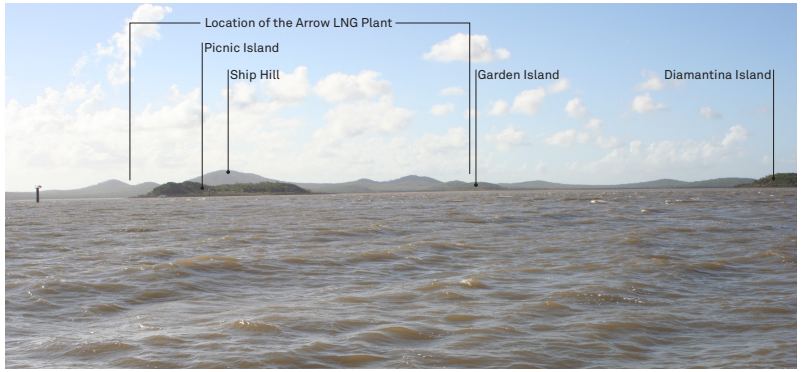


Viewpoint 7b: Artist impression (visualisation) showing potential view from Port Curtis by Witt Island

	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoints 6 - 7	Figure No: 28

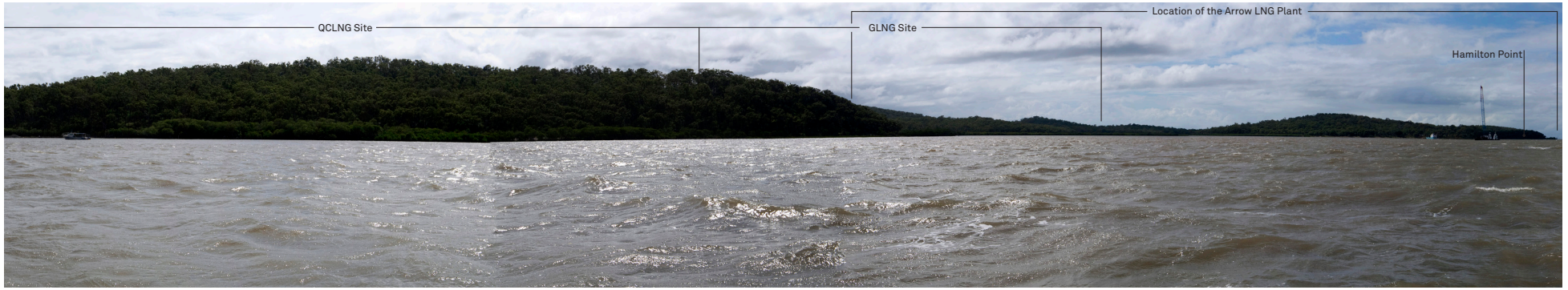
Viewpoint 8a: View from Port Curtis by Tide Island

Viewpoint 8b: Artist impression (visualisation) - View from Port Curtis by Tide Island

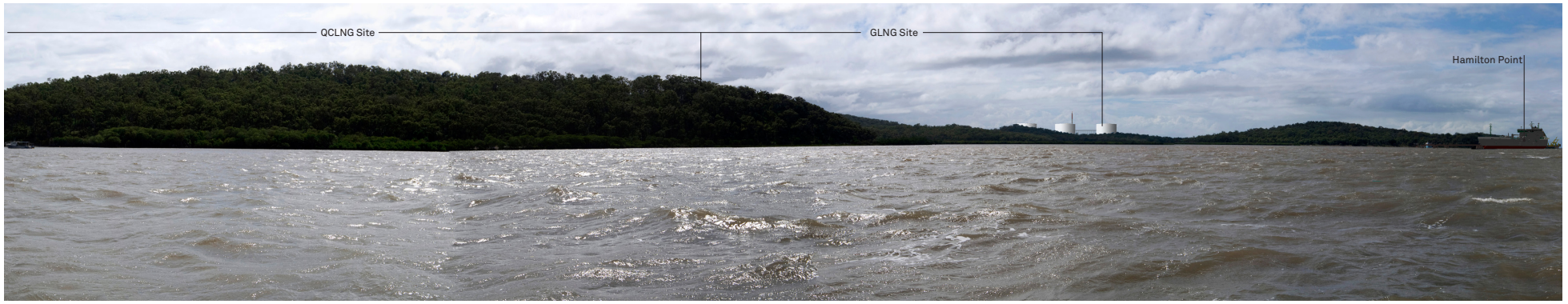


Viewpoint 9: View from the South End Ferry Service and the Main Shipping Channel

	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoints 8 - 9	Figure No: 29



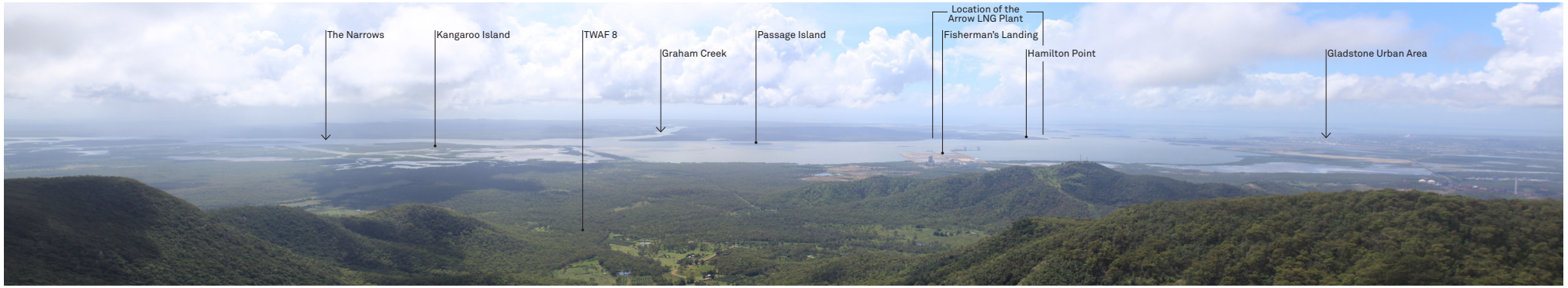
Viewpoint 10a: View from Port Curtis Shipping Channel



Viewpoint 10b: Artist impression (visualisation) showing potential view from Port Curtis Shipping Channel

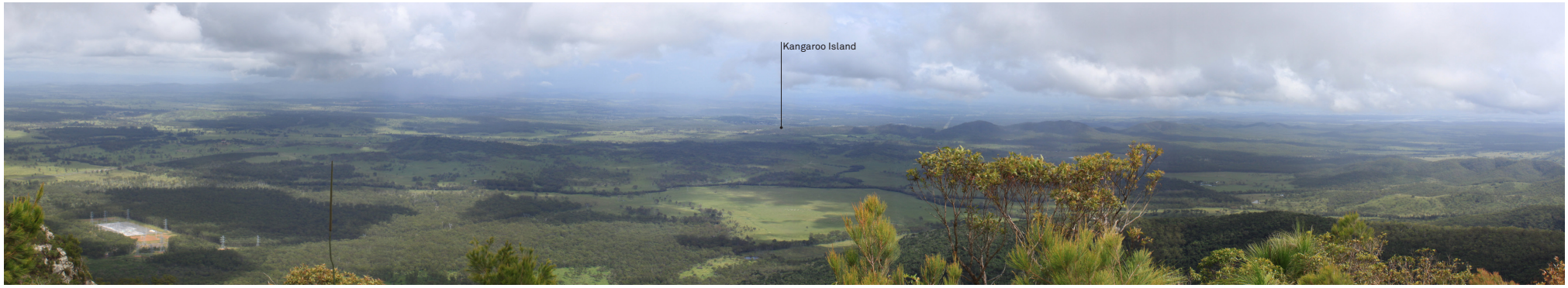
Viewpoint 11. View from Laird Point on Curtis Island

	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoints 10 - 11	Figure No: 30



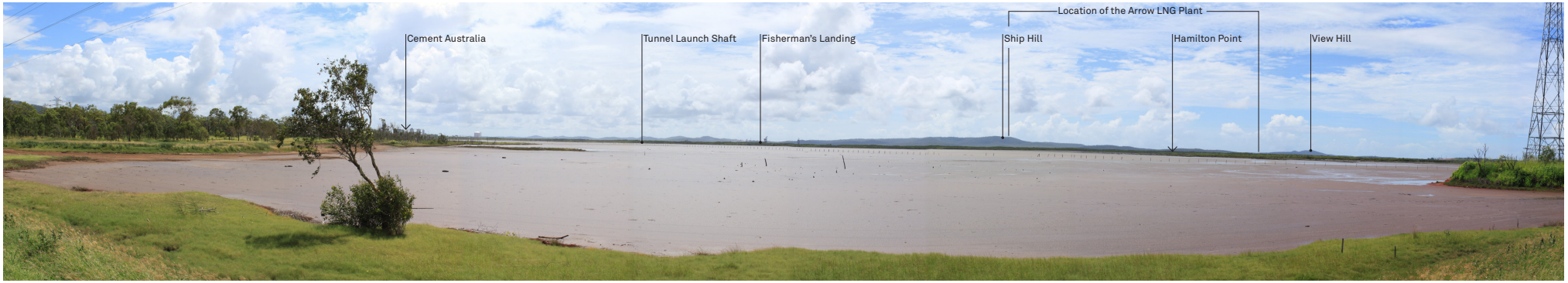
Viewpoint 12a: View from Mount Larcom Summit (east)

Viewpoint 12b: View from Mount Larcom Summit (north)



Viewpoint 12c: View from Mount Larcom Summit (west)

	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoints 12a - 12c	Figure No: 31



Viewpoint 13: View from Reid Road and Gladstone - Mount Larcom Road intersection (view from the end of Landing Road)

Viewpoint 14: View from Flinders Street towards TWAF 7

Viewpoint 15: View from Calliope River - Targinie Road, towards TWAF 8

	AECOM		Arrow Energy Arrow LNG Plant	arrow energy	Viewpoints 13 - 15	Figure No: 32

Viewpoint 13: View from Reid Road and Gladstone - Mount Larcom Road intersection (view from the end of Landing Road)

Viewpoint 14: View from Flinders Street towards TWAF 7

Viewpoint 15: View from Calliope River - Targinie Road, towards TWAF 8

	AECOM		Arrow Energy Arrow LNG Plant	arrowenergy	Viewpoints 13 - 15	Figure No: 32

5.3.4 Summary of Visual Impact Assessment

Table 23 summarises the visual impact assessment for the viewpoints described above. Impacts of moderate significance and above have been highlighted.

Table 23 Summary of Visual Impact Assessment Evaluation

Visual receptor	Sensitivity		Visual Magnitude of Change		Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts on Viewpoints						
Viewpoint 1: Auckland Point	High	*Construction*	**High**	**Medium**	**Moderate-Major**	**Moderate**
		Operation	**High**	**Medium**	**Moderate-Major**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
Viewpoint 2: Spinnaker Park	High	*Construction*	**Medium**	**Medium**	**Moderate**	**Moderate**
		Operation	**Medium**	**Medium**	**Moderate**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor-Moderate**	**Minor-Moderate**
Viewpoint 3: Gladstone CBD	Medium	*Construction*	**Medium**	**Medium**	**Minor - Moderate**	**Minor - Moderate**
		Operation	**Medium**	**Medium**	**Minor - Moderate**	**Minor - Moderate**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**
Viewpoint 4: Round Hill Lookout	High	*Construction*	**Medium**	**Medium**	**Moderate**	**Moderate**
		Operation	**Medium**	**Medium**	**Moderate**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor - Moderate**	**Minor-Moderate**
Viewpoint 5: South End	High	*Construction*	**Low**	**Low**	**Minor - Moderate**	**Minor - Moderate**
		Operation	**Low**	**Low**	**Minor - Moderate**	**Minor - Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
Viewpoint 6: Nr Turtle Island	Medium	*Construction*	**High**	**High**	**Moderate**	**Moderate**
		Operation	**High**	**High**	**Moderate**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**
Viewpoint 7: Nr Witt Island	Medium	*Construction*	**Very High**	**High**	**Moderate - Major**	**Moderate**
		Operation	**Very High**	**High**	**Moderate - Major**	**Moderate**
		Decommissioning	**Medium**	**Medium**	**Minor - Moderate**	**Minor-Moderate**
Viewpoint 8: Tide Island	Medium	*Construction*	**Very High**	**High**	**Moderate - Major**	**Moderate**
		Operation	**Very High**	**High**	**Moderate - Major**	**Moderate**
		Decommissioning	**Medium**	**Medium**	**Minor - Moderate**	**Minor-Moderate**
Viewpoint 9: South End Ferry	Medium	*Construction*	**High**	**High**	**Moderate**	**Moderate**
		Operation	**High**	**High**	**Moderate**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**
Viewpoint 10: Close to	Medium	*Construction*	**Very High**	**High**	**Moderate-Major**	**Moderate**

Visual receptor	Sensitivity		Visual Magnitude of Change		Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts on Viewpoints						
Shipping Channel		*Operation*	**Very High**	**High**	**Moderate-Major**	**Moderate**
		Decommissioning	**Low**	**Low**	**Minor**	**Minor**
Viewpoint 11: Laird Point	High	*Construction*	**Medium**	**Low**	**Moderate**	**Minor-Moderate**
		Operation	**Medium**	**Low**	**Moderate**	**Minor-Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
Viewpoint 12: Mount Larcom	High	*Construction*	**High**	**Medium**	**Moderate - Major**	**Moderate**
		Operation	**High**	**Medium**	**Moderate - Major**	**Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
Viewpoint 13: Reid Road	Low	*Construction*	**High**	**High**	**Minor – Moderate**	**Minor – Moderate**
		Operation	**Medium**	**Low**	**Minor**	**Minor-Negligible**
		Decommissioning	**Low**	**Low**	**Minor – Negligible**	**Minor – Negligible**
Viewpoint 14: Flinders Street	Medium	*Construction*	**High**	**High**	**Moderate**	**Moderate**
		Operation	**No impact**	**No impact**	**No impact**	**No impact**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
Viewpoint 15: Calliope River-Targinie Road	Medium	*Construction*	**High**	**High**	**Moderate**	**Moderate**
		Operation	**Medium**	**Medium**	**Minor - Moderate**	**Minor - Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**

Effect on Sensitive Receptors:

In summary, the project could be viewed by a large number of people living or working in Gladstone or travelling along roads and waterways within and around the study area. Given, that the LNG plant is located over 5.0 km from most sensitive viewers (e.g., residents and road users) due to the presence of Port Curtis, it is predicted that the obstruction of sunlight during the construction and eventual operation would not occur so visual impacts are limited to impacts on the attractiveness and character of the view in the daytime or night-time effects due to facility lighting (considered in **Section 5.4** below).

The most sensitive viewpoints are from scenic lookouts and parks that may be expected to have a large number of viewers whose interest is focussed on landscape appreciation. These include Auckland Point, Spinnaker Park, Round Hill Lookout and the summit of Mount Larcom. Viewpoints from Port Curtis have generally been ascribed a medium sensitivity to change grading, since these generally have lower numbers of viewers. Only one vantage point has been ascribed a low level of sensitivity relating. This is on a road and where the viewers' proprietary interest is not anticipated to be on landscape appreciation.

The most significantly affected group of views are those obtained from Port Curtis immediately south of the LNG plant which are close views experienced by potentially sensitive viewers. Three of the representative viewpoints (Viewpoints 7, 8 and 10) located close to Witt, Tide and South Passage islands are anticipated to sustain impacts of moderate to major significance against the project scenario. The proportion of change viewed in these views is generally high during both construction and operation phases. However, all of these views would be affected by the presence of the consented GLNG, QCLNG, and Fishermans Landing Northern Expansion projects. These decrease the relative magnitude of most impacts associated with the Arrow LNG Plant because the greatest

visual impacts are related to the incursion of industrial activities across Port Curtis onto the natural landscape of Curtis Island. Against the natural baseline the Arrow LNG Plant would be a dominant change. However, in the context of the baseline approved LNG Plants, the Arrow LNG Plant would appear considerably less noticeable. Against this baseline, the greatest level of visual impact anticipated to be sustained in views from Port Curtis would be moderate.

Similarly, from the mainland the most significantly affected views are those obtained from the elevated vantage points of Round Hill (Viewpoint 4) and Auckland Point (Viewpoint 1) within the City of Gladstone and from Mount Larcom (Viewpoint 12). The greatest impact on these views under the project scenario will be the incursion of industrial activity into the currently natural landscape of Curtis Island, albeit these vantage points are experienced in the context of existing industrial activity. Where a lower magnitude of change grading has been given (medium or low), this is generally in locations where land cover such as RG Tanna Coal Terminal wharfs (Viewpoint 2) intrudes on the view and is anticipated to screen most of the project. For each of these viewpoints the significance of the impact when viewed against the baseline scenario decreases to moderate.

For most viewpoints construction and operational impacts are considered to have the same level of significance of visual impact. At decommissioning the impact reduces for nearly all views to, at greatest, minor-moderate.

MOF, TWAF and Launch Sites:

With regards to the assessment of the MOF options, the MOF on Boatshed Point (MOF1) would be visible from many of the selected viewpoints including from the mainland lookouts. The MOF at South Hamilton Point would, be visible from the northern part of Port Curtis, including the passage leading into The Narrows. Overall, in the context of the scale of the project, the visual impact of the MOFs is a minor concern. For similar reasons, the contribution of the various Launch Site options to the visual impact of the Arrow LNG Plant is minor when experienced from the selected vantage points. Launch Site 1 Is visible to a greater extent from the Narrows whereas Launch Site 4N affects from the vicinity of the Gladstone CBD to a greater extent.

With regards to the mainland TWAF options, the significance of the impact of both on the viewpoints at construction phase is assessed to be moderate due to a medium level of sensitivity (residents for TWAF 7 and state forest users for TWAF 8) and high level of visual impact anticipated. TWAF 8 is likely to be visible from sensitive recreational viewpoints such as Mount Larcom and would (temporarily) introduce buildings into a quiet rural landscape with high visual amenity. The impacts of TWAF 8 are likely to extend into the operation phase as the loss of vegetation will still affect the visual character of the landscape. The visual impacts of TWAF 7 relate to its location close to a residential area of Gladstone. However, the site is the former ash pond of Gladstone NRG Power Station and most views of the site would not be elevated to the extent illustrated by Viewpoint 14.

5.4 Landscape and Visual Impacts of Lighting

This section considers the landscape and visual impacts of lighting associated with the LNG plant and associated infrastructure, mainland tunnel launch site and tunnel spoil disposal area, MOF and TWAF sites. This assessment only considers the landscape and visual impacts of the LNG plant lighting in relation to the projects rural or natural setting and, on views obtained by visually sensitive receptors (particularly residents and recreational users). The impact of lighting on navigation of vessels in Gladstone harbor, from increased vehicular and rail movements at night and the potential impacts of lighting on fauna habitats, are considers in other technical studies. The impacts of lighting are considered against the lighting baseline assessment (existing conditions) presented in Section 4.6 and on the basis of the assumed lighting impacts presented in **Table 18**.

5.4.1 Summary of Landscape and Visual Impacts of Lighting

This is a summary of the landscape and visual impacts of the lighting. For full details refer to **Appendix 3**.

The exact impact or acceptability of night lighting is difficult to define as it is dependent on individual perceptions and sensitivities as well as the presence of existing light at the viewing source. Given this difficulty, this assessment has been undertaken in a qualitative way to explore the impacts on key landscape and visual resources, as opposed to a quantitative assessment.

