# 3 TOPOGRAPHY & GEOMORPHOLOGY

This chapter provides a summary of the topography and geomorphology of the LNG Component of the Queensland Curtis LNG (QCLNG) Project, in particular the LNG Facility and surrounding area on Curtis Island. The chapter has been compiled using available data and published information, including aerial photographs, geological reports, topographic maps and database searches, supplemented by field investigations undertaken in October and November 2008[1].

Field investigations incorporated detailed soil sampling and chemical characterisation of soils to assess the proposed Project's impact on the erosion potential of soils and landscape. Soil sampling analytical results and soil characterisation is presented in *Volume 5, Chapter 4*.

Environmentally sensitive areas, or areas of high conservation value, are addressed in *Volume 5, Chapter 7*.

## 3.1 DESCRIPTION OF PROJECT ENVIRONMENTAL OBJECTIVES

The Project environmental objective for topography and geomorphology is: to maintain a stable landform that does not result in uncontrolled erosion.

## 3.2 REGIONAL TOPOGRAPHY

### 3.2.1 Southern Curtis Island

A topographic map showing the LNG Facility site and surrounds, including the proposed pipeline and road route, is provided in *Figure 5.3.1*.

The LNG Facility is located along the south-west coast of Curtis Island, in an area characterised by undulating hilly terrain. In general, the elevation across the site increases to the east (inland) from the coastal boundary of the LNG Facility, rising to an elevation of more than 80 m within the site near the eastern boundary. Immediately beyond the eastern site boundary a long valley runs south-east to north-west, with the proposed road and pipeline to be constructed roughly along the valley alignment.

Further to the east of the valley, and commencing approximately 350 m east of the eastern site boundary, a long ridgeline runs south-east to north-west extending almost from Graham Creek (northern end) to North China Bay. This ridgeline rises to approximately 145 m and forms a barrier separating the Curtis Island Industry Precinct of the Gladstone State Development Area

1 Environmental Resources Management Australia (2009) *Queensland Curtis LNG Plant: Geology and Soils Report*.

(GSDA) from the Environmental Management Precinct of the GSDA, described in *Volume 2, Chapter 4* of this Environmental Impact Statement (EIS).

The ridgeline provides a natural visual buffer between the LNG Facility and the community at South End, as detailed in *Volume 5, Chapter 16*. The ridgeline's ability to act as an effective acoustic barrier is discussed in *Volume 5, Chapter 13*.

A smaller ridgeline runs along the southern/south-eastern boundary of the LNG Facility site, rising from the coast to a height of approximately 110 m at the south-eastern corner of the site. This ridgeline also acts as a visual and acoustic barrier, screening nearly all elements of the proposed LNG Facility from viewpoints within and around Gladstone City. This is discussed in *Volume 5, Chapter 16.*

This smaller ridgeline also acts as an acoustic buffer attenuating noise and vibration impacts arising from LNG Facility construction and operations for sensitive receptors to the south and south-east of the site, including Gladstone City. Further detailed discussion of noise and vibration impacts and mitigation strategies is provided in *Volume 5, Chapter 13.*

Both the proposed pipeline and road would make landfall on Curtis Island at Laird Point and head east for approximately 1.5 km through hilly terrain (up to approximately 40 m Australian Height Datum) before turning in a more southerly direction towards the back (eastern boundary) of the LNG Facility site.

From there, the road route runs south-east along the valley previously discussed, at the back of the LNG Facility, with the pipeline traversing the western side of the valley before climbing up to the eastern site boundary and entering the plant through a topographic saddle between two hills at the back of the LNG Facility site.

Topographic gradients across the southern portion of Curtis Island in the vicinity of the LNG Facility site are mapped as part of the bushfire assessment provided in *Volume 5, Chapter 18* (*Figure 5.18.7*).

### *3.2.2 Mainland Approach*

The proposed mainland approach of the pipeline to The Narrows crossing, running eastward from Calliope River – Targinie Road to Friend Point, descends (as it heads eastward) through gently undulating terrain to the tidal mudflats in the vicinity of Friend Point.

The proposed Mainland Road and Bridge Approach, running roughly parallel to the coast heading north from Fishermans Landing, traverses flat to very gently undulating terrain and tidal mudflats.

**Legend**

- Proposed QCLNG Site Boundary
- Indicative Wet Lease Area
- Possible Curtis Island Road/Bridge Corridor
- Proposed Export Pipeline

**Source Note:**

Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
Curtis Island Road/Bridge Corridor - Connell Wagner
5m Contours ( AHD) - Department of Environment & Resource Management

Projection: UTM MGA Zone 56 Datum: GDA 94

0 200 400 800 m

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| | | | |
|---|---|---|---|
| Project | Queensland Curtis LNG Project | Title | Topographic Map of QCLNG Site Area - Curtis Island |
| Client | QGC - A BG Group business | | |
| Drawn | JB | Volume 5 | Figure 5.3.1 |
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### 3.2.3 LNG Facility Topography

The LNG Facility site rises from sea level (along its western boundary) up to more than 80 m near the eastern site boundary, with the elevation of the majority of the site between 10 m and 25 m Australian Height Datum (AHD). The LNG Plant footprint, within the LNG Facility, is located within a basin-like structure with hills on the southern, northern and western boundaries. The highest ground elevation within the footprint of the LNG Plant site is approximately 50 m AHD at the back (eastern site) of the LNG Plant.

The western margin of the site is flanked by intertidal to supratidal salt and mangrove flats. The intertidal flats range from approximately 0.5 m to 3 m above sea level and extend approximately 100 m to 250 m from the line of lowest astronomical tide (LAT).

The flats commonly contain alluvial deposits consisting of angular to sub-angular clasts derived from the adjacent surrounding hills. The clasts range in size from 2 mm to 300 mm, with larger clasts (20 mm to 100 mm