The impact of lighting is affected by atmospheric conditions and the level of moon light. This assessment has considered the worst case scenario, when atmospheric conditions are assumed to be clear and moon lighting is minimal. Currently there are no light sources from the LNG plant site on Curtis Island and it is considered to be an intrinsically dark landscape. However it is not a remote site and is influenced by existing artificial light sources in the LVIA study area and is therefore assessed to be an Environmental Zone E2: Low district brightness. It is in

relatively close proximity to other industrial facilities which generate relatively high levels of light pollution or spill sources into the surrounding areas e.g., the highly lit and visible RG Tanna Coal terminal is approximately 4 km immediately south and Clinker Wharf and Cement Australia at Fishermans Landing is approximately 6 km due west of the LNG plant. These are illustrated on **Figure 20**. The assessment also considers the implications of the baseline consented schemes on the relative contribution of the Arrow LNG Plant to lighting impacts i.e. the QCLNG and GLNG projects.

An assessment of the lighting impacts on designated areas is not required as it is considered through the landscape assessment. A range of significance levels were identified, ranging from negligible to major as summarised in **Table 24** below. Impacts rated as being of moderate significance or above have been highlighted.

Table 24 Summary table of assessment of significance of night-time effects on landscape character

Landscape receptor	**Sensitivity to light**		**Landscape Magnitude of Change**		**Judgement of Significance of Landscape Impact**	
			Project	**Baseline**	**Project**	**Baseline**
Impacts of lighting on Landscape Character						
LCT 1: Forested Mountain or Ridge	Medium	*Construction*	**Medium**	**Medium**	**Minor to moderate**	**Minor-Moderate**
		Operation	**High**.	**High**	**Moderate**	**Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 2: Undulating or Flat Forest	Medium	*Construction*	**Medium**	**Medium**.	**Minor to moderate**	**Minor-Moderate**
		Operation	**High**	**High**	**Moderate**	**Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 3: Wooded Rural	Medium	*Construction*	**Medium**	**Medium**	**Minor to moderate**	**Minor to moderate**
		Operation	**No impact**	**No impact**	**No impact**	**No impact**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 4: Open Rural	Medium	*Construction*	**Medium**	**Medium**	**Moderate**	**Moderate**
		Operation	**No impact**	**No impact**	**No impact**	**No impact**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 5: Industrial / Extractive Industries	Negligible	*Construction*	**Low**	**Low**	**Negligible**	**Negligible**
		Operation	**Low**	**Low**	**Negligible**	**Negligible**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 6: Urban	Low	*Construction*	**Medium**	**Medium**.	**Minor**	**Minor**
		Operation	**Medium**	**Medium**	**Minor**	**Minor**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 7: Coastal or Estuarine Plain	Medium	*Construction*	**High**	**High**	**Moderate**	**Moderate**
		Operation	**High**	**High**	**Moderate**	**Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
LCT 8: Waterscape	Medium	*Construction*	**High**	**High**	**Moderate**	**Moderate**
		Operation	**High**	**High**	**Moderate**	**Moderate**

Landscape receptor	Sensitivity to light		Landscape Magnitude of Change		Judgement of Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Landscape Character						
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**

Table 25 Assessment of significance of night-time effects on viewpoints

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
Viewpoint			Project	Baseline	Project	Baseline
Impacts of lighting on Viewpoints						
1. View from Auckland Point	Medium	*Construction*	**High**	**Medium**	**Moderate**	**Minor to Moderate**
		Operation	**Very high**	**High**	**Moderate to Major**	**Moderate**
		Decommissioning	**No impact**	**No impact:**	**No impact**	**No impact**
2.View from Spinnaker Park	Medium	*Construction*	**Medium**	**Medium**	**Minor to Moderate**	**Minor to Moderate**
		Operation	**High**	**Medium**	**Moderate**	**Minor to Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
3.View from Gladstone CBD	Medium	*Construction*	**Low**	**Low**	**Minor**	**Minor**
		Operation	**Medium**	**Medium**	**Minor to Moderate**	**Minor to Moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
4. View from Round Hill Lookout	Medium	*Construction*	**Low**	**Low**	**Minor**	**Minor**
		Operation	**Low**	**Low:**	**Minor**	**Minor**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
5. View from South End	Medium	*Construction*	**No impact:**	**No impact**	**No impact**	**No impact**
		Operation	**Low**.	**Low**	**Minor**	**Minor**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
6. View from Port Curtis by Turtle Island	Low (medium relating to Turtle Island residents)	*Construction*	**High**	**High**	**Minor to moderate** (moderate relating to Turtle Island residents)	**Minor to moderate** (moderate relating to Turtle Island residents)
		Operation	**Very high**	**Very high**	**Moderate** (moderate to major for Turtle Island residents)	**Moderate** (moderate to major for Turtle Island residents)

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
Viewpoint			**Project**	**Baseline**	**Project**	**Baseline**
Impacts of lighting on Viewpoints						
		Decommissioning	**No impact**	**No impact:**	**No impact**	**No impact**
7. View from Port Curtis by Witt Island	Low (medium relating to Witt Island residents)	*Construction*	**High**:	**High**	**Minor to moderate** (moderate relating to Witt Island residents)	**Minor to moderate** (moderate relating to Witt Island residents)
		Operation	**Very high**	**Very high**	**Moderate** (moderate to major for Witt Island residents)	**Moderate** (moderate to major for Witt Island residents)
		Decommissioning	**No impact**	**No impact:**	**No impact**	**No impact**
8. View from Port Curtis by Tide Island	Low (medium relating to Tide Island residents)	*Construction*	**Very high**	**Very high**	**Moderate** (moderate to major relating to Tide Island residents)	**Moderate** (moderate to major relating to Tide Island residents)
		Operation	**Very high**	**Very high**	**Moderate** (moderate to major for Tide Island residents)	**Moderate** (moderate to major for Tide Island residents)
		Decommissioning	**No impact**	**No impact:**	**No impact**	**No impact**
9. View from the South End Ferry Service and the Main Shipping Channel	Low	*Construction*	**High**	**Medium**	**Minor to Moderate**	**Minor**
		Operation	**High**	**Medium**	**Minor to Moderate**	**Minor**
		Decommissioning	**No impact:**	**No impact:**	**No impact**	**No impact**
10. View from Port Curtis Shipping Channel	Low	*Construction*	**High**	**Medium**	**Minor to Moderate**	**Minor**
		Operation	**Very high**	**High**	**Moderate**	**Minor to moderate**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**
11. View from Laird Point on Curtis Island	Medium	*Construction*	**Low**	**Low**	**Minor**	**Minor (negligible)**
		Operation	**Medium**	**Low**	**Minor to moderate**	**Minor**
		Decommissioning	**No impact**	**No impact:**	**No impact**	**No impact**
12. View from Mount Larcom Summit	Negligible	*Construction*	**Medium**	**Low**	**Negligible**	**Negligible**
		Operation	**Low**	**Low**	**Negligible**	**Negligible**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
Viewpoint			**Project**	**Baseline**	**Project**	**Baseline**
Impacts of lighting on Viewpoints						
13. View from Reid Road and Gladstone - Mount Larcom Road intersection	Negligible	*Construction*	**High**	**High**	**Minor**	**Minor**
		Operation	**Medium**	**Low**	**Negligible**	**Negligible**
		Decommissioning	**No impact**	**No impact:**	**No impact**	**No impact**
14. View from Flinders Street	Medium	*Construction*	**Medium**	**Medium**	**Minor to moderate**	**Minor to moderate**
		Operation	**No impact**	**No impact**	**No impact**	**No impact**
		Decommissioning	**No impact**	**No impact:**	**No impact**	**No impact**
15. View from Calliope River-Targinie Road	Medium	*Construction*	**Medium**	**Medium**	**Minor to moderate**	**Minor to moderate**
		Operation	**No impact**	**No impact:**	**No impact**	**No impact**
		Decommissioning	**No impact**	**No impact**	**No impact**	**No impact**

Against the baseline condition of the two other approved and brightly lit LNG plants on Curtis Island the magnitude of the impact arising from the lighting of the Arrow LNG Plant would be lower than against the project scenario which assumes an 'undeveloped' context to the Arrow LNG plant. Accordingly the significance of the impact also diminishes as the Arrow LNG Plant would be viewed against a lit context (as opposed to the inherently dark landscape (Lighting Zone E2) that currently characterises Curtis Island).

Against the baseline, the construction impact of lighting is judged to be, at greatest, of moderate significance on landscape receptors and moderate on visual receptors. Key light sources on Curtis Island during the construction phase are the perimeter security lights, construction vehicles and lighting associated with the construction camp. The construction camp at Boatshed Point, is anticipated to be a highly visible lit component in very close proximity to a small handful of sensitive visual receptors i.e., residents on Tide and Witt Islands and recreational water vehicles. The lighting impacts during this phase have been limited by Arrow Energy's commitment to minimise night work at the LNG plant beyond 7pm (as discussed previously) reducing the duration of lighting impacts. At the construction phase lighting impacts would also be experienced associated with the TWAF7 and TWAF8 sites. At operation these facilities will not be present so there would be no impacts at this time.

Even though there are some differences between the lighting associated with the construction and operation phases the overall significance of the impacts is predicted to be the similar for most receptors during construction and operation phases. Key light sources during the operation phase are anticipated to be fixed permanent lights (i.e., perimeter fencing, operational lighting and maritime lighting), the pilot light from the flare and intermittent emergency flaring.

Many of the viewpoints were assessed to have a lower sensitivity to night time lighting impacts than to day time views. This is because many of the viewpoints, particularly those associated with the Port Curtis islands, will have very infrequent visitation at night and those in the area are not likely to be focused on landscape appreciation. Whilst individually residents are more sensitive, there are very few residents living on these islands. The greatest operational impacts on a landscape receptor are the moderate impacts experienced by LCT1, LCT2, LCT7 and LCT8. These four LCTs are predicted to sustain a "high" magnitude of change as they are either directly impacted by the proposal or located in close proximity to the site. These landscapes are currently not lit, however their character is already influenced by other significant light sources in relatively close proximity. Existing key sources of artificial light include Clinton Coal Terminal, approximately 4 km south and Cement Australia at Fishermans Landing. Overall the introduction of new artificial light onto Curtis Island, will extend the current lighting found on

the mainland over Port Curtis and onto Curtis Island, and intensify the existing light levels in the study area, particularly on the waterscape of Port Curtis.

There are no sensitive local viewing locations at close distance on Curtis Island. South End is over 7 km east of the LNG plant. The most significant night time effects on views are the moderate / moderate to major impacts experienced by users of lookouts in Gladstone (particularly Auckland Point) and on residents living on Turtle, Witt and Tide Island. However, against the baseline these impacts diminish to minor – moderate/moderate. Impacts from the vantage points on Port Curtis would be higher, except it is anticipated that few viewers would be on the water after dark. Indirect and direct light pollution sources are predicted i.e., gentle sky glow and bright "spots", from some sources such as the elevated flaring. Some of the existing light sources actually assist in obscuring some views e.g., Clinton Coal Terminal and Wharf obscures some of the view for users of Spinnaker Park (i.e., Viewpoint 2). The views selected from Gladstone represent the worst case scenario and thus the significance of the impacts is higher than that anticipated on LCT 6: Urban as a whole. For most other visual receptors in Gladstone, the majority of the impact of additional light is anticipated to represent an increase in sky glow, with the exception of the intermittent visual impact of the elevated gas flaring during upset conditions. The effects are anticipated to not generally be apparent from within the residences at Gladstone at night when the internal house lights are on or from the immediate area around the residences when external lighting is on. Given the distance (i.e., over 4 km) of these receptors from this gas venting, the visual impact is predicted to be minor – negligible. The same is predicted for residents in South End and those on Facing Island.

With regards to the MOF options it is noted that these make a minor contribution to the night-time visual impact as they are low-lying (in contrast to more prominent lit structures such as the flare). Lighting associated with the Boatshed Point MOF would be visible in night-time views from the City of Gladstone including the key vantage points such as Auckland Point.

TWAF7 would have little impact on lighting impact as it is located in a currently lit landscape associated with the urban area of Gladstone. Lighting associated with TWAF8 would be noticeable as it is located in an area that is currently quiet and dark.

At decommissioning it is not anticipated that any lighting impact would remain as the sites would no longer be lit.

5.5 Summary of Landscape and Visual Impact

Table 26 summarises the significance of the landscape and visual impacts discussed in the preceding chapters.

Table 26 Summary table of assessment of effects

Sensitive Receptor	Significance: Construction	Significance: Operation	Significance: Night-time (greatest impact for either construction or operation)	Significance: decommissioning
Visual Receptor - Viewpoints (Viewpoint assessment for the view from the following locations)				
Viewpoint 1: Auckland Point	**Moderate - Major**	**Moderate-Major**	**Moderate - Major**	**Minor- Moderate**
Viewpoint 2: Spinnaker Park	**Moderate**	**Moderate**	**Moderate**	**Minor - Moderate**
Viewpoint 3: Gladstone CBD	**Minor-Moderate**	**Minor-Moderate**	**Minor-Moderate**	**Minor**
Viewpoint 4: Round Hill Lookout	**Moderate**	**Moderate**	**Minor**	**Minor- Moderate**
Viewpoint 5: South End	**Minor-Moderate**	**Minor-Moderate**	**Minor**	**No impact**
Viewpoint 6: Port Curtis near Turtle Island	**Moderate**	**Moderate**	**Moderate**	**Minor**

Sensitive Receptor	Significance: Construction	Significance: Operation	Significance: Night-time (greatest impact for either construction or operation)	Significance: decommissioning
Visual Receptor - Viewpoints (Viewpoint assessment for the view from the following locations)				
Viewpoint 7: Port Curtis near Witt Island	**Moderate-Major**	**Moderate-Major**	**Moderate - Major**	**Minor-Moderate**
Viewpoint 8: Port Curtis by Tide Island	**Moderate-Major**	**Moderate-Major**	**Moderate - Major**	**Minor-Moderate**
Viewpoint 9: South End Ferry	**Moderate**	**Moderate**	**Minor- Moderate**	**Minor**
Viewpoint 10: close to Shipping Channel	**Moderate - Major**	**Moderate-Major**	**Moderate**	**Minor**
Viewpoint 11: Laird Point on Curtis Island	**Moderate**	**Moderate**	**Minor-Moderate**	**No impact**
Viewpoint 12: Mount Larcom Summit	**Moderate - Major**	**Moderate- Major**	**Negligible**	**No impact**
Viewpoint 13: Reid Road and Gladstone-Mount Larcom Road intersection	**Minor - Moderate**	**Minor**	**Negligible**	**Minor- Negligible**
Viewpoint 14: Flinders Street near Forest Road	**Moderate**	**No impact**	**Minor-Moderate**	**No impact**
Viewpoint 15: Calliope River-Targinie Road	**Moderate**	**Minor-Moderate**	**Minor -Moderate**	**No impact**
Landscape Receptor – Designated Landscapes				
Great Barrier Reef World Heritage Area	**Moderate**	**Moderate**	**N/A**	**Minor - Moderate**
Great Barrier Reef Marine Park	**Minor - Moderate**	**Minor - Moderate**	**N/A**	**Minor - Moderate**
Australian Heritage Commission Register of National Estate:				
The Narrows	**Moderate**	**Moderate**	**N/A**	**Minor - Moderate**
Garden Island Conservation Park	**Moderate - Major**	**Minor - Moderate**	**N/A**	**Minor - Moderate**
Mount Larcom	**No impact**	**No impact**	**N/A**	**No impact**
Curtis Coast Regional Coastal Management Plan				

Sensitive Receptor	Significance: Construction	Significance: Operation	Significance: Night-time (greatest impact for either construction or operation)	Significance: decommissioning
Visual Receptor - Viewpoints (Viewpoint assessment for the view from the following locations)				
(2003)				
Islands and Offshore Features	**Moderate**	**Moderate**	**N/A**	**Minor - Moderate**
Coastal Wetlands	**Minor - Moderate**	**Moderate**	**N/A**	**Minor**
Narrows Estuary	**Minor - Moderate**	**Minor - Moderate**	**N/A**	**Minor**
Riverine Creeks and Corridors	**Minor**	**Minor**	**N/A**	**No impact**
Curtis Island Strike Ridge	**Moderate**	**Moderate**	**N/A**	**Minor**
Mount Larcom Range	**Negligible**	**Negligible**	**N/A**	**Negligible**
Targinie State Forest	**Minor**	**No impact**	**N/A**	**No impact**
Landscape Receptor –Landscape Character				
LCT 1: Forested Mountain or Ridge	**Moderate – Major**	**Moderate – Major**	**Moderate**	**Minor – Moderate**
LCT 2: Undulating or Flat Forest	**Moderate – Major**	**Moderate – Major**	**Moderate**	**Minor**
LCT 3: Wooded Rural	**Minor - Moderate**	**Minor – Moderate**	**Minor – Moderate**	**Minor**
LCT 4: Open Rural	**Minor**	**No impact**	**Moderate**	**No impact**
LCT 5: Industrial/Extractive Industries	**Negligible**	**Negligible**	**Negligible**	**Negligible**
LCT 6: Urban	**Negligible**	**Negligible**	**Minor**	**No impact**
LCT 7: Coastal/Estuarine Plain	**Moderate – Major**	**Moderate – Major**	**Moderate**	**Minor – Moderate**
LCT 8: Waterscape	**Minor – Moderate**	**Minor – Moderate**	**Moderate**	**Minor**

.

6.0 Avoidance, Mitigation and Management Measures

Mitigation measures have been developed based upon a hierarchy of:

- *Avoid* – prevent the impact occurring i.e., through site selection and siting of infrastructure.
- *Minimise* – limit the extent of the impact e.g., through minimising the height of intrusive elements.
- *Manage* – limit the impact e.g., through ongoing vegetation management to restrict views.

The development of the mitigation measures has had regard to the management measures for the various scenic coastal landscapes identified in the Curtis Coast Regional Coastal Management Plan. This includes the following key landscape features and the management measures (extracted from Schedule 1 of the CCRCMP):

1) Curtis Island is identified as "Islands and off shore features". The measures stated are: "*Ensure the development remains unobtrusive and compatible with landscape values"* and "*Screen access points from other development from viewpoints."*

2) Curtis Island and The Narrows are identified as "Coastal wetlands". Key scenic amenity management measures stated are: "*Minimise visual breaks in areas of continuous mangrove vegetation"* and "*Maintain existing vegetation along waterways to a maximum extent to form natural landscape edge and screen*."

3) The Narrows is identifies as "Estuaries and inlets". Key scenic amenity management measures stated are: "*Minimise visual breaks in areas of continuous vegetation"; "Maintain existing vegetation along waterways to a maximum extent to form a natural landscape edge and screen"* and *"Ensure infrastructure in areas of high visual quality does not obscure views to water or intrude on waterways."*

4) Numerous creeks are identified as "riverine corridors and creeks". Key scenic amenity management measures stated are: "*Maintain creek corridors and riverine vegetation within developments and rural lands, forming a linear open space corridors"* and "*Rehabilitate degraded or fragmented corridors vegetation forming part of visual edges to form a continuous band of vegetation."*

5) Curtis Island strike ridge system and Mount Larcom Ranges are identified as "Coastal Mountain ranges": Key scenic management measures stated are: "*Avoid clearing of vegetation on ridgelines, skylines or other highly visible areas; Encourage rehabilitation planting in denuded areas; Avoid or screen visual scarring associated with roads, development or other infrastructure"* and "*Limit development to below ridgelines."*

6.1 Mitigation Proposals

The avoidance, mitigation and management measures have been divided into the following sections:

- Avoidance through concept and detailed design.
- Mitigation during construction, operation and at decommissioning.
  - Vegetation.
  - Earthworks.
  - Built Form.
  - Lighting.

6.1.1 Avoidance through concept design

A range of measures have been incorporated into the LNG Plant concept design that will limit the landscape and visual impacts of the proposal. These measures have been factored into the impact assessment evaluations presented in the previous section but are described here for completeness:

- Protection of the tip of Boatshed Point from clearing and cutting to preserve areas of vegetation that assist in screening lower parts of the LNG plant and construction camp in views.
- Where possible maintaining vegetation along the eastern boundary of the LNG plant site to provide some screening to views from the east.
- Detailed terracing of the landform using breaks within the project area that mimic natural contours to reduce cut and fill and attempt to 'lower' infrastructure into the natural landform.
- Detailed siting of site components such as laydown areas and camp buildings at TWAF8 to protect the creek and some of the vegetation

- Avoiding construction impacts on Targinie Creek and associated vegetation within TWAF8.
- Limiting night time working and associated lighting impacts for some activities including construction of the LNG plant (construction activities generally restricted to between the hours of 7am and 7pm, except during exceptional circumstances and where large modules arrive).

6.1.2 Avoidance through detailed design

The following site planning activities are recommended to assist in integrating the facilities into their landscape and visual context:

- Where there are options for the siting of different infrastructure, consider landscape and visual impacts alongside other factors in determining which option is selected. .
- Consider development of an Environmental Compliance Plan including landscape and rehabilitation/decommissioning proposals for the elements of the project, particularly the selected TWAF site which will require remediation after the first construction phase.
- Where possible make further modification in the detailed design of the development footprint to:
  - Minimise cutting into the high ground of the Curtis Island Strike Ridge System (including Ship Hill). This would assist in maintaining a vegetated backdrop and visually absorbing the built form of the development into the landscape. This is particularly important when viewed from the mainland and Port Curtis.

6.1.3 Mitigation during construction

- For the construction camp: Given the potential high visibility of the construction camp utilise industry standard to minimise the landscape and visual impacts and intrusion on these sites. For example, fence off areas of vegetation to be maintained to minimise the vegetation clearance and protect vegetative buffers (e.g., on boundaries and street tree provision). Limit the overall height of buildings to stay below the maintained ground level of the front of Boatshed point to the greatest extent possible.
- Restrict movement of personnel and construction activities to the greatest extent possible, particularly at night when lighting effects would also be evident. Where possible during construction phase seek to restrict LNG plant construction and pipe laying activities after 7pm as already proposed by Arrow Energy and described in **Table 17** above.
- Site stockpiles within lay down areas with regard to visibility i.e., use those laydown areas that are more enclosed in preference to more open areas wherever possible.
- Maintain a high standard of site cleanliness and presentation at all times. Fencing and signage should present a positive image of Arrow Energy and its contractors. Regularly remove rubbish and dispose of appropriately.
- Following completion of construction works in each area remove all temporary structures. As appropriate and as detailed in the technical studies considering impacts on soils and landforms, undertake detailed grading of disturbed surfaces to achieve appropriate ground levels; where possible matching pre-construction levels, particularly in riverine, estuarine and coastal locations where restoration of marine plants will depend on water/salinity levels.

6.1.4 Vegetation

- Investigate further retention of existing vegetation cover on area of disturbance insofar as this is possible without conflicting with the health and safety or construction/operation requirements of the project area. For example this could include exploring opportunities to avoid impacts on the marine vegetation west of the Boatshed Creek haul road.
- To the greatest extent consistent with the bushfire strategy, investigate further planting of forested landscape buffer around the eastern, southern and western boundaries, using bush regeneration techniques and endemic tree species of local provenance (as identified in the ecological technical study). This would assist in maintaining the visual integrity of the island edge and would provide a partially forested setting (assuming the forested backdrop and forested sides to the development are retained) for the LNG plant. In particular investigate the provision of a buffer between the area of disturbance and coastal plains and wetlands on the southern boundary of the LNG site on Curtis Island (i.e., Boatshed Point, and Hamilton Point). The buffer should be planted at the earliest possible time; either prior to or at the commencement of construction works and would need to be fenced off to protect it from disturbance. It should be located to screen the boundary

fence from external view. Wherever possible and visually appropriate incorporate excess spoil from site excavations into bunding at the base of buffer planting (topsoil zone must be included). This would increase the overall height of the screen planting.

- Except where the technical studies considering impacts on soils and landforms indicate an alternative approach, undertake planting rehabilitation works at the earliest opportunity to minimise erosion and the presence of areas of bare soil. Where appropriate, use a sterile cover crop on longer-term stockpiles.
- Seek opportunities to re-locate / sell /donate to environmental projects vegetation that can readily be transplanted e.g., Grass Trees.
- Reinstate the post-construction landscape with the greatest extent of tree/shrub cover commensurate with the natural community to provide a range of environmental functions. In undertaking rehabilitation works for the TWAF sites, aim to leave the site in a better condition than prior to construction works, with reference to the findings of the Flora report (Ecosure, 2011).
- At decommissioning, reinstate the post-operation landscape with the greatest extent of tree/shrub cover commensurate with the natural community with reference to the findings of the Flora report (Ecosure, 2011).

6.1.5 Earthworks

- Where terracing is undertaken investigate the provision of planting at the top, toe and on the retaining structure itself. Investigate provision of “green” retaining type structures e.g., perma crib, gabions or where the rock is stable leave as “exposed bedrock”. Avoid the use of shotcrete and plain concrete walls.
- Preserve site topsoil for re-use.
- Reinstate natural ground levels to the greatest extent possible, particularly in coastal regions to facilitate the return of mangroves and other salinity-level dependent natural vegetation.
- If terracing is considered impracticable, consider planting of bands of screening vegetation parallel with the shoreline between elements of the development, where health and safety requirements allow and make provision for screen planting along the top edge and toe of the retaining wall.
- Shore protection should be designed to reflect natural forms. Investigate utilising existing rock, potentially local materials that are excavated during the construction cutting activities.
- Use the excavated rock from area of disturbance in the LNG plant e.g., for hard standing areas (road, laydown areas), for the rock buffer (mattress protection) along the shoreline.

6.1.6 Built form

- Use a colour palette for built form that blends with the predominant background colours and which reflect natural hues from the surrounding landscape, e.g., insofar is compatible with health and safety requirements use darker recessive colours for elements viewed against a forested backdrop, such as black for fencing elements, neutral greys for elements that are likely to be sky lined, and olive greens for building walls and rooflines that are likely to be viewed against a vegetated backdrop. Paint selection should avoid reflective high gloss finishes to minimise reflection of sunlight. Consider opportunities to undertake discussions with other proponents to provide a suite of colours for key components that is uniform to all sites.
- Select materials that are sensitive to site context: Avoid materials that generate glare by using muted and ‘dull’ finishes wherever possible. Investigate the potential use of new “insulating’” paints that may allow greater flexibility in the colour of LNG structures without compromising safety aspects (it is noted the LNG storage tanks may need to be painted reflective white for safety reasons, but this has not yet been confirmed).
- Investigate an appropriate after use for the area of disturbance.
- Though detailed architectural design break up the built forms of plant and non plant buildings where feasible to reduce the “mass” and “bulk” of the buildings.
- Road barriers along the haul roads: investigate provision of barriers that are visually unobtrusive e.g., wire rope (brifen).

6.1.7 Lighting

To minimise the impact on sensitive receptors and the surrounding ecological environment there is a need to ensure light pollution and associated visual impacts at night are mitigated. The following strategies should be investigated for incorporation into the detailed lighting design:

- Detailed lighting design to be in line with Australian Standards.
- Requirement for aviation lighting to be consistent with Gladstone Airport Obstacle Limitation Surface Plan (OLS).
- Where practicable limit construction works of activities that would need to be highly lit to day-time hours to the greatest extent possible thus minimising the use of temporary lighting and the creation of night time visual impacts. It is noted that night-time construction activities will be likely as set out in **Section 5.1** and **Table 17** and **Table 18** above.
- Where practicable use “passive” lighting methods, such as the installation of reflectorised roadway markers, lines, warnings or information signs and furnishing reflectors.
- Where practicable use solar powered LED studs in roadways and paths of travel.
- Use directional lighting to focus only upon the area required to be illuminated.
- Investigate limiting the working hours of some external floodlit areas e.g., roadways, according to the requirements of site activities, safety and security.
- Use sensory lighting where possible i.e., in locations where permanent lighting is not required.
- Where practicable use high pressure sodium instead of low pressure sodium for street lighting: This produces light that covers all ranges within the electromagnetic spectrum thus improving colour rendition. This means that colours are seen normally and visual recognition is significantly improved.

7.0 Residual Impacts

Considering the impacts identified in **Section 5.0**and the avoidance, mitigation and management measures described in **Section 6.0**, the remaining residual impacts are summarised below. The residual impact assessment is based upon the same landscape and visual receptors and method of assessment from the main assessment. In determining the residual impact the sensitivity of receptors remains the same. However there is potential for the magnitude of change to decrease as a result of the proposed mitigation measures. This, in turn, can reduce the significance level of impact.

It is noted that whilst the identified mitigation measures would diminish the impacts at a localised (site) the LVIA concludes that none of the proposed mitigation measures would be sufficient to change the category of the impact significance assessment. This is because the size of the project components and technical requirement to be adjacent to open water mean there is little opportunity for measures that seek to 'screen' or 'hide' the facility within landform, such as are frequently used for other industrial projects i.e., there is no possibility of hiding the LNG storage tanks or flare stack behind vegetation due to their height and bulk.

Most of the potential measures that have the greatest ability to reduce landscape and visual impact have already been included in the concept design for the LNG plant. These design measures, which include terracing of the landform to better integrate the LNG plant and construction camp onto Curtis Island, are not considered in the residual impact assessment as they are an integral part of the LNG Plant being assessed. Therefore the additional measures proposed relate to 'small scale' activities such as buffer planting, which may locally reduce the perception of impacts but are not sufficiently 'bold' enough to change the magnitude category given the impossibility of using vegetation to screen facilities that exceed 40 m. Local mitigation *would* enhance the appearance of the site for local visual receptors e.g., recreation users of Port Curtis, particularly at a lower level where additional planting can help assimilate plant into the local landscape. However, whilst these receptors would benefit most from the on-site mitigation, the scheme is also (unavoidably) the most dominant in views obtained from these locations. Accordingly, whilst there are qualitative improvements arising from the proposed mitigation, the ability to change the magnitude of change (e.g. from dominant to considerable) to a lower category is minimal

At decommissioning the residual impact of the project would be of, at greatest, low landscape and visual significance for all effects identified. At this time revegetation of the affected sites would ensure they largely revert back to their former condition where they would be assimilated into the current character of the Gladstone landscape.

7.1.1 Inspection and Monitoring

Undertake a vegetation management regime in accordance with principles established in the ecological study (Ecosure, 2011) to maintain vegetation on and around the project site, particularly of those areas that assist in integrating the project into its landscape context through providing screening.

8.0 Cumulative Impacts

8.1 Introduction

As industrial development (particularly the for the LNG industry) expands in the Gladstone area, together with the continuation of other large-scale infrastructure such as new railway links (e.g., Moura to Aldoga); it is necessary to consider their cumulative landscape and visual impacts. A key concern is their visibility, but also their ancillary development such as access tracks, mobile camps, increased traffic on rural roads and their effect on the landscape. Of particular importance is:

- How these developments relate to each other in the design and relationship to their settings (e.g., massing, height, scale, form, style);
- Their frequency as one moves through the landscape i.e., as seen sequentially from main transport and recreational routes; and
- Their visual separation to allow experience of the character of the landscape in-between.

Cumulative effects may arise where a landscape character receptor or view is affected by more than one development, and where the study areas for two or more developments overlap so that they are experienced at proximity where they may have an incremental effect.

The cumulative situation changes frequently as applications are made or withdrawn. It is therefore necessary to decide on a cut-off date when the sites and layouts to be included are fixed. April 2011 has been used as a cut-off for this cumulative assessment; any changes in the development situation after this date have not been incorporated in the assessment.

With the onset of the GSDA, large scale, typically industrial development is anticipated to expand in the LVIA study area over the next 30 years. This will be accompanied by the development of other large-scale supporting infrastructure. The Arrow LNG Plant is part of the GSDA and also considered to comprise a large scale industrial development character; accordingly it is necessary to consider the cumulative landscape and visual impacts of the Arrow LNG Plant on the study area, in addition to other such developments.

The cumulative assessment methodology has been undertaken in line with **Section 3.0** These projects (including significant developments currently in construction, approved developments, or developments currently undertaking or have recently submitted an EIS) are located within proximity to the Arrow LNG Plant.

8.2 Projects included in the landscape and visual cumulative impact assessment

Table 27 below outlines the projects that meet the criteria in the methodology. The location of these projects is illustrated in **Figure 33** These projects have been assessed in the table below to determine if further cumulative impact assessment is required.

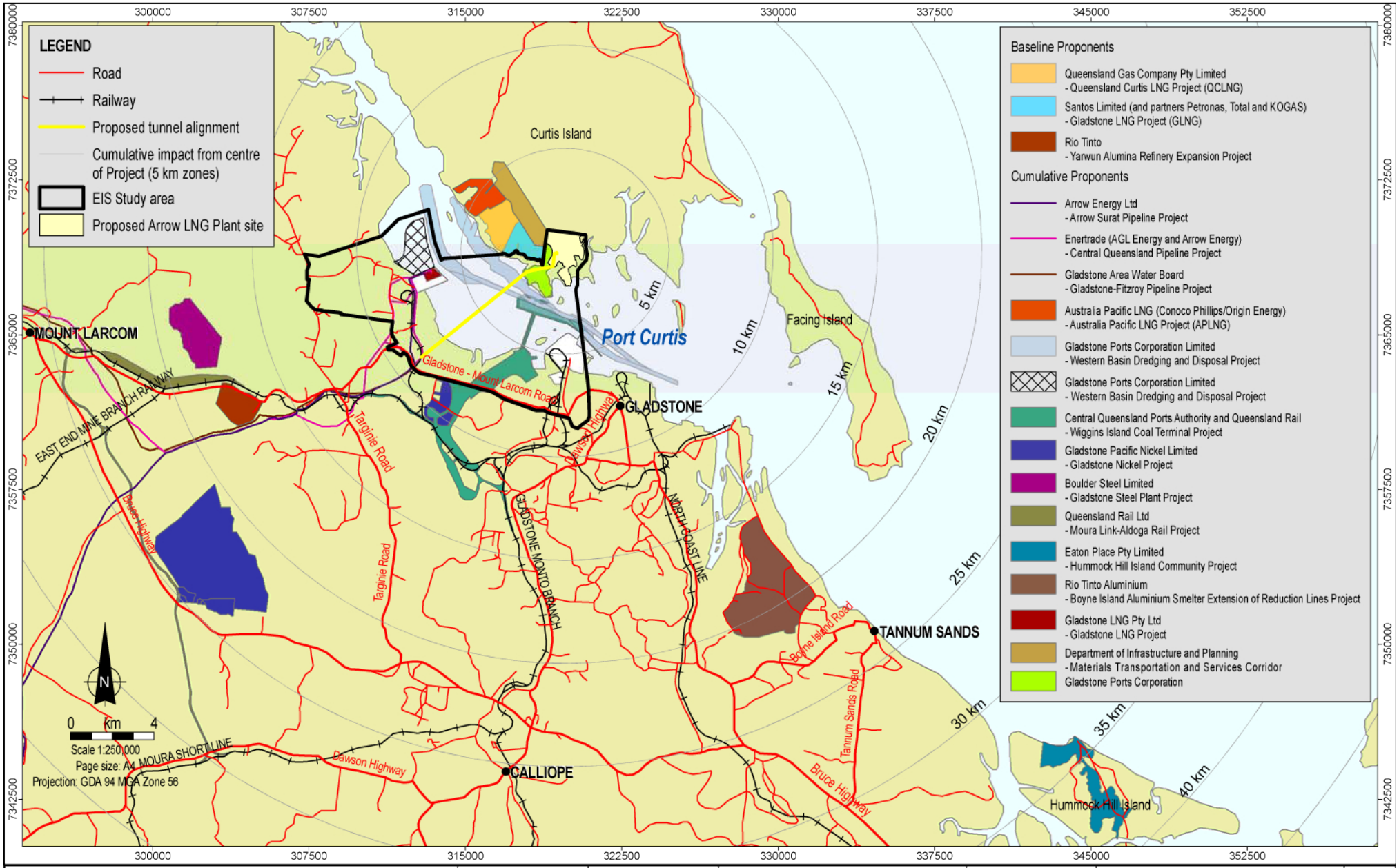
Table 27 Assessment of projects for inclusion in the cumulative landscape and visual assessment

Name of project and Proponent(s)	Status (as of April 2011) and location	Description	For inclusion in LVIA cumulative assessment
Australia Pacific LNG Project: Australia Pacific LNG Limited (ConocoPhillips and Origin Energy)	**Status**: EIS and Supplementary EIS complete. Project approved with conditions from the Coordinator-General of the State of Queensland (CG). **Location**: Curtis Island, approximately 2.5 km north west of the Arrow LNG Plant in the Curtis Island Industry Precinct of the GSDA.	The Australia Pacific LNG Project is proposed to span from gas fields in the Surat and Bowen Basins in Queensland along a 450 km pipeline to the planned LNG plant (with a maximum capacity of up to 18Mtpa) near Laird Point on Curtis Island off Gladstone.	**Yes**, cumulative landscape and visual impacts are likely. This proposal falls within the ZTV of the Arrow LNG Plant.
Western Basin Strategic Dredging and Disposal Project Gladstone Ports Corporation Limited	**Status**: EIS and Supplementary EIS complete. Project approved with conditions by the CG and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). **Location**: Port of Gladstone, immediately west of Hamilton Point and north China Bay.	This project accommodates the long-term dredging and material disposal that is required to provide access to the existing and proposed Gladstone Western Basin Port (Port of Gladstone, from Auckland Point to The Narrows) facilities. Dredging associated with the deepening and widening of existing channels, swing basins and berth pockets. Dredged material will be placed into reclamation areas near Fishermans Landing to create land reserve.	**Yes**, cumulative landscape and visual impacts are likely. This proposal falls within the Arrow LNG Plant ZTV's. The Arrow LNG Plant directly interfaces with this proposal which facilitates shipping access to the harbour and LNG plants. The Arrow LNG Plant tunnel option is located in the dredging area.
Fishermans Landing Northern Expansion Project Gladstone Ports Corporation Limited	**Status**: EIS and Supplementary EIS complete. Project approved with conditions by the CG. **Location**: North of the existing port facility at Fishermans Landing, and approximately 4 km west of the Arrow LNG Plant.	Expansion of Fishermans Landing by reclamation (approximately 153 hectares). Reclamation will provide for the containment of dredge material from future maintenance and capital dredge programs.	**Yes**, cumulative landscape and visual impacts are likely. This proposal falls within the Arrow LNG Plant ZTV's and Launch Site 4N is located on this land.
Arrow Surat Pipeline Project (formerly Surat-Gladstone Pipeline)	**Status**: EIS complete and assessment report received. Location: From Dalby to Gladstone	Construction of a high-pressure gas pipeline to deliver coal seam gas from Dalby to Gladstone to connect Arrow Energy's coal seam gas resources in the Surat Basin to Gladstone.	**Yes**, cumulative landscape and visual impacts are likely during the construction phase only. This pipeline and gas gathering station would directly connect to the project, as

Name of project and Proponent(s)	Status (as of April 2011) and location	Description	For inclusion in LVIA cumulative assessment
Arrow Energy			LNG from this pipeline will feed the Arrow LNG Plant on Curtis Island However **the** extent for cumulative impacts, during the operation phase is limited since the pipeline would be largely underground with little surface infrastructure.
Central Queensland Pipeline Project Enertrade (AGL/Arrow Energy)	**Status**: EIS and Supplementary EIS complete. Project approved with conditions by the CG and DSEWPC. **Location**: From Mount Larcom, along Gladstone–Mount Larcom Road and around the south of Gladstone to southeast to Gladstone.	Construction of a high pressure gas transmission pipeline from Moranbah to Gladstone. The pipeline will be laid in a 30 m wide corridor from the existing compressor station at Moranbah generally south to southeast to Gladstone with a total length of approximately 440km.	**Yes**, cumulative landscape and visual impacts are likely during the construction phase. The Central Queensland Pipeline falls within the Arrow LNG Plant ZTV's. The pipeline is anticipated to be underground so cumulative impacts during operation are likely to be limited.
Wiggins Island Coal Terminal Project Central Queensland Ports Authority and Queensland Rail	**Status**: EIS and Supplementary EIS complete. Project approved with conditions. **Location**: On the northern bank of the Calliope River mouth.	Development of a coal terminal in the Port of Gladstone with an initial capacity of 25 Mtpa and an upgrade capability to 70Mtpa anticipated to be completed by 2020. The main components are dredging and reclamation, dump stations and inloading conveyor streams, coal stockyard and materials handling systems, three ship loading conveyor streams across four berths, an additional two berths for other purposes; substation, workshops, administration,, amenities and lighting for the coal terminal and vegetation planting around the facility.	**Yes**, cumulative landscape and visual impacts are likely. This proposal falls within the Arrow LNG Plant ZTV's.
Gladstone Nickel Project Gladstone Pacific Nickel Limited	**Status**: EIS and Supplementary EIS complete. Project approved with conditions by the CG. **Location**: 8 km west of Gladstone in Yarwun Precinct of Gladstone State Development Area.	Project comprises development of a greenfield high pressure acid leach (HPAL) refinery in the Yarwun Precinct of the GSDA; development of slurry and water pipelines between Marlborough and the plant site and development of a tailings storage facility in the GSDA and ore importing facilities at the Port of Gladstone at Wiggins Island terminal.	**Yes**, cumulative landscape and visual impacts are likely. This proposal falls within the Arrow LNG Plant ZTV's.
Gladstone Steel	**Status**: Initial Advice Statement complete	Development of a an integrated steel making	**No**, lies outside the ZTV for the Arrow

Name of project and Proponent(s)	Status (as of April 2011) and location	Description	For inclusion in LVIA cumulative assessment
Plant Project Boulder Steel Limited	and EIS in progress **Location**: East of Mount Larcom approximately 6 km from the eastern edge of the study area.	plant at a site in the Aldoga Precinct.	LNG Plant so limited to sequential impacts only.
Moura Link Aldoga Rail Project Queensland Rail Ltd	**Status**: EIS complete. Project approved with conditions by the CG, no supplementary EIS required. **Location**: Along the Bruce Highway to Mount Larcom. Crossing from the Bruce Highway to Gladstone–Mount Larcom Road and along Gladstone–Mount Larcom Road to Yarwun.	Comprises development of a new rail line via the Moura Short Line to the existing North Coast Line, development of a rolling stock maintenance yard at Aldoga in the GSDA and quadruplication of the North Coast Line from the new yard to east of Yarwun.	**No**, cumulative landscape and visual impacts are unlikely. The proposal falls outside the Arrow LNG Plant's ZTV and combined views of the LNG plant and this railway are not predicted (except a possible successive visual impact from Mount Larcom Summit).
Gladstone-Fitzroy Pipeline Project Gladstone Area Water Board	**Status**: EIS and Supplementary EIS complete. Project approved with conditions by the CG. Pending approval with conditions from DSEWPC. **Location**: Within the study area, from Mount Larcom to the Arrow Surat Pipeline Project, where it follows the Arrow Surat Pipeline to the Gladstone City Gate.	To connect the Fitzroy River with Gladstone Area Water Boards' raw water supply network through approximately 115 km pipeline, linking two major sources of water for the region. Comprises development of an underground pipeline to connect existing infrastructure from Laurel Bank to Yarwun with development of an intake and pump station, water treatment plant, booster pump station and a reservoir.	**No**, limited extent for cumulative impacts, since the pipeline would be largely underground with little surface infrastructure.
Hummock Hill Island Community Project Eaton Place Pty Limited	**Status**: EIS and Supplementary EIS complete. Pending approval with conditions by the CG and DSEWPC. **Location**: 30 km south of Gladstone.	Development of a residential and tourism community, including education facilities and a golf course, to accommodate the population of approximately 4000 on Hummock Hill Island.	**No**: considered too far and divorced from the landscape context of the study area for significant landscape and visual effects to be anticipated.
Boyne Island Aluminium Smelter Extension of Reduction Lines Rio Tinto Aluminium	**Status**: EIS complete. Works deferred. **Location**: 12 km south-east of Gladstone.	Comprises expansion of the existing Boyne Island Aluminium Smelter, located at Boyne Island about 12 km south-east of Gladstone. The Boyne Island Aluminium Smelter Extension of Reduction Lines Project was planned to extend the three potlines significantly increasing the smelters capacity (to 733000 tonnes per annum	**No**: negligible cumulative landscape and visual impacts are anticipated with Arrow LNG Plant. Even though the development is within the LNG plant ZTV, it is at a considerable distance from Arrow LNG Plant. Given its locality, any views of Arrow LNG Plant and this proposal are

Name of project and Proponent(s)	Status (as of April 2011) and location	Description	For inclusion in LVIA cumulative assessment
		of aluminium product)	anticipated to be “Successive”.
Gladstone LNG Project (Fishermans Landing) Gladstone LNG Pty Ltd	**Status**: EIS and supplementary EIS complete. Project approved with conditions by DERM. **Location**: Approximately 5km west of the Arrow LNG Plant.	Development of a 1.6 Mtpa LNG plant and export terminal at Fisherman’s Landing. Note: this is different from the GLNG project proposed by Santos adjacent to the Arrow LNG Plant.	**Yes**, cumulative landscape and visual impacts are likely. This proposal falls within the Arrow LNG Plant ZTV.



Source of Figure: Coffey Environments

AECOM

Arrow Energy

Arrow LNG Plant

arrowenergy

Cumulative Assessment

Figure No: 33

8.3 Cumulative Impact Assessment

In total, including the Arrow LNG Plant project and those projects considered as part of the baseline assessment, it is concluded there are 12 projects in the study area, which if developed or constructed may result in cumulative landscape and visual impacts:

- Arrow LNG Plant (this project).
- Queensland Cutis LNG Project (QGC and BG Group).
- Gladstone LNG Project (Santos and Partners).
- Yarwun Alumina Refinery Expansion Project (Rio Tinto).
- Australia Pacific LNG Limited (ConocoPhillips and Origin Energy).
- Western Basin Dredging and Disposal Project (Gladstone Ports Corporation Limited).
- Fishermans Landing Northern Expansion Project (Gladstone Ports Corporation Limited).
- Arrow Surat Pipeline Project (Arrow Energy).
- Central Queensland Pipeline Project (Enertrade - AGL/Arrow Energy).
- Wiggins Island Coal Terminal Project (Central Queensland Ports Authority and Queensland Rail).
- Gladstone Nickel Project (Gladstone Pacific Nickel Limited).
- Gladstone LNG Project (Fishermans Landing) (Gladstone LNG Pty Ltd).

8.3.1 General character of projects included in the cumulative assessment

For simplification, the projects described above can be considered to fall into three basic categories with regards to their potential to generate cumulative landscape and visual impacts:

- Large scale, high impact, industrial facilities including bulky plant components with potential to be viewed over long distances and considerably industrialise landscape character.
- Large scale dredging and land reclamation projects that would affect landscape character, particularly during the construction phase, but are less likely to be visible for extensive distances.
- Pipeline projects that may cause visual impacts during the construction phase but are likely to be largely underground and will not cause cumulative visual impact during operation.

As the timing of these projects is unknown it cannot be accurately determined which construction activities will be occurring concurrently. Furthermore, as some projects pass from construction to operation phase their impacts will diminish (e.g., the underground pipelines) whereas the impacts of others may increase (e.g., Wiggins Island Coal Terminal Project). As a worst case it is assumed that it is possible (albeit unlikely) that construction of all projects will take place concurrently. It is also assumed that eventually all projects will reach operation phase so cumulative operational impacts are assessed on this basis. Decommissioning is not considered as the potential for decommissioning of these activities or any other existing industrial developments to occur cannot be predicted with any accuracy.

8.3.2 Likely impacts on landscape and visual values during construction

During the construction phase for all of these types of projects, major (albeit short term) impacts on landscape character, views and visual amenity are likely to result. Key visual impacts would arise due to the presence of construction traffic and crews, construction compounds, large scale machinery including tall cranes, and exposed soil due to cut/fill activities. These construction activities are likely to contrast with the current local landscape character and would be perceived adversely by sensitive viewer groups. The cumulative impacts of construction activities on Curtis Island associated with the Arrow LNG Plant, the QCLNG and GLNG projects (which form part of the baseline assessment) and APLNG projects will have a particularly noticeable impact on landscape character and views from the mainland as the forested island is cleared and uncharacteristic construction equipment introduced. Whilst still significant, the effects of construction on the character of the mainland would be perceived to be lower as this area is already significantly developed for industry and zoned for further development associated with the GSDA.

8.3.3 Likely impacts on landscape and visual values during operation

In many cases, the proposed developments are located on greenfield sties; thus changing a large area of the character around Gladstone. Whilst industrial development is already a key characteristic of the Gladstone area, the proposed developments are likely to be highly visible and will considerably intensify and extend the areas of LCT 5 *Industrial Extractive* with associated loss of some of the more 'natural' character areas including *Undulating / Flat Forest* (LCT 2,), *Coastal / Estuarine Plain* (LCT 7) and *Waterscape* (LCT 8). This alteration in character is consistent with the proposals for the GSDA. As for construction phase, the cumulative impacts of the Arrow LNG Plant during operation would be particularly relevant in relation to the other LNG plants proposed on Curtis Island. These projects would result in substantial alteration of the character of the Curtis Island landscape from a natural to industrial landscape. This change is significant in relation to the visual amenity of many vantage points located in Gladstone. It is also significant in relation to impacts on designated landscapes; particularly The Narrows, which is an important landscape recognised in relation to the GBRWHA, CCRCMP and Australian Heritage Commission Register of the National Estate.

8.4 Summary of cumulative impact assessment

This is a summary of the landscape and visual cumulative impact assessment. For full details refer to **Appendix 3**: Detailed Evaluation of Cumulative Landscape and Visual Impacts. A range of cumulative landscape and visual impacts were identified in both scenarios from *major* to *minor – negligible*. A summary table of the findings and supporting discussion is provided in **Table 28** below.

Table 28 Summary table of assessment of cumulative impact on landscape and visual receptors

Cumulative Impacts	Sensitivity to Change	Magnitude of Change	Significance of Impact
Landscape Designation			
International Planning Designation, Policy and Guidance			
Great Barrier Reef World Heritage Area (GBRWHA).	High	**High**	**Moderate to Major**
Great Barrier Reef Marine Park.	High	**Medium**	**Moderate**
National Planning Designation, Policy and Guidance			
Australian Heritage Commission Register of National Estate:			
The Narrows.	High	**High**	**Moderate to Major**
Garden Island Conservation Park.	High	**High**	**Moderate to Major**
Mount Larcom Range.	High	**Medium**	**Moderate**
State Planning Designation, Policy and Guidance			
Curtis Coast Regional Coastal Management Plan (2003)			
Islands and off shore features: *Curtis Island.*	Medium	**Very high**	**Moderate-Major**
Coastal wetlands: Curtis Island and The Narrows.	Medium	**Very high**	**Moderate to Major**
Estuaries and Inlets: The Narrows.	Medium	**High**	**Moderate**
Riverine Corridors and Creeks: *Calliope River, Auckland Creek,* etc.	Medium	**High**	**Moderate**
Coastal Mountain ranges: *Curtis Island Strike Ridge* and *Mount Larcom Range.*	Medium	**Very High** (Curtis Island Strike Ridge) **Medium** (Mount Larcom Range)	**Moderate to Major** (Curtis Island Strike Ridge) **Minor to Moderate** (Mount Larcom Range)
Targinie State Forest	Medium	**Low**	**Minor**
Landscape Character Types			
LCT 1: Forested Mountain or Ridge.	High	**Very high**	**Major**.

LCT 2: Undulating or Flat Forest.	Medium	**Very high**	**Moderate to Major**
LCT 3: Wooded Rural.	Medium	**High**	**Moderate**
LCT 4: Open Rural.	Medium	**Medium**	**Minor to Moderate**
LCT 5: Industrial / Extractive Industries.	Negligible	**Low**	**Negligible**
LCT 6: Urban.	Low	**Medium**	**Minor**
LCT 7: Coastal / Estuarine Plain.	High	**Very High**	**Major**
LCT 8: Waterscape.	Medium	**High**	**Moderate**
Representative Viewpoint			
Viewpoint 1: Auckland Point.	High	**Very high**	**Major**
Viewpoint 2. Spinnaker Park.	High	**High**	**Moderate - major**
Viewpoint 3. Gladstone CBD.	Medium	**Medium**	**Minor - moderate**
Viewpoint 4. Round Hill Lookout.	High	**High**	**Moderate - Major**
Viewpoint 5. South End.	High	**Low**	**Minor - moderate**
Viewpoint 6. Port Curtis by Turtle Island.	Medium	**Very high**	**Moderate to Major**
Viewpoint 7. Port Curtis by Witt Island.	Medium	**Very high**	**Moderate to Major**
Viewpoint 8. Port Curtis by Tide Island.	Medium	**Very high**	**Moderate to Major**.
Viewpoint 9. South End Ferry.	Medium	**High**	**Moderate**.
Viewpoint 10. Port Curtis Shipping Channel.	Medium	**Very high**	**Moderate to major**.
Viewpoint 11. Laird Point on Curtis Island	High	**Very high**	**Major**
Viewpoint 12.From Mount Larcom Summit	High	**Very high**	**Major**
Viewpoint 13.From Reid Road and Gladstone - Mount Larcom Road intersection.	Low	**Very high**	**Moderate**

The cumulative landscape and visual impact assessment above considers a number of projects. It is recognised that additional large scale industrial development may occur over larger tracts of this study area, resulting in further changes and impacts on landscape character and the visual context. In particular the inherently rural landscapes of the Targinie and Aldoga Precincts are predicted to change to industrial landscapes. It is considered that the rural values of these areas would be changed, however some of the key features and elements of landscape and visual resource (such as the waterways and the forested mountains or ridges e.g., Mount Larcom and Scrubby Mountain) will be maintained.

Due to the uncertainty regarding relative timing of the operations the cumulative impact assumes the simultaneous worst case of construction/operation for each of the schemes assessed. Some of the projects i.e. dredging and pipelines would have a worse impact during the construction phase. Other impacts, e.g., large industrial infrastructure may have a similar level of impact during both construction and operation.

The assessment illustrated that the impact on a large number of landscape and visual receptors would be *major* or *moderate – major*; should the majority of the developments take place. The key receptors include:

- Three types of landscape planning receptors (designated landscapes) including the Great Barrier Reef World Heritage Area (GBRWHA), Areas listed on the Australian Heritage Commission Register of National Estate (The Narrows, Garden Island Conservation Park) and significant landscapes of the Curtis Coast Regional Coastal Management Plan (2003) (Islands and off shore features: Curtis Island , Coastal wetlands:

Curtis Island and The Narrows and Coastal Mountain ranges: Curtis Island Strike Ridge and Mount Larcom Range).

- Three of the Landscape Character Types i.e., LCT 1: *Forested Mountain / Ridge*, LCT 2: *Undulating / Flat Forest and* LCT 8: Waterscape Ten viewpoints: 1, 2, 4, 6, 7, 8, 9, 10, 11 and 12.

The impacts on visual receptors are likely to be higher than those on the landscape resource. This is due to a large amount of prominent industrial development proposed, affecting many views of the Port Curtis landscape. The proposed development on Curtis Island (including the baseline scenarios – Arrow LNG Plant, QCLNG, GLNG) would extend extensive industrial development from the mainland to the island. Even though some of the character of Port Curtis is influenced by existing industrial development on the mainland, Curtis Island is currently viewed as an inherently natural landscape feature, thus the impact on the strike ridge and the island is considered to be of major significance. The developments on Curtis Island are anticipated to comprise a homogenous built form and scale, which would strongly contrast with the surrounding natural setting.

The GSDA has identified an Environmental Management Precinct to the east of the Curtis Island Industry Precinct, which includes part of the distinctive Curtis Island Strike Ridge system. Retaining this forested ridge (located in LCT 1) as a natural backdrop to the GSDA is a key priority; which will also assist in maintaining visual connections between the GSDA and its distinctive landscape setting. The retention of these natural striking features (including Ship Hill and Mount Larcom Range) will maintain some mountainous views from the Port Curtis waterscape.

On the mainland, the development around Port Curtis is concentrated in two areas, including the Fishermans Landing Northern Expansion Project (already under construction) and the Wiggins Island Coal Export Terminal site. They are separated by a 5 to 6 km stretch of protected coastal plain (located within LCT 7), which would be maintained and continue to provide a natural visual buffer between the two areas of development. Although this natural stretch would break up, thus lowering the intensity of the industrial development on the mainland around Port Curtis the extension of Fishermans Landing Port would extend the industrial development on the mainland by approximately 2 km north of Fishermans Landing.

In conclusion, the collective intensity of industrial type development around Port Curtis (including an increase in movement and activity within waterways) will add to the appearance of this landscape (a large and busy industrial port); in particular, those activities associated with the Port of Gladstone Western Basin Dredging and Disposal and the additional boat freight (including the large LNG carriers associated with the various LNG export facilities which may contribute approximately 15% of the total shipping through Gladstone Port). Assuming these projects are approved and constructed, the impacts on many landscape features (such as Curtis Island and Mount Larcom range) and the visual resource would be significant.

8.5 Cumulative Lighting Assessment

This section concludes with consideration of the cumulative situation anticipated with lighting of the projects listed. The assessment does not know the full details of the lighting associated with these projects, however it has assumed the artificial lighting would either be similar to those currently existing or that proposed for the Arrow LNG Plant.

Should all the developments occur, it is predicted that there will be a substantial increase in the overall artificial light levels throughout the study area, especially the northern part of the study area falling within the GSDA precincts shown on **Figure 6** , particularly around Port Curtis and the south western part of Curtis Island. A key impact of light at night that may occur could be simultaneous gas venting from any of the four LNG export facilities on Curtis Island i.e., Arrow LNG Plant, QCLNG and GLNG (assessed in the baseline conditions) and APLNG considered in the cumulative assessment. The chance of this would be extremely low. This is anticipated to be an extremely rare occurrence and is anticipated to occur at a substantial distance from sensitive light receptors with the exception of those residents and recreational users on and around Turtle, Witt and Tide Islands.

Given many of the projects considered would introduce light into inherently darker landscapes i.e., Environmental Zones E1 and E2**,** the overall levels of sky glow, glare and light trespass throughout the study area would increase substantially. The sky glow impact may extend into areas outside the study area. This substantial intensification of light levels throughout the study area, associated with these new developments is anticipated to elevate the magnitude of change on all the landscape and visual receptors in the study area.

9.0 Conclusion and Recommendations

9.1 Impacts of the Arrow LNG Plant on Landscape and Visual Amenity

The assessment makes the following conclusions:

Impacts against Baseline

- A number of LNG plants on Curtis Island and the mainland have already been approved, including the development of the QCLNG project and GLNG project. The infrastructure associated with these facilities has not yet been constructed but provides a baseline against which the Arrow LNG Plant project needs to be assessed.
- The relative impact of the Arrow LNG Plant is generally reduced by the presence of LNG plants on Curtis Island. This is because the greatest level of landscape and visual impact relates to the incursion of industrial development onto the current natural forested landscape of Curtis Island. The Arrow LNG Plant would contrast greatly with this natural character which would be noticeable in views from the mainland. However, with the development of other LNG plants the contrast would be lessened and affected views would already experience the industrialisation of the affected area of Curtis Island.

Impacts on Designated Landscapes

- The most important designated landscape in the study area is the GBRWHA. Construction and operation phases will cause, at greatest, an impact of moderate significance (project scenario) on this landscape declining to minor-moderate against the baseline scenario.
- The greatest impact on a designated landscape during the construction phase (only) will be the moderate-major impact on Garden Island, which is on the Australian Heritage Commission Register of the National Estate.
- Other affected designated landscapes, which would be affected at a moderate level of impact significance against the undeveloped baseline are The Narrows (Register of the National Estate) and a number of landscapes of state significance included in the Curtis Coast Regional Coastal Management Plan i.e., Islands and Offshore Features (Curtis Island), Coastal Wetlands, and Coastal Mountain Ranges (Curtis Island Strike Ridge), With the exception of the Coastal Wetlands these impacts decline to minor-moderate significance against the baseline of approved LNG plants.

Impacts on Landscape Character

- The greatest impacts on landscape character during both operation and construction phase of up to moderate-major significance against the baseline are anticipated to affect LCT 7: Coastal or Estuarine Plain with LCT 1: Forested Mountain or Ridge and LCT 2: Undulating or Flat Forest; receiving moderate impacts. This relates to direct and indirect impacts associated with removal of vegetation and characteristic elements and significant affects on the setting of the remaining areas.

Impacts on Visual Amenity

- Important viewpoints in the study area are assessed to be tourist lookouts, views obtained by residents of Port Curtis Islands, views obtained from water vessels on Port Curtis and the view from the summit of Mount Larcom.
- The impacts of the greatest significance are the moderate to major effects experienced viewed against the current island landscape from Auckland Point lookout (Viewpoint 1), and from the water/islands close to the LNG plant i.e. Turtle Island (Viewpoint 6), Witt Island (Viewpoint 7), Tide Island (Viewpoint 8) and shipping channel (Viewpoint 10) and those views obtained from the summit of Mount Larcom. The significance of each these impacts declines against the baseline scenario to at greatest moderate significance when viewed against the anticipated highly developed context associated with the construction of the QCLNG and GLNG plants.

- Views are likely to be affected mainly in construction and operation phases with little impact remaining following decommissioning except for those views very close to the affected sites.

Lighting Impacts

- Many of the receptors identified are sensitive to the effects of construction and operational lighting associated with the project.
- LCT 1: Forested Mountain or Ridge; LCT 2: Undulating or Flat Forest; LCT 4: Open Rural, LCT 7: Coastal and LCT 8: Waterscape are likely to experience moderate impacts associated with lighting.
- The viewpoints most affected by lighting are similar to those most affected by night time impacts. The greatest significance is anticipated for views from Auckland Point lookout (Viewpoint 1) which would experience a moderate impact against the baseline scenario of the proposed LNG plants during operation (moderate to major impact against current situation). A moderate impact would also be experienced against the baseline by residents of Witt and Tide Island (Viewpoints 7 and 8),and Turtle Island (Viewpoint 6).

Cumulative Impacts

- A large number of additional proposals have been made for industrial and extractive industrial projects and pipelines in the area around Gladstone. Many of these have potential to result in cumulative landscape and visual impact.
- The cumulative assessment of impacts indicates that impacts of major significance on the landscape and visual values of the Gladstone area will arise due to these projects.

9.2 Recommendations

A range of mitigation measures are proposed that seek to further integrate the facility into the landscape and minimise the landscape and visual impact to the greatest extent possible. It is recommended that these measures be given further consideration and, where possible, are adopted during the construction, operational and decommissioning phases of the project. These measures are presented in **Section 6.1.**

10.0 References

- Arrow Energy (photos as noted in the report)
- Australian Heritage Council Act, 2003
- Calliope Shire Planning Scheme: 2007
- Coastal Protection and Management Act 1995
- Coffey Environments (2011) Landuse and Planning Technical Study. Brisbane, Australia.
- Coffey Environments (photos as noted in the report)
- Coffey Environments (2011). Marine and Estuarine Ecology Impact Assessment. Report prepared by Coffey Environments, Brisbane for Arrow Energy, Brisbane.
- Coordinator General of the State of Queensland (January 2010) Shell Australia LNG Project Environmental Impact Statement Terms of Reference,
- Curtis Coast Regional Coastal Management Plan (2003), Environmental Protection Agency
- Determination regarding including World Heritage Places in the National Heritage List: Australian Government Department of the Environment and Water Resources, Environment and Heritage Legislation Amendment act (No. 1) 2003
- Ecosure (2011), Arrow LNG Plant, Terrestrial Ecology Impact Assessment. Report to Arrow CSG (Australia) Pty Ltd and Coffey Environments Australia Pty Ltd. Publication Location - West Burleigh, Australia.
- Environment Protection and Biodiversity Conservation (EPBC) Act, 1999
- Gladstone City Council Planning Scheme, December 2006.
- Gladstone State Development Area (July 2008), Queensland Government
- Great Barrier Reef Marine Park Act, 1975
- Great Barrier Reef Marine Park Authority (January 1981) *Nomination of The Great Barrier Reef, by the Commonwealth of Australia, for inclusion in the World heritage List* (United Nations Educational, Scientific and Cultural Organisation).
- Landscape Character Assessment, Guidance for England and Scotland prepared on behalf of the Countryside Agency and Scottish Natural Heritage, 2002
- National Forest Policy Statement: A new focus for Australia's Forests, Commonwealth of Australia 1992, second edition1995
- Nature Conservation Act 1992. Prepared by the Office of the Queensland Parliamentary Counsel
- Nature Conservation and Other Legislation Amendment Bill 2000
- Queensland Government, Environment Protection Agency Queensland Parks and Wildlife Service (September 2003) Curtis Coast Regional Coastal Management Plan
- Queensland Government, the Coordinator General (July 2008), *Development Scheme for the Gladstone State Development Area*.
- Scottish Natural Heritage (2006) *Visual Representation of Windfarms: Good Practice Guidance*.
- Scottish Natural Heritage and The Countryside Agency, UK (2006) *Topic Paper 6: Techniques and Criteria for Judging Capacity and Sensitivity*.
- Shell (photos as noted in the text)
- State Planning Policy 1/ 92 Development and the Conservation of Agricultural Land
- The Australian Government Department of Sustainability, Environment, Water, Population and Communities (2008) *Criteria for places for the Register of the National Estate*.
- The City of Gladstone Planning Scheme 2005
- The Great Barrier Reef Marine Park Authority (2003) *Great Barrier Reef Marine Park Zoning Plan 2003*.
- The Institution of Lighting Engineers (2005), *Guidance Notes for Reduction of Obstructive Lighting: UK.*
- The Landscape Institute and the Institute of Environmental Management and Assessment, UK (2002) *The Guidelines for Landscape and Visual Impact Assessment, Second Edition*.

- The Landscape Institute, UK (2009) *Landscape Institute Advice Note 01/09: Use of photography and photomontage in landscape and visual assessment*.
- Western Australian Planning Commission (2007) *Visual Landscape Planning in Western Australia; a manual for evaluation, assessment, siting and design*.
- World Heritage Nomination, IUCN Technical Review, (International Union of Conservation of Nature and natural Resources), July 1981

Appendices

Appendix 1: Detailed Evaluation of Impacts and Effects on Sensitive Landscape Receptors

Appendix 1A Impacts on Designated Areas

Table 29 illustrates how the judgement regarding the significance of the landscape impact on key designated areas is made. It combines an appraisal of the overall sensitivity of the designated area to change combined with an evaluation of the predicted magnitude of change associated with the proposals. The table considers the impacts at a project level, than makes a commentary on the existing baseline established by the approved projects.

Table 29 Assessment of significance of impacts on landscape planning designations, policy and guidance

Landscape receptor	Sensitivity		Landscape Magnitude of Change		Judgement of Significance of Landscape Impact	
		Phase	**Project**	**Baseline (QCLNG and GLNG)**	**Project**	**Baseline**
International Planning Designation, Policy and Guidance						
Great Barrier Reef World Heritage Area (GBRWHA)	**High**	*Construction*	**Medium**: The construction activities will impact on the current view of Curtis Island as a natural forested island that provides a distinct, visual contrast to the existing industrialised activities in and around Port Curtis. However, only a small section of the GBRWHA will be affected the area of Port Curtis is already considerably undermined by the close proximity to industrial development associated with Gladstone which consequently lowers the magnitude of change. The construction of the Arrow LNG Plant would be viewed within the context of the broader industrial landscape. Views from the east that are currently less affected by industrial elements would continue to be curtailed by the forested ridgeline of Ship Hill and the Curtis Island Strike Ridge which lie beyond the area of disturbance. Thus the landscape values of the GBRWHA would be maintained beyond Port Curtis. Consequently, it is considered the LNG project would result in a considerable change over a restricted area that will not fundamentally change the character of the GBRWHA.	**Low:** The construction activities associated with the baseline LNG plants would already have changed the character of the southern part of Curtis Island from natural to industrial. Against this baseline, the change posed by the Arrow LNG Plant would represent a barely perceptible change in landscape characteristics at the scale of the GBRWHA. The change at Curtis Island would result in a minor loss of the overall area of the GBRWHA of the exceptional natural beauty and high	**Moderate**	**Minor-Moderate**

				landscape and aesthetic values for which the WHA was designated.		
		Operation	**Medium:** The operational character of the project would have a noticeable affect o n the GBRWHA. The rationale for this is as per construction impacts.	**Low:** The baseline LNG plants would already have influence the values of the GBRWHA for the reasons set out for construction.	**Moderate**	**Moderate-Minor**
		Decommissioning	**Low:** it is anticipated that following site restoration to a forested landscape, the changes brought about by this project on the GBRWHA would be barely perceptible.	**Low:** The decommissioning of the other LNG plants would result in an overall imperceptible change on the WHA landscape values.	**Minor-Moderate**	**Minor-Moderate**
Great Barrier Reef World Marine Park (GBR Marine Park)	High	*Construction*	**Low**: There would be no direct impact on the GBR Marine Park during construction. Barely perceptible indirect impacts may be experienced in the vicinity of South End or Curtis Island, or by visitors accessing the GBR Marine Park. These impacts would comprise views of construction activities, in particular construction traffic/dredging within Port Curtis. This could impact on the values for which the GBR Marine Park was designated. However, given the influence of the existing industrial activities on this landscape the magnitude of this change would be low. Furthermore most visitors to the GBR Marine Park would not, be visiting and experiencing the Gladstone / Port Curtis area as they would be attracted to the coral reefs and islands found elsewhere in the Marine Park. By contrast should a large scale industrial development, such as the LNG plant, been proposed in a GBR Marine Park landscape that has no existing industrial influences on its character such as the north and eastern part of Curtis Island, by Keppel Bay, the magnitude of change would be	**Low:** The presence of the baseline schemes would not affect the magnitude of change during the construction phase.	**Minor-Moderate**	**Minor-Moderate**

			considered greater.			
		Operation	**Low:** The operational character of the project would have a noticeable effect on the GBRWHA. The principal impacts would be the effects on character (as experienced by park visitors accessing the marine park from Gladstone) and due to the presence of the large LNG carriers passing through the Marine Park, although it is noted that carriers already pass through this area from the coal terminal and other export facilities around Gladstone so the increase may not be obvious.	**Low:** During the operation phase the presence of the other baseline schemes would result in the presence of a greater number of carriers affecting the GBR Marine Park character, but would not change the category of the magnitude assessment.	**Minor-Moderate**	**Minor-Moderate**
		Decommissioning	**Low:** it is anticipated that following site restoration to a forested landscape, the changes brought about by this project on the GBR Marine Park would be imperceptible.	**Low:** The decommissioning of the other LNG plants would result in an overall imperceptible change on the GBR Marine Park landscape values.	**Minor-Moderate**	**Minor-Moderate**
National Planning Designation, Policy and Guidance						
Australian Heritage Commission Register of the National Estate:						
The Narrows	High	*Construction*	**Medium**: The project construction activities would have no direct landscape impacts upon The Narrows. Some construction activities may be observed from The Narrows which would indirectly impact landscape character. This includes the construction of Launch Site 4N, MOF 3, the LNG jetty and cranes constructing the upper elements of the LNG plant. Construction traffic and dredging activities and could also be discerned but only from the most southern part of The Narrows (See **Section 5.3**).	**Low:** The presence of the baseline LNG plants which are located much closer to The Narrows would make the magnitude of change to The Narrows associated with the construction of the Arrow LNG Plant	**Moderate**	**Minor-Moderate**

			Therefore, the significant aesthetic landscape values and characteristics for which The Narrows has been designated, would be largely maintained during construction i.e., the uncommon passage and the distinct natural coastline.	virtually imperceptible, lowering the magnitude of change.		
		Operation	**Medium**: The project would have no direct landscape impacts upon The Narrows during operation. Some project infrastructure may be visible from The Narrows which would affect views and, therefore, indirectly impact landscape character. This infrastructure would include Launch Site 4N, MOF 3, the LNG jetty and potentially upper elements such as the emergency flare stack. The LNG carriers would also be visible. Only from the most southern part of The Narrows would views be obtained (See **Section 5.3**). Therefore, the significant aesthetic landscape values and characteristics for which The Narrows has been designated, would be largely maintained i.e., the uncommon passage and the distinct natural coastline.	**Low:** The presence of the baseline LNG plants which are located much closer to The Narrows would make the magnitude of change to The Narrows associated with the Arrow LNG Plant virtually imperceptible, lowering the magnitude of change.	**Moderate**	**Minor-Moderate**
		Decommissioning	**Low:** it is anticipated that following site restoration to a forested landscape and removal of the marine infrastructure, the changes brought about by this project on The Narrows landscape would be imperceptible.	**Low:** The decommissioning of the other LNG plants would result in an overall imperceptible change on the landscape values of The Narrows.	**Minor-Moderate**	**Minor-Moderate**
Garden Island Conservation Park	Medium	*Construction*	**High**: An indirect impact on the landscape of Garden Island is anticipated as a result of the project. The LNG plant is in very close proximity and Garden Island would be noticeably affected by views of construction activities, particularly the Boatshed Point Construction Camp and transport of people and materials to the Boatshed Point MOF. The magnitude of the effect is lessened as Garden Island's setting is already influenced by existing industrial activity. It is also reduced as the designation is largely on nature	**High:** The magnitude remains high as Garden Island is located closest to the Arrow LNG Plant site so the construction of the Arrow LNG Plant will have a more dominant effect than any of the other schemes.	**Moderate-major**	**Moderate-major**

			conservation grounds rather than landscape grounds, and its inherent character would not be fundamentally changed by the project.			
		Operation	**Medium**: An indirect impact on the landscape of Garden Island is anticipated as a result of the project. The LNG plant is in very close proximity to Garden Island and it would be noticeably affected by views of the LNG plant. The magnitude is lessened as Garden Island's setting is already influenced by existing industrial activity. It is also reduced as the designation is largely on nature conservation grounds rather than landscape grounds, and its inherent character would not be fundamentally changed by the project.	**Medium:** The magnitude remains medium as Garden Island is located closest to the Arrow LNG Plant site so the operation of the Arrow LNG Plant will have a more dominant effect than any of the other schemes.	**Minor-Moderate**	**Minor-Moderate**
		Decommissioning	**Low:** it is anticipated that following site restoration to a forested landscape and removal of the marine infrastructure, the changes brought about by this project on the landscape values of Garden Island would be minimal.	**Low:** The decommissioning of the other LNG plants would have little effect on the landscape of Garden Island.	**Minor-Moderate**	**Minor-Moderate**
Mount Larcom Range	Medium	*Construction*	**No impact**: The construction activities associated with the project would not directly affect the landscape value of Mount Larcom Range. The existing character of views from Mount Larcom is industrialised so whilst the construction activities may be perceptible this would not affect the landscape value for which Mount Larcom has been nominated for inclusion on the register.	**No impact:** Construction activities associated with the baseline LNG plants would not affect the landscape values for which the Mount Larcom Range has been nominated.	**No impact**	**No impact**
		Operation	**No impact**: The project would not directly affect the landscape value of Mount Larcom Range in regard to its value as a "*scenic backdrop to the city of Gladstone*". While views of the project may be possible from Mount Larcom (see Section 5.3), given the existing industrialised character of much of the view, the impact of the Arrow LNG Plant is considered to be only noticeable.	**No impact:** The presence of the baseline LNG plants would not affect the landscape values for which the Mount Larcom Range has been nominated.	**No impact**	**No impact**
		Decommissioning	**No impact**: At this scale and distance it is not anticipated	**No Impact**: At this scale	**No impact**	**No impact**

			that any impacts would still be discernable following decommissioning.	and distance it is not anticipated that any impacts would still be discernable following decommissioning of the baseline LNG plants.		
State Planning Designation, Policy and Guidance						
Curtis Coast Regional Coastal Management Plan (2003)						
Islands and Offshore Features: Curtis Island	Medium	*Construction*	**High:** The construction activities would contrast strongly with the current landscape values of the island (vegetation and natural qualities). This would result in considerable direct and indirect changes of landscape characteristics over a restricted area of Curtis Island which is likely to considerably change the values of the landscape for which the Island is recognised in the CCRCMP.	**Medium:** The character of Curtis Island would already be considerably affected due to the construction the baseline schemes. The magnitude of change associated with the Arrow LNG Plant would be perceived as lower.	**Moderate**	**Minor-Moderate**
		Operation	**High:** The LNG plant would be highly visible from a number of existing publicly accessible viewpoints and at a local scale would contrast strongly with current landscape values of the island (vegetation and natural qualities). The LNG plant would result in considerable change of landscape characteristics over a restricted area of the island which is likely to considerably change the character of the landscape.	**Medium:** The character of Curtis Island would already be considerably affected due to the infrastructure of the baseline schemes. The magnitude of change associated with the Arrow LNG Plant would be perceived as lower.	**Moderate**	**Minor-Moderate**
		Decommissioning	**Medium:** Following decommissioning some impacts on the features of Curtis Island would remain evident, particularly landform changes. This would diminish as vegetation	**Medium:** The decommissioning of the baseline schemes would	**Minor-Moderate**	**Moderate**

			rehabilitation and regeneration matures.	be evident but would not be perceived to lower the magnitude associated with the Arrow LNG Plant.		
Coastal Wetlands: Curtis Island and The Narrows	Medium	*Construction*	**Medium**: During the construction phase changes to this landscape feature would be barely perceptible with some vegetation clearance would be evident associated with the construction of marine facilities affecting this landscape features.	**Medium:** The coastal wetlands are considered important on the basis of particular natural elements so the changes to other areas of these landscapes associated with the baseline schemes is irrelevant to the project baseline.	**Minor-Moderate**	**Minor-Moderate**
		Operation	**High**: The LNG plant would impact directly on the landscape character of the coastal wetlands. Al though the LNG plant is sited immediately adjacent to wetland landscapes, the characteristics of these areas would be largely retained. However, particular impacts would be evident in the vicinity of the tunnel entrance pad. The gas pipeline would cut through a significant area of wetlands south of Fishermans Landing. During operation some natural rehabilitation of the wetlands would occur.	**High:** as discussed for operation.	**Moderate**	**Moderate**
		Decommissioning	**Low:** Following decommissioning it is anticipated that revegetation would rapidly occur to regenerate affected wetland areas.	**Low:** as discussed for operation.	**Minor**	**Minor**
Estuaries and Inlets: The Narrows	Medium	*Construction*	**Medium**: The project construction activities would have no direct landscape impacts upon The Narrows. Some construction activities may be observed from The Narrows which would indirectly impact landscape character. This includes the construction of Launch Site 4N, MOF 3, the LNG jetty and cranes constructing the upper elements of the LNG plant. Construction traffic and dredging activities and could also be discerned but only from the most southern part of The Narrows (See **Section 5.3**).	**Low:** The presence of the baseline LNG plants which are located much closer to The Narrows would make the magnitude of change to The Narrows associated with the construction of the Arrow LNG Plant	**Minor-Moderate**	**Minor**

			Therefore, the significant aesthetic landscape values and characteristics for which The Narrows has been designated, would be largely maintained during construction i.e., the uncommon passage and the distinct natural coastline.	virtually imperceptible, lowering the magnitude of change.		
		Operation	**Medium**: The project would have no direct landscape impacts upon The Narrows during operation. Some project infrastructure may be visible from The Narrows which would affect views and, therefore, indirectly impact landscape character. This infrastructure would include Launch Site 4N, MOF 3, the LNG jetty and potentially upper elements such as the emergency flare stack. The LNG carriers would also be visible. Only from the most southern part of The Narrows would views be obtained (see Section 5.3). Therefore, the significant aesthetic landscape values and characteristics for which The Narrows has been designated, would be largely maintained i.e., the uncommon passage and the distinct natural coastline.	**Low:** The presence of the baseline LNG plants which are located much closer to The Narrows would make the magnitude of change to The Narrows associated with the Arrow LNG Plant virtually imperceptible, lowering the magnitude of change.	**Minor-Moderate**	**Minor**
		Decommissioning	**Low:** it is anticipated that following site restoration to a forested landscape and removal of the marine infrastructure, the changes brought about by this project on The Narrows landscape would be imperceptible.	**Low:** The decommissioning of the other LNG plants would result in an overall imperceptible change on the landscape values of The Narrows.	**Minor**	**Minor**
Riverine Creeks and Corridors: Calliope River, Auckland Creek, Targinie Creek and Creek on Curtis Island	Medium	*Construction*	**Low**: Creeks identified as "*riverine corridors and creeks*" include the waterway on Curtis Island that runs through the LNG plant, the creek that passes through TWAF 8 (Targinie Creek), Auckland Creek passing around TWAF7 and the Calliope River in the vicinity of launch site 1. The effect of construction activities on most of these would be noticeable with the change being restricted to a limited area. The LNG plant would considerably alter one of these landscape features within the project area as it would	**Low:** The baseline does not affect the magnitude of impact since the impacts of the scheme are specific impacts associated with a limited area.	**Minor**	**Minor**

			require a creek diversion. The change to this creek would be considerable but over a restricted area and overall is not likely to be perceptible			
		Operation	**Low**: The effect of the LNG plant during operation on most of these would be noticeable with the change being restricted to a limited area and the likelihood of vegetation regeneration associated with most affected locations.	**Low:** as per operation	**Minor**	**Minor**
		Decommissioning	**No impact:** Following decommissioning it is likely that the affected sites would be fully restored and no change would be perceptible.	**No impact: as per operation**	**No impact**	**No impact**
Coastal Mountain Ranges: Curtis Island Strike Ridge	Medium	*Construction*	**High**: An indirect impact on the landscape setting of the Curtis Island strike ridge is anticipated during construction. The LNG plant construction activities would occur at the base of the western flanks of the Curtis Island strike ridge system, of which Ship Hill is a part. The introduction of uncharacteristic construction activities and large scale clearance adjacent to this inherently natural looking ridge would generate a considerable change in landscape characteristics, over a confined area.	**Medium**: The precedent of existing construction adjacent to the Curtis Island Strike Ridge set by the baseline conditions reduces the magnitude of change associated with the Arrow LNG Plant.	**Moderate**	**Minor-Moderate**
		Operation	**High**: An indirect impact on the landscape setting of the Curtis Island strike ridge is anticipated. The LNG plant is located at the base of the western flanks of the Curtis Island strike ridge system, of which Ship Hill is a part. The introduction of uncharacteristic industrial elements at the base of this inherently natural looking ridge would generate a noticeable change in landscape characteristics, over a confined area.	**Medium:** as discussed for Construction	**Moderate**.	**Minor-Moderate**
		Decommissioning	**Low:** the effect on the Curtis Island strike ridge would be barely perceptible following decommissioning.	**Low:** The decommissioning of all baseline schemes would leave a barely perceptible change in the valued landscape	**Minor**	**Minor**

				characteristics.		
Coastal Mountain Ranges: Mount Larcom Range	Medium	*Construction*	**Imperceptible**: The impact on the characteristics of the Mount Larcom Range would also be indirect but would be imperceptible during construction because the range is already influenced by other existing industrial activity.	**Imperceptible**: The precedent of existing construction set by the baseline conditions does not change the magnitude of change associated with the Arrow LNG Plant.	**Negligible**	**Negligible**
		Operation	**Imperceptible**: The impact on the characteristics of the Mount Larcom Range would also be indirect but would be imperceptible because the range is already influenced by other existing industrial activity.	**Imperceptible:** as discussed for Construction	**Negligible**	**Negligible**
		Decommissioning	**Imperceptible:** there would be no impact on Mount Larcom.	**Imperceptible:** as discussed	**Negligible**	**Negligible**
Vegetation Management Act 1999 State Forestry Policy						
Targinie State Forest	Medium	*Construction*	**Low**: Targinie State Forest is not directly impacted by the project. There may be indirect impacts associated with TWAF 8 associated with construction personnel travelling between construction sites and accommodation. The accommodation may also be visible from some parts of the state forest. However, it is noted that the prime purpose of the designation is not the protection of landscape values.	**Low:** The other proponent's schemes do not affect Targinie State forest so there is no change against the baseline.	**Minor**	**Minor**
		Operation	**No impact:** Following construction, TWAF 8 would be abandoned (restored) so there would be no impacts during the operational phase.	**No impact:** There would be no impacts from any of the schemes during operation phase.	**No impact**	**No impact**
		Decommissioning	**No impact:** As discussed for Operation	**No impact:** As discussed for Operation	**No impact**	**No impact**

Appendix 1B Impacts on Landscape Character Types (LCTs)

The following table illustrates how the significance of the landscape impacts on the landscape character types (LCT) is determined. It combines the overall sensitivity of the LCTs to change as set out in **Section 4.4.11** and the magnitude of change associated with the project to evaluate the significance of the impact using the methodology defined in **Section 3.0**.

The magnitude assessment assumes a worst case scenario and the assessment is based upon the area of LCT which would be impacted to the greatest extent by the project. The project assessment considers the current situation in each of the LCTs with the study area. The baseline assessment considers an assumed scenario, including the Arrow LNG Plant, QCLNG and GLNG facilities.

Table 30 Assessment of Significance of impacts on landscape character types (LCTs)

Landscape receptor	Sensitivity		Landscape Magnitude of Change		Judgement of Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts on Landscape Character						
LCT 1: Forested Mountain Ridge	High	*Construction*	**High**: The Arrow LNG Plant would not directly affect any areas of this LCT. Indirect impacts to the perception of landscape character are possible where the project lies close to this LCT. Two areas may be impacted: This area of LCT 1 on Curtis Island Strike Ridge(Ship Hill) would experience an indirect impact. The LNG plant construction activities would occur at the base of the western flanks of the Curtis Island strike ridge system, of which Ship Hill is a part. The introduction of uncharacteristic construction activities and large scale clearance adjacent to this inherently natural looking ridge would generate a considerable change in landscape characteristics, over a confined area. Even though the forest covered elevated landform not be directly affected, it would be viewed with the construction of an industrial development in the immediate foreground, impacting on the setting of this LCT. The area of LCT 1 at the Forest Road Boat Ridge may also experience indirect impacts due to the construction of TWAF8. The magnitude of this change is considered less than for Curtis Island (Low).	**Medium**: The precedent of existing construction adjacent to the Curtis Island Strike Ridge set by the baseline conditions reduces the magnitude of change associated with the Arrow LNG Plant.	**Moderate-Major**	**Moderate**

		Operation	**High**: An indirect impact on the landscape setting of the Curtis Island strike ridge is anticipated. The LNG plant is located at the base of the western flanks of the Curtis Island strike ridge system, of which Ship Hill is a part. The introduction of uncharacteristic industrial elements at the base of this inherently natural looking ridge would generate a considerable change in landscape characteristics, over a confined area.	**Medium**: The precedent of existing construction adjacent to the Curtis Island Strike Ridge set by the baseline conditions reduces the magnitude of change associated with the Arrow LNG Plant.	**Moderate-Major**	**Moderate**
		Decommissioning	**Low:** the effect on the Curtis Island strike ridge would be barely perceptible following decommissioning and there would be no impact on Mount Larcom.	**Low:** The decommissioning of all baseline schemes would leave a barely perceptible change in the valued landscape characteristics.	**Minor-Moderate**	**Minor-Moderate**
LCT 2: Undulating or Flat Forest	Medium	*Construction*	**Very High**: The LNG plant is located within an area of LCT 2. A direct impact would be experienced over a relatively large area of this LCT. Its fundamental characteristics would be changed during the construction phase by vegetation clearing, landform modifications from that of a forested landscape to an industrial landscape type (LCT 5). The construction activities would be a dominant element of the landscape. A key element of this LCT - forest - would be permanently removed and replaced with an entirely new type of development, with no precedent within this LCT. TWAF8 also occurs within LCT 2 and its character would be impacted considerably by the removal of vegetation required to accommodate the construction camp.	**High:** When viewed in conjunction with existing construction activities the contrast with the existing landscape character would be less obvious.	**Moderate-Major**	**Moderate**
		Operation	**Very High**: A direct impact would be experienced over a relatively large area of this LCT. During operation, this LCTs fundamental characteristics would be industrial in contrast to the existing forested and natural character which would be viewed as a dominant change that would change the perception of Curtis Island. A similar effect would be experienced due to the presence of uncharacteristic elements within the TWAF8 site,	**High:** When viewed in conjunction with existing construction activities the contrast with the existing landscape character would be less obvious.	**Moderate to major**	**Moderate**

			adjacent to Targinie State Forest.			
		Decommissioning	**Low:** the effect on LCT 2 on Curtis Island would decrease to barely perceptible following decommissioning as it is envisaged that natural revegetation and remediation would gradually erase evidence of the LNG activities, although the ground modifications are likely to still be perceptible at close range.	**Low:** The decommissioning of all baseline schemes would leave a barely perceptible change in the valued landscape characteristics.	**Minor**	**Minor**
LCT 3: Wooded Rural	Medium	*Construction*	**Medium:** During construction the LNG plant would generate a direct impact on a small area of this landscape type, resulting in the removal of most of this area. As none of this landscape on Curtis Island or adjacent to the scheme on the mainland would remain, there is no impact during construction on this LCT elsewhere.	**Medium:** This LCT does not occur elsewhere in this part of Curtis Island so the baseline scheme does not affect the magnitude of change.	**Minor-Moderate** (Curtis Island)	**Minor-Moderate** (Curtis Island)
		Operation	**Medium:** During operation, the LNG plant would have noticeably replaced this landscape type. There is no impact during operation on this LCT elsewhere.	**Medium:** This LCT does not occur elsewhere in this part of Curtis Island so the baseline scheme does not affect the magnitude of change.	**Minor-Moderate** (Curtis Island)	**Minor-Moderate** (Curtis Island)
		Decommissioning	**Low:** Following decommissioning the loss of this landscape type would be barely perceptible.	**Low:** The presence of the baseline schemes would not affect the perception of change in this landscape type following decommissioning.	**Minor**	**Minor**
LCT 4: Open Rural	Medium	*Construction*	**Low:** A small area of LCT 4 may be affected during the construction of TWAF8 resulting in the replacement of open rural landscape with construction camp facilities.	**Low:** as the existing baseline schemes have no effect on LCT 4 there is no change to the baseline.	**Minor**	**Minor**
		Operation	**No impact:** Following the construction phase TWAF8 would be abandoned and restored so no change would be evident during the plant operation phase.	**No impact:** as described for Project Operation phase.	**No impact**	**No impact**
		Decommissioning	**No impact:** Following the construction phase TWAF8 would be abandoned and restored so no change would be evident during the plant operation phase.	**No impact:** as described for Project Operation phase.	**No impact**	**No impact**

LCT 5: Industrial / Extractive Industries	Negligible	*Construction*	**Low:** The construction of the LNG plant would generate an indirect impact on the setting of the industrial landscapes of Gladstone as well as direct impacts on small areas including TWAF7 and Launch Site 1. The LNG plant would principally have the same characteristics as the existing industrial areas and result in an intensification of the existing landscape character. This would represent an imperceptible change on this LCT's setting and therefore generate a **low** magnitude of change.	**Low:** Since the baseline schemes do not strongly affect the industrial landscapes there is no change on the perception of change within LCT 5	**Negligible**	**Negligible**
		Operation	**Low**: The LNG plant would directly affect the industrial landscape character in the vicinity of TWF7 and Launch Site 1. However, because these features are industrial in character they would intensify the existing landscape character rather than changing it; so the change would be barely perceptible.	**Low:** Since the baseline schemes do not strongly affect the industrial landscapes there is no change on the perception of change within LCT 5	**Negligible**	**Negligible**
		Decommissioning	**Low:** Following decommissioning the industrial areas will return to their former state, although it is noted that the implementation of the GSDA may have affected the baseline.	**Low:** Since the baseline schemes do not strongly affect the industrial landscapes there is no change on the perception of change within LCT 5	**Negligible**	**Negligible**
LCT 6: Urban	Low	*Construction*	**Low:** This LCT would not be directly impacted by the construction activity associated with the LNG plant. Indirect impacts would be minimal because of the distance of the development from the urban LCT, and because views from Gladstone already include large scale industrial activities in the foreground of the view. The greatest influence would be the barely perceptible change in landscape characteristics associated with the interface between the Gladstone residential area and TWAF7.	**Low:** The baseline schemes do not affect the urban landscape type and, therefore, there are no changes to the baseline associated with the construction of these schemes.	**Minor-Negligible**	**Minor-Negligible**
		Operation	**Low:** This LCT would not be directly impacted by the operation of the LNG plant. Indirect impacts would be minimal because of the distance of the development from the urban LCT, and because views from Gladstone	**Low:** The baseline schemes do not affect the urban landscape type and, therefore, there are no changes to the baseline	**Minor-Negligible**	**Minor-Negligible**

			already include large scale industrial activities, similar to the proposed LNG project, in the foreground of the view	associated with the operation of these schemes.		
		Decommissioning	**No impact:** Following decommissioning the industrial areas will return to their former state, although it is noted that the implementation of the GSDA may have affected the baseline.	**No impact:** Since the baseline schemes do not strongly affect the industrial landscapes there is no change on the perception of change within LCT 5	**No impact**	**No impact**
LCT 7: Coastal or Estuarine Plain	High	*Construction*	**High**: During the construction phase changes to the landscape character of this LCT would be considerable with some vegetation clearance evident associated with the construction of marine facilities, as well as laydown areas on this LCT on Curtis Island, and the presence of the tunnel spoil disposal area south of Fishermans Landing.	**High:** The coastal wetlands are considered important on the basis of particular natural elements so the changes to other areas of these landscapes associated with the baseline schemes is irrelevant to the project baseline.	**Moderate-Major**	**Moderate-Major**
		Operation	**High**: The LNG plant would impact directly on the landscape character of LCT 7: Al though the LNG plant is sited immediately adjacent to wetland landscapes, the characteristics of these areas would be largely retained. However, particular impacts would be evident due to the presence of the tunnel entrance pad. The gas pipeline would also cut through a significant area of wetlands south of Fishermans Landing. During operation some natural rehabilitation of the wetlands is likely to occur.	**High:** as discussed for operation.	**Moderate-Major**	**Moderate-Major**
		Decommissioning	**Low:** Following decommissioning it is anticipated that revegetation would rapidly occur to regenerate affected wetland areas.	**Low:** as discussed for operation.	**Minor-Moderate**	**Minor-Moderate**
LCT 8: Waterscape	Medium	*Construction*	**High**: A small area of the waterscape would be directly impacted during the construction phase of the LNG plant with the building (and associated dredging) of the jetty, MOF and launch Sites. This direct change is considered to generate a considerable change but over a very restricted area. Silt plumes associated with dredging may also be present adversely affecting visual quality. Frequent construction traffic crossing Port Curtis would	**Medium:** Activities associated with the construction of the baseline schemes would increase the level of activity against which the Arrow LNG Plant would be viewed.	**Moderate**	**Minor-Moderate**

			also be evident. However, given the existing industrial context of Port Curtis, the landscape character of this LCT would not fundamentally change.			
		Operation	**Medium**: A small area of the waterscape would be directly impacted during the operational phase of the LNG plant with the building of the jetty, MOF and launch Sites. This direct change is considered to generate a considerable change but over a very restricted area. However, given the existing industrial context of Port Curtis, the landscape character of this LCT would not fundamentally change.	**Medium:** The operation of the baseline schemes would not change the magnitude of impact of the Arrow LNG Plant during operation as impacts would remain noticeable.	**Minor-Moderate**	**Minor-Moderate**
		Decommissioning	**Low:** Following decommissioning there would be barely perceptible changes remaining to the waterscape LCT.	**Low**: The existing schemes do not change the extent to which the scheme would be noticeable.	**Minor**	**Minor**

Appendix 2: Detailed Evaluation of Landscape and Visual Impacts of Light Sources

Appendix 2A Assessment of the Landscape Impacts of Lighting

The area of the LCT considered in this assessment is the nearest part of this landscape character type to the project area of disturbance, as opposed to considering the impact on the entire LCT within the study area. This approach determines the worst case scenario. It is noted that regarding the night-time impacts there are no meaningful differences between the MOF options on Curtis Island although there are variations in the TWAF options as noted below.

Table 31 Table of assessment of significance of lighting impacts on landscape receptors

Landscape receptor	Sensitivity to light		Landscape Magnitude of Change		Judgement of Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Landscape Character						
LCT 1: Forested Mountain Ridge	Medium	*Construction*	**Medium**: The area of this LCT that would be most affected is the Curtis Island Strike Ridge. Sky glow will only be emitted associated with the construction activities between twighlight and 7pm.	**Medium**: Despite the presence of the baseline schemes the increase in light associated with the Arrow LNG Plant would still be noticeable.	**Minor to moderate**	**Minor-Moderate**
		Operation	**High**: An extensive area of this is anticipated to be experience considerable change due to the lighting of the LNG facility which will operate round-the-clock as well as intermittent venting of the emergency flare.	**High**: Despite the presence of the baseline schemes the increase in light associated with the Arrow LNG Plant would still be considerable.	**Moderate**	**Moderate**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
LCT 2: Undulating or Flat Forest	Medium	*Construction*	**Medium**: The areas of this LCT that would be most affected are the undulating forest landscape on Curtis Island and direct impacts on the area of TWAF 8. Sky glow will only be emitted associated with the construction activities between twighlight and 7pm.	**Medium**: Despite the presence of the baseline schemes the increase in light associated with the Arrow LNG Plant would still be noticeable. TWAF8 is entirely unaffected by the baseline.	**Minor to moderate**	**Minor-Moderate**
		Operation	**High**: An extensive area is anticipated to be partially lit by the proposal due to the lighting of the LNG facility which will operate round-the-clock as well as intermittent venting of the emergency flare. Note: TWAF 8 will not be lit during this phase.	**High**: Despite the presence of the baseline schemes the increase in light associated with the Arrow LNG Plant would still bring about a considerable change.	**Moderate**	**Moderate**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
LCT 3: Wooded	Medium	*Construction*	**Medium:** TWAF 8 lies within this landscape type and would result in a noticeable increase in light glow in the Targinie area. No	**Medium**: The baseline schemes do not affect the TWAF8 area so this is unaffected.	**Minor to moderate**	**Minor to moderate**

Landscape receptor	Sensitivity to light		Landscape Magnitude of Change		Judgement of Significance of Landscape Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Landscape Character						
Rural			significant areas of this LCT will remain on Curtis Island.			
		Operation	**No impact:** No areas of this LCT will be affected by operational lighting.	**No impact:** No areas of this LCT will be affected by operational lighting of the baseline schemes.	**No impact**	**No impact**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
LCT 4: Open Rural	Medium	*Construction*	**Medium:** TWAF 8 lies within part of this LCT and would result in a noticeable increase in light glow in the Targinie area. The LNG facility will not affect any areas of this LCT.	**Medium**: The baseline schemes do not affect the TWAF8 area so this is unaffected.	**Moderate**	**Moderate**
		Operation	**No impact:** No lighting will remain on the TWAF 8 site	**No impact:** No areas of this LCT will be affected by operational lighting of the baseline schemes.	**No impact**	**No impact**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
LCT 5: Industrial / Extractive Industries	Negligible	*Construction*	**Low**: The closest area of this LCT to the LNG facility is approximately 3.5 km away at Clinton Wharf. An area of this LCT will also be directly affected associated with TWAF 7. The change will be barely perceptible against the current highly lit context of these areas.	**Low**: The baseline schemes do not affect the TWAF7 area so the magnitude of change is unaffected.	**Negligible**	**Negligible**
		Operation	**Low**: Some light glow from the LNG facility may affect this LCT in the vicinity of Fishermans Landing and Wiggins Island to a barely perceptible level, particularly associated with intermittent venting of the emergency flare.	**Low:** No areas of this LCT will be affected by operational lighting of the baseline schemes.	**Negligible**	**Negligible**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
LCT 6:	Low	*Construction*	**Medium**: The closest area of Gladstone is	**Medium**: The baseline schemes do not	**Minor**	**Minor**

Landscape receptor	Sensitivity to light		Landscape Magnitude of Change		Judgement of Significance of Landscape Impact	
			Project	**Baseline**	**Project**	**Baseline**
Impacts of lighting on Landscape Character						
Urban			approximately 5 km away from the LNG plant. The foreground between Gladstone and LNG plant is the waterscape, which has limited capacity to buffer sky glow, so some night-time effects of construction lighting are likely to be perceived, albeit only to 7pm and in the context of the existing industrial activity TWAF8 is also located adjacent to the existing residential area and lighting from this facility is likely to be noticeable to residents.	affect the element causing the greatest change on the Urban LCT i.e., The TWAF7 area, so magnitude is unaffected.		
		Operation	**Medium**: Skyglow associated with the all-hours operation of the LNG plant and the occasional venting of the emergency flare would indirectly affect this area. The TWAF 8 site would not be present in this phase.	**Medium:** The Arrow LNG Plant is closest to the Urban LCT of Gladstone. Whilst the baseline schemes marginally increase the baseline light levels against this change would be experienced, the magnitude is anticipated to remain medium.	**Minor**	**Minor**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
LCT 7: Coastal or Estuarine Plain	Medium	*Construction*	**High:** An extensive area is anticipated to be partially lit during the construction phase by the LNG plant construction activities (until 7 pm) affecting this LCT on Curtis Island. The areas south of Fisherman's Landing on the mainland associated with the mainland tunnel launch site and tunnel spoil disposal area would also be affected (round-the-clock) by construction lighting. These activities are anticipated to generate glare and sky glow. The magnitude of change is considerable.	**High**: Although the baseline schemes will raise the brightness levels against which these construction activities would be experienced, it is still anticipated that the lighting levels would considerably increase as a result of the Arrow LNG Plant and the magnitude of change would be high.	**Moderate**	**Moderate**

Landscape receptor	Sensitivity to light		Landscape Magnitude of Change		Judgement of Significance of Landscape Impact	
			Project	**Baseline**	**Project**	**Baseline**
Impacts of lighting on Landscape Character						
		Operation	**High**: An extensive area of this LCT on Curtis Island is anticipated to be partially lit by the round-the-clock operation of the LNG plant and intermittent flaring of the emergency flare. The development may generate glare or sky glow.	**High**: Despite the presence of the baseline schemes the increase in light associated with the Arrow LNG Plant would still be considerable.	**Moderate**	**Moderate**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
LCT 8: Waterscape	Medium	*Construction*	**High**: The area of LCT 8 associated with Port Curtis would be considerably affected during the construction phase by the increased construction water traffic carrying personnel and materials, the tunnel construction activities and the lighting of the plant construction activities (until 7 pm)	**High**: Despite the presence of the baseline schemes the increase in light levels specifically associated with the Arrow LNG Plant would still be considerable.	**Moderate**	**Moderate**
		Operation	**High**: An extensive area is anticipated to be partially lit by the project during operation (round-the-clock). The development will generate glare and sky glow, particularly during emergency flaring activities.	**High**: Despite the presence of the baseline schemes the increase in light levels specifically associated with the Arrow LNG Plant would still be considerable.	**Moderate**	**Moderate**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**

Appendix 2B: Assessment of the Visual Impacts of Lighting

Table 32 Table of assessment of significance of lighting impacts on visual receptors

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Viewpoints						
Viewpoint 1. View from Auckland Point	Medium	*Construction*	**High**: Clearly perceptible light level change impacts anticipated within a limited duration of time up until approximately 7pm. These would affect a distant part of this elevated view which currently appears dark. The construction may generate glare and sky glow.	**Medium**: The baseline LNG facilities on Curtis Island would provide a lit context against which the lighting associated with the construction activities would appear less dominant.	**Moderate**	**Minor to Moderate**
		Operation	**Very high**: Major light level change anticipated affecting a substantial but distant part of this elevated view, including any intermittent flaring that may be necessary. The development may generate glare and sky glow. Night lighting of the LNG plant may evoke a subjective response i.e., whilst some viewers would object to the intrusion of lighting into a dark landscape some viewers may consider the lit LNG facility at night to be a feature of interest.	**High**: The baseline LNG facilities on Curtis Island would provide a lit context against which the lighting associated with the operation activities would appear less noticeable. The Arrow LNG Plant lighting would therefore appear to blend into an industrial context to a greater extent.	**Moderate to Major**	**Moderate**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 2. View from Spinnaker Park	Medium	*Construction*	**Medium**: Clearly perceptible light level change impacts anticipated within a limited duration of time up until approximately 7pm. These would affect a distant part of this elevated view which currently appears dark. The construction may generate glare and sky glow but would be diminished by the existing context of industrial lighting associated with the Coal terminal.	**Medium**: The baseline LNG facilities on Curtis Island would provide a lit context against which the lighting associated with the construction activities would appear less dominant. However, the effects of the LNG construction would remain noticeable and therefore the magnitude does not change.	**Minor to Moderate**	**Minor to Moderate**

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Viewpoints						
		Operation	**High**: The brightly lit infrastructure of Clinton Coal Terminal and Wharf obscures some of the view for users of Spinnaker Park and therefore the light level change associated with the lit plant and flare venting would be perceptible at an intermediate distance. The development may generate glare and sky glow. The magnitude of change is considered **high**.	**Medium**: The baseline LNG facilities on Curtis Island would provide a lit context against which the lighting associated with the operation activities would appear less noticeable. The Arrow LNG Plant lighting would therefore appear to blend into an industrial context to a greater extent.	**Moderate**	**Minor to Moderate**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 3.View from Gladstone CBD	Medium	*Construction*	**Low**: The light level change would be perceptible within a limited duration of time up until approximately 7pm. These would affect a distant part of this elevated view but would be diminished by the existing context of industrial lighting between the CBD and Curtis Island.	**Low**: The baseline LNG facilities on Curtis Island would provide a lit context against which the lighting associated with the operation activities would contrast less. However, the Arrow LNG Plant lighting would still be perceptible.	**Minor**	**Minor**
		Operation	**Medium**: The new lighting is anticipated to be clearly perceptible in views at this distance. Even should the flare be activated at night, the impact is considered to generate only glare or sky glow. Therefore the magnitude of change is considered **medium.**	**Medium**: The baseline LNG facilities on Curtis Island would provide a lit context against which the lighting associated with the operation activities would appear less noticeable. However the Arrow LNG Plant lighting would be the most prominent lit LNG facility from this vantage point.	**Minor to Moderate**	**Minor to Moderate**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 4. View from Round Hill	Medium	*Construction*	**Low:** At this far distance, particularly given the context of industrial and residential development in the foreground of the view, the construction lighting associated with the	**Low**: The baseline LNG facilities on Curtis Island would provide a lit context against which the lighting associated with the operation activities would contrast	**Minor**	**Minor**

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Viewpoints						
Lookout			Arrow LNG Plant would be barely perceptible.	less. However, the Arrow LNG Plant lighting would still be perceptible.		
		Operation	**Low:** At this far distance, particularly given the context of industrial and residential development in the foreground of the view, the operational lighting associated with the Arrow LNG Plant would be barely perceptible, although occasional intermittent flaring may be noticeable.	**Low:** Whilst the baseline LNG plants would increase the lit context of Curtis Island the effects of the Arrow LNG Plant would still be perceptible.	**Minor**	**Minor**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 5. View from South End	Medium	*Construction*	**No impact:** The short duration of construction lighting (until 7pm), distance of South End from the LNG plant and effects of intervening landform mean that there are unlikely to be perceptible changes associated with construction lighting from this vantage point.	**No impact:** as for construction. The baseline schemes do not change this situation.	**No impact**	**No impact**
		Operation	**Low**: Only the venting flare would be directly viewed. The remaining new lighting is anticipated to generate additional sky glow which is expected to blend in with the existing light situation. Given the intermittent frequency of gas venting, and that South End is a considerable distance from the project, a magnitude of change is considered low.	**Low**: the baseline schemes are further from South End than the Arrow LNG Plant and, therefore, do not diminish its relative impact.	**Minor**	**Minor**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 6. View from Port Curtis	Low (medium relating to	*Construction*	**High**: Although only present for a limited duration (until 7pm), lighting associated with construction activities would be considerably	**High:** Although the QCLNG and GLNG plants would decrease the contrast of the construction lighting against the existing	**Minor to moderate** (moderate relating	**Minor to moderate** (moderate

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Viewpoints						
by Turtle Island	Turtle Island residents)		visible from here.	environment, the Arrow LNG Plant would be the dominant light source in this specific location.	to Turtle Island residents)	relating to Turtle Island residents)
		Operation	**Very high:** Major light level change anticipated affecting a substantial part of the view. The intermittent venting of the gas would be viewed at a close distance and lighting associated with facilities would be clearly visible. The development may generate glare and sky glow change.	**Very high:** Although the QCLNG and GLNG plants would decrease the contrast of the lighting against the existing environment, the Arrow LNG Plant would be the dominant light source in this specific location.	**Moderate** (moderate to major for Turtle Island residents)	**Moderate** (moderate to major for Turtle Island residents)
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 7. View from Port Curtis by Witt Island	Low (medium relating to Witt Island residents)	*Construction*	**High**: Although only present for a limited duration (until 7pm), lighting associated with construction activities would be considerably visible from here.	**High:** Although the QCLNG and GLNG plants would decrease the contrast of the construction lighting against the existing environment, the Arrow LNG Plant would be the dominant light source in this specific location.	**Minor to moderate** (moderate relating to Witt Island residents)	**Minor to moderate** (moderate relating to Witt Island residents)
		Operation	**Very high:** Major light level change anticipated affecting a substantial part of the view. The intermittent venting of the gas would be viewed at a close distance and lighting associated with facilities would be clearly visible. The development may generate glare and sky glow change.	**Very high:** Although the QCLNG and GLNG plants would decrease the contrast of the lighting against the existing environment, the Arrow LNG Plant would be the dominant light source in this specific location.	**Moderate** (moderate to major for Witt Island residents)	**Moderate** (moderate to major for Witt Island residents)
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 8. View from Port Curtis by Tide	Low (medium relating to Tide Island	*Construction*	**Very high**: Although only present for a limited duration (until 7pm), lighting associated with construction activities would be considerably visible from here.	**Very high:** Although the QCLNG and GLNG plants would decrease the contrast of the construction lighting against the existing environment, the	**Moderate** (moderate to major relating to Tide Island	**Moderate** (moderate to major relating to Tide Island

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Viewpoints						
Island	residents)			Arrow LNG Plant would be the dominant light source in this specific location.	residents)	residents)
		Operation	**Very high:** Major light level change anticipated affecting a substantial part of the view. The intermittent venting of the gas would be viewed at a close distance and lighting associated with facilities would be clearly visible. The development may generate glare and sky glow change.	**Very high:** Although the QCLNG and GLNG plants would decrease the contrast of the lighting against the existing environment, the Arrow LNG Plant would be the dominant light source in this specific location.	**Moderate** (moderate to major for Tide Island residents)	**Moderate** (moderate to major for Tide Island residents)
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 9. View from the South End Ferry Service and the Main Shipping Channel	Low	*Construction*	**High**: Although only present for a limited duration (until 7pm), lighting associated with construction activities would be considerably visible from here.	**Medium:** The QCLNG and GLNG plants would be the dominant lit element in this view and would decrease the contrast of the construction lighting against the existing environment.	**Minor to Moderate**	**Minor**
		Operation	**High:** Light level change anticipated but at some distance affecting a substantial part of the view associated with the round-the-clock lighting of the LNG plant and the intermittent venting of the emergency flare. The development may generate glare and sky glow.	**Medium:** The QCLNG and GLNG plants would be the dominant lit element in this view and would significantly decrease the respective contribution to and contrast of the Arrow LNG Plant with light levels.	**Minor to Moderate**	**Minor**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 10. View from Port Curtis Shipping Channel	Low	*Construction*	**High**: Although only present for a limited duration (until 7pm), lighting associated with construction activities would be considerably visible from here.	**Medium:** The QCLNG and GLNG plants would be the dominant lit element in this view and would decrease the contrast of the construction lighting against the existing environment.	**Minor to Moderate**	**Minor**
		Operation	**Very high :** Major light level change anticipated affecting a substantial part of the view associated with the round-the-clock lighting of the LNG plant and the intermittent	**High:** The QCLNG and GLNG plants would be the dominant lit element in this view and would significantly decrease the respective contribution to and contrast of	**Moderate**	**Minor to moderate**

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Viewpoints						
			venting of the emergency flare. The development may generate glare and sky glow.	the Arrow LNG Plant with light levels.		
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 11. View from Laird Point on Curtis Island	Medium	*Construction*	**Low**: The change in light level from here associated with construction activities is anticipated to be low due to the distance from the LNG facility.	**Low**: The Arrow LNG Plant lighting associated with construction would be imperceptible in relation to lighting associated with the baseline schemes.	**Minor**	**Minor (negligible)**
		Operation	**Medium:** Only the venting flare would be directly viewed. Other development lighting is anticipated to generate additional sky glow and is expected to blend in with the existing view to a moderate extent.	**Low:** The QCLNG and GLNG plants would be the dominant lit element in this view and would decrease the contrast of the construction lighting against the existing environment.	**Minor to moderate**	**Minor**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 12. View from Mount Larcom Summit	Negligible	*Construction*	**Medium**: The changes in light level associated with the LNG facility during construction are anticipated to be barely noticeable from this elevated viewing location which is a considerable distance from the LNG site. There may be some noticeable effects of the TWAF 8 lighting.	**Low:** The baseline schemes do not affect the lighting assessment from this vantage point due to the effect of distance.	**Negligible**	**Negligible**
		Operation	**Low**: The changes in light level are anticipated to be barely noticeable from this elevated viewing location. The change is anticipated to be minor due to the long distance of the view and existing lit context of industrial and urban development around Port Curtis. The lighting is expected to blend in with the existing lighting context to a	**Low:** The baseline schemes do not affect the lighting assessment from this vantage point due to the effect of distance.	**Negligible**	**Negligible**

Visual receptor	Sensitivity to light		Visual Magnitude of Change		Judgement of Significance of Visual Impact	
			Project	Baseline	Project	Baseline
Impacts of lighting on Viewpoints						
			moderate extent.			
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
13. View from Reid Road and Gladstone - Mount Larcom Road intersection	Negligible	*Construction*	**High**: Light level changes during construction will be evident relating to the tunnel activities that will occur around the clock.	**High :** Since the construction activities related to the Arrow LNG Plant are the dominant lighting element at short distances in this view, the baseline schemes do not affect the lighting assessment from this vantage point.	**Minor**	**Minor**
		Operation	**Medium**: The changes in light level are anticipated to be noticeable from this location. However the change is anticipated to be a minor level of light change in the longer distance view, which is expected to blend in with the existing lighting context to a moderate extent. This is associated with the round-the-clock working of the LNG plant and the emergency flare.	**Low:** During the operation phase the activities associated with the baseline schemes will be more dominant than the lighting of the Arrow LNG Plant. This diminishes the relative magnitude of the Arrow LNG Plant lighting.	**Negligible**	**Negligible**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 14. View from Flinders Street	Medium	*Construction*	**Medium**: This view would experience lighting associated with TWAF 7. These facilities are anticipated to be 'domestic' level lighting.	**Medium**: The TWAF is the dominant element of the view and is unaffected by the baseline schemes.	**Minor to moderate**	**Minor to moderate**
		Operation	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
Viewpoint 15. View from Calliope River-Targinie Road	Medium	*Construction*	**Medium**: This view would experience lighting associated with TWAF8. These facilities are anticipated to be 'domestic' level lighting.	**Medium**: The TWAF is the dominant element of the view and is unaffected by the baseline schemes.	**Minor to moderate**	**Minor to moderate**
		Operation	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**
		Decommissioning	**No impact:** No lighting will remain on site	**No impact:** No lighting will remain on site	**No impact**	**No impact**

Appendix 3: Detailed Evaluation of Cumulative Landscape and Visual Impacts

Assuming the projects shown on **Figure 33** and the Arrow LNG Plant are approved and constructed, there are likely to be cumulative landscape and visual impacts on the landscape of the area around Port Curtis, Gladstone.

The following tables **Table 33** to **Table 35** provide an overview of the key impacts anticipated to affect designated landscapes, landscape character and the representative viewpoints.

Appendix 3A Consideration of Cumulative Impacts on Landscape Planning Designations

Table 33 provides an overview of cumulative impacts associated with industrial actives affecting the key landscape designations in the study area.

Table 33 Assessment of cumulative impacts on Landscape Planning Designations

Cumulative Impacts on Landscape Designations			
Landscape Designation	**Sensitivity to Change**	**Judgement on the Magnitude of Change**	**Significance of Impact**
International Planning Designation, Policy and Guidance			
Great Barrier Reef World Heritage Area (GBRWHA)	**High**	**High:** At a local level, even though the activities are consolidated in the Gladstone region, the change associated with this large scale development would substantially increase and intensify the industrial activity over a wide area of Port Curtis. These projects would be clearly evident and highly visible, and even with the presence of existing industrial development in the locality would generate a considerable change, albeit concentrated in the Gladstone area. In particular WHA landscape values would be affected by the incursion of industrial development onto the largely natural island setting of Curtis Island associated with the GLNG project, APLNG project, Arrow LNG Plant and QCLNG project. The Western Basin Strategic Dredging and Disposal Project and the Fishermans Landing Northern Expansion Project are also key causes of landscape change.	**Moderate to Major**
Great Barrier Reef Marine Park	**High**	**Medium**: Despite the observations made in relation to the WHA it is noted that the industrial intensification around Gladstone does not directly affect the GBR Marine Park. Indirect impacts will be noticeable, particularly relating to an intensification of large LNG and export vessels in Port Curtis and passing through the Marine Park in the area of Gladstone which affects a small part of the Marine Park.	**Moderate**
National Planning Designation, Policy and Guidance			
Australian Heritage Commission Register of National Estate:			

The Narrows.	**High**	**High**: The southern part (or entrance to The Narrows) may be directly impacted by a number of these proposals particularly the APLNG project, QCLNG project and GLNG project. The dredging associated with pipelines in this location will result in sediment plumes during construction. During operation the main changes would relate to the Fisherman's Landing Northern Expansion project in the vicinity of The Narrows. However the change would be restricted to a small area on the southern border of The Narrows and would not fundamentally change the character of entire protected area which is already partially affected by industrial activity.	**Moderate to Major**
Garden Island Conservation Park.	**High**	**High** An indirect impact is anticipated on the "setting" of this landscape arising from increased traffic of LNG tankers, dredging associated with the Western Basin Strategic Dredging Project and the perception of industrial intensification associated with the Wiggins Island Coal Terminal Project. However, the Arrow LNG Plant is the closest to Garden Island so the magnitude of effect remains high.	**Moderate to Major**
Mount Larcom Range.	**High**	**Medium:** Whilst the Arrow LNG Plant does not affect the landscape character of Mount Larcom, some or all (as in the case of the view from the summit) of the proposed developments considered in the cumulative assessment may be viewed and influence its setting. It is important to note that this discussion considers primarily the "setting of Mount Larcom" as opposed to the impact on the view from the summit. Furthermore views to Mount Larcom range will have greater level of industrial development visible at the base of the range, for example related to the Gladstone Steel Plant Project and Yarwun Alumina Refinery Expansion . This would generate a noticeable change in characteristics of the range over a wide area, but would not fundamentally change the character of the range.	**Moderate**
State Planning Designation, Policy and Guidance			
Curtis Coast Regional Coastal Management Plan (2003)			
Islands and off shore features: *Curtis Island*	**Medium**	. **Very high:** This is principally because there is no precedent for industrial development on Curtis Island, which is a natural forested island landscape . The introduction of the Arrow LNG Plant and APLNG, QCLNG and GLNG industrial developments and the Common User Infrastructure Corridor on the southern part of Curtis Island will fundamentally change the	**Moderate-Major**

		character of this part of the island.	
Coastal wetlands: Curtis Island and The Narrows	**Medium**	**Very high:** Many of the proposed developments considered in the cumulative assessment are inland and avoid impacting these landscapes directly; however there are extensive coastal areas around Port Curtis where these features are directly impacted by the proposed developments. In these situations the impact may generate a considerable change, but over a restricted area. In some cases the developments is located on the boundary of these areas, impacting on the setting of these features over a wider area. The most significant projects are the LNG Projects on Curtis Island, the Wiggins Island Coal Terminal Project and Fisherman's Landing Northern Expansion.	**Moderate to Major**
Estuaries and Inlets: The Narrows	**Medium**	**High**: as for the justification associated with The Narrows listing on the Australian Heritage Commission Register of National Estate, above.	**Moderate**
Riverine Corridors and Creeks: *Calliope River, Auckland Creek,* etc.	**Medium**	**High*:*** A number of riverine corridor and creek features will be directly impacted by the developments considered. This includes The Arrow LNG Plant impacts associated with Launch Site 1 on the Calliope Rive, numerous diversions and impacts on the setting of the creeks on the western edge of Curtis Island (associated with APLNG, GLNG, QCLNG and Arrow LNG Plant plants) and Curtis Island. Where this occurs, it is predicted that their aesthetic values and character will change considerable but over a restricted area.	**Moderate**
Coastal Mountain ranges: *Curtis Island Strike Ridge* and *Mount Larcom Range*	**Medium**	**Very high (Curtis Island Strike Ridge):** There is no precedent for industrial development at the base of the Curtis Island Strike Ridge currently and it will be significantly affected by the APLNG, QCLNG, GLNG, Arrow LNG Plant and Common User Infrastructure Corridor projects, which will significantly change its setting and inherent landscape values. **Medium**: The change is anticipated to be the same as Mount Larcom Listed on the Australian Heritage Commission Register of National Estate. Refer to row above for additional information.	**Moderate to Major** (Curtis Island Strike Ridge) **Minor to Moderate** (Mount Larcom Range)
Targinie State Forest	**Medium**	**Low:** The greatest influence on Targinie State Forest would be associated with the Arrow LNG Plant and significant additional cumulative impacts aren't predicted.	**Minor**

Appendix 3B Consideration of cumulative impacts on landscape character types

Table 34 provides an overview of cumulative impacts associated with industrial actives affecting the key landscape character types identified in the study area.

The area of the LCTs considered in this assessment is the nearest or most affected part of this LCT to the proposals, as opposed to considering the impact on the entire LCT within the study area. This approach determines the worst case scenario.

Table 34 Assessment of cumulative impacts on Landscape Character Types

Cumulative Impacts on Landscape Character Types			
Landscape Receptor	**Sensitivity to Change**	**Judgement on the Magnitude of Change**	**Significance of Impact**
LCT 1: Forested Mountain or Ridge	**High**	**Very high:** The LNG developments are likely to directly impact the lower western flanks or boundary of the Curtis Island Strike Ridge system. This is where the Northern Infrastructure Corridor is situated. Where directly impacted, the fundamental characteristics would change from a natural forested landscape to LCT 5, an industrial landscape. Where indirect impacts are predicted on areas of this LCT arising from the modification of the natural context to this landscape type the magnitude of change would be lower, as the key landscape characteristics would be maintained. Furthermore from Port Curtis the landscape character of this LCT is already influenced by existing industrial activities, which reduces the magnitude of change.	**Major**
LCT 2: Undulating or Flat Forest	**Medium**	**Very high:** The developments will directly impact on a large area of this LCT on the western part of Curtis Island and therefore the cumulative effect of these developments on this type will be most intense in this locality. The Wiggins Island Coal Terminal project will also affect areas of this LCT on the mainland. Despite the characterising influence over parts of this LCT by other existing industrial activities, the change associated with the introduction of unprecedented industrial development on Curtis Island will be relatively isolated from other areas where industrial activities are currently place. The new industrial development would dominate and fundamentally change the characteristics of this LCT in this locality.	**Moderate to Major**
LCT 3: Wooded Rural	**Medium**	**High:** The projects result in the removal of the area of this LCT on Curtis Island associated with the Arrow LNG Plant (although it is noted that this area would naturally be LCT 2). Many of the pipeline and linear projects on the mainland including the Wiggins Island Coal Terminal Project also affect areas of this LCT falling within the LVIA study area, principally during the construction period.	**Moderate**
LCT 4: Open Rural	**Medium**	**Medium**: The largest direct impact is anticipated during the construction stage of the proposed pipelines in the GSDA, Northern Infrastructure Corridor, south of The Narrows Road. All of this development principally introduces unprecedented construction activities (such as earthworks) that are anticipated to contrast and be	**Minor to Moderate**

		highly visible in this LCT. These activities would generate fundamental changes to the landscape character but the disturbed area would be confined to a relatively narrow footprint. Once operating, the remaining right of way of the pipeline projects, would not be visible and but would be only noticeable and would not fundamentally affect the character of this LCT. Indirectly, the introduction of large scale industrial development immediately adjacent to this LCT, would be highly visible and change the setting of the inherently rural landscape.	
LCT 5: Industrial / Extractive Industries	**Negligible**	**Low**: Development activities in this LCT include the Wiggins Island Coal Terminal. Such projects would intensify the existing character and would be noticeable but would not fundamentally change the character of the landscape.	**Negligible**
LCT 6: Urban	**Low**	**Medium**: The closest Urban LCT of Gladstone is approximately 2 km away from the closest development at Wiggins Island Coal Export Terminal and no direct impacts would be experienced from the projects identified. The majority of the developments around Port Curtis will be at n intermediate to long distance from Gladstone. The existing industrial activities in the landscape between Gladstone (where the majority of the additional projects are proposed) already exert an industrialising influence over parts of this LCT. The additional intensification associated with the development projects would noticeably industrialise the setting of the Gladstone Urban Area. In addition some urban intensification may occur indirectly as a result of additional housing required to house plant workers. Such a change would be noticeable but would not fundamentally change the character of the landscape.	**Minor**
LCT 7: Coastal / Estuarine Plain	**High**	**Very High:** Many of the projects considered in the cumulative assessment will directly and fundamentally change the character of areas of this LCT around Port Curtis. This includes all of the LNG projects located on Curtis Island, the Fisherman's Landing Northern Expansion project, the Wiggins Island Coal Terminal and (during construction) many of the feed gas pipelines. Some areas of this LCT's character are already influenced by industrial development and overall the landscape characteristics of such areas would be retained. The GSDA is likely to further diminish the natural character and physical extent of this LCT.	**Major**
LCT 8: Waterscape	**Medium**	**High:** The projects considered in this scenario would directly impact large areas of this LCT to the west of Curtis Island and south of the entrance to The Narrows. The cumulative impact and subsequent effect of these developments on this LCT will be most intense in these localities. The existing industrial activities already influence the character of some of this LCT, which lowers the intensity of the change. However the change associated with the introduction of industrial	**Moderate**

		development would still be continuous over a wide area and generate a considerable change in this locality. Key changes are associated with the Wiggins Island Coal Terminal, Fisherman's landing Northern Expansion, and (during construction) the Western Basin Strategic Dredging and Disposal Project.	

Appendix 3C Consideration of Cumulative Impacts on Visual Receptors

Views from Gladstone (viewpoints 1– 4), from Port Curtis (viewpoints 5-11) and from other mainland locations with views of Port Curtis (viewpoints 12 – 13) are considered in the cumulative assessment. Viewpoints 14 – 15 are excluded as these views principally concern the Arrow LNG Plant TWAF options.

Table 35 describes the cumulative impacts predicted upon these viewpoints.

Table 35 Assessment of cumulative impacts on Representative Viewpoints

Representative Viewpoint Assessment			
Viewpoint	**Sensitivity to Change**	**Judgement on the Magnitude of Change**	**Significance of Impact**
Viewpoint 1:Auckland Point	High	**Very high**: The closest project is approximately 2 km away at Wiggins Island Coal Export Terminal. This site is largely screened by the RG Tanna Coal Terminal in the foreground of the view. Views of the developments proposed around Fishermans Island would be partially screened by RG Tanna Coal Terminal, however would be visible in the background against a mountain range background. All waterside development considered in this scenario would increase the intensity and amount of industrial development in the view, resulting in a notable to immediately apparent contribution to the overall cumulative situation – this would be a "combined" impact. The extent of the new industrial development would make up a larger portion of the view and be clearly perceptible in a significant part of the view. The Curtis Island Industrial Precinct development would be the most visible waterside development. Collectively this development would extend the industrial landscape across Port Curtis from the mainland to Curtis Island and would be viewed in the middle to background of this view. Even though existing industrial development is in the middle to foreground of this view the cumulative effect is considered likely to fundamentally change the character of the visible landscape. **.**	**Major**
Viewpoint 2.From Spinnaker Park	High	**High**: Projects considered in this scenario that may be viewed (during the day time) from Spinnaker Park may include the North China Bay dredging operations of the Port of Gladstone Western Basin Dredging and Disposal and, potentially some aspects of the Wiggins Island Coal Terminal Project. The other developments would be screened by RG Tanna Coal Terminal. The visible dredging activities are anticipated to be incremental from this viewing situation and the main contributor to the cumulative and "combined" impact would be Hamilton Point Port project. The combined	**Moderate - major**

		impact of these two developments would represent a considerable change in the view.	
Viewpoint 3.From Gladstone CBD	Medium	**Medium**: The same developments are anticipated to be viewed as viewpoint 2. However the combined impact of the three developments would be largely screened by RG Tanna Coal Terminal and the visual change would represent a noticeable change at a longer distance. The cumulative magnitude of change would therefore be medium.	**Minor - moderate**
Viewpoint 4.From Round Hill Lookout	High	**High**: Even though this viewpoint is a long distance from the projects considered in the cumulative assessment, it provides one of two unique situations in the study area, where clear, elevated and uninterrupted views are achieved. The view would contain all waterside development, even though the projects at Fishermans' Island are partially screened by vegetation. Most of the proposed development would be set against the backdrop of forested ridgelines and mountains (LCT 1) and should not break the horizon The development on Curtis Island Industrial Precinct would be the most visible waterside development. This development would extend the industrial landscape across Port Curtis from the mainland to Curtis Island and would be viewed in the middle to background of this view. It would collectively, increase the intensity and amount of industrial development in the view, resulting in a substantially extension of the distinct industrial development and contributing to the overall cumulative situation – this would be a "combined" impact. Even with the existing industrial development in the middle and foreground of this view influencing the views character, the magnitude of change associated with this large scale development is predicted to be considerable.	**Moderate - Major**
Viewpoint 5.From South End	High	**Low**: The only additional waterside development that may be viewed from South End is the north China Bay dredging operations of the Port of Gladstone Western Basin Dredging and Disposal (construction phase). The other projects would be screened by the intervening landform and vegetation of Curtis Island. The visible dredging activities are anticipated to be viewed incrementally from this viewing situation.	**Minor - moderate**
Viewpoint 6.From Port Curtis by Turtle Island	Medium	Very high: Additional waterside developments that may be viewed (during the day time) from this viewpoint are the north China Bay dredging operations of the Port of Gladstone Western Basin Dredging and Disposal project and the Wiggins Island Coal Terminal project. The other developments would be screened by a combination of the intervening landform of Curtis Island and islands in the fore and middle ground of the view. The visible dredging activities are anticipated to be incremental from this viewing situation and the main contributor to the cumulative and "combined" impact is the Arrow LNG Plant and Wiggins Island. However the close distance change from an inherently natural view	**Moderate to Major**

		to a one with industrial development is anticipated to generate a dominant change.	
Viewpoint 7.From Port Curtis by Witt Island	Medium	**Very high**: Additional waterside developments that may be viewed (during the day time) from this viewpoint are the dredging operations of the Port of Gladstone Western Basin Dredging and Disposal project and, from this vantage point looking southwards, the Wiggins Island Coal Terminal project. The other developments would be screened by a combination of the intervening landform of Curtis Island and islands in the fore and middle ground of the view. The close distance change from a inherently natural view to a one with industrial development is anticipated to generate a dominant change.	**Moderate to Major**
Viewpoint 8.From Port Curtis by Tide Island	Medium	**Very high**: The Arrow LNG Plant would be the most dominant aspect. However, additional "successive impacts would be associated with the dredging activities associated with north China Bay dredging operations of the Port of Gladstone Western Basin Dredging and Disposal. Views of the developments around Fishermans Island may be partially screened by Hamilton Point and where viewed would be visible in the background against a mountain range. During the day time the combined impacts are anticipated for APLNG, QCLNG and GLNG and the Arrow LNG Plant, whist "successive" impacts are anticipated for the other development.	**Moderate to Major**.
Viewpoint 9.From South End Ferry	Medium	**High**: The Arrow LNG Plant would be the most dominant aspect. However, additional "successive impacts would be associated with the dredging activities associated with dredging operations of the Port of Gladstone Western Basin Dredging and Disposal and the Wiggins Island Coal Terminal Project.	**Moderate**
Viewpoint 10.From Port Curtis Shipping Channel looking east	Medium	**Very high**: The most visible development, as a "combined" impact, is anticipated to be the GLNG project considered under the baseline scenario. However the dredging activities associated with north China Bay dredging operations of the Port of Gladstone Western Basin Dredging and Disposal may also be visible. Views of the developments around Fishermans Island and the remaining development on Curtis Island including the Wiggins Island Coal Export Terminal, the QCLNG and APLNG will be viewed as "Successive" impacts. Even though industrial activities influence the character of other parts of the view, the view is currently principally of a "natural" forested landscape (LCT 2) and waterscape (LCT 8). The change from this natural landscape to an industrial landscape would be dramatic and dominant given the close proximity to this viewpoint.	**Moderate to major**
Viewpoint 11.From Laird Point on Curtis	High	**Very high:** This viewpoint is located within the APLNG site but would also experience direct views of QCLNG and GLNG. These developments would therefore be	**Major**

Island		highly visible, combined with views of the other Curtis Island Industry Precinct developments. It is predicted that the majority of the Arrow LNG Plant would be screened by the other Curtis Island Industry Precinct developments. Furthermore the developments proposed around Fishermans Island would be highly visible from this vantage point, as well as the Port of Gladstone Western Basin Dredging and Disposal in the middle to background of the view. It is also possible that the Wiggins Island Coal Export Terminal would be viewed. All of this development would be viewed in a landscape already partially influenced and characterised by industrial activities. However the view of Curtis Island from this view is of "natural" principally untouched forested (LCT 2) and coastal plain (LCT 7) landscapes. The change from this natural landscape to an industrial landscape would be dramatic given the close proximity to this viewpoint.	
Viewpoint 12.From Mount Larcom Summit (view looking west, north west and south west)	High	**Very high**: As opposed to the consideration of the impact on the "setting of Mount Larcom" – considered in the landscape planning designation table, this discussion is concerned with the impact on the view from this regionally important viewpoint. Even though this viewpoint is a long distance from the projects considered in this scenario of the cumulative assessment, it provides one of two unique situations in the study area, where clear, elevated and uninterrupted views are achieved. All the waterside development in this scenario would be clearly perceptible including Gladstone Pacific Nickel Refinery. Even from this elevated location, most of the development is predicted to be sited against the backdrop of forested ridgelines and mountains (LCT 1) It should not break the horizon (though at the time of this assessment, details regarding the heights of proposals was not known). The new, industrial landscape type would extend the industrial landscape across Port Curtis from the mainland to the "natural" landscape of Curtis Island. It would collectively, substantially increase the intensity and amount of industrial development in the view, resulting in extending the distinct and dominant industrial development – this would be a "combined" impact. Some of the existing industrial development in this view already influences its character however the large scale change and the further industrialisation likely as a result of the GSDA is still anticipated to generate a very high magnitude of change.	**Major**
Viewpoint 13.From Reid Road and Gladstone - Mount Larcom Road intersection	Low	**Very high**: The most visible development in this view is anticipated to be the construction activities associated with the Tunnel Entrance of the Arrow LNG Plant. Other developments during operation that will result in a considerable change in the view will include the Fishermans Island Northern Expansion Project and Wiggins Island Coal Export Terminal. In the middle	**Moderate**

		distance of the view the developments in the Curtis Island Industry Precinct including Arrow LNG Plant, APLNG, QCLNG and GLNG are predicted to be visible. In addition Gladstone Pacific Nickel Refinery and Yarwun Alumina Refinery may also be visible on the western side of Mount Larcom – Gladstone Road.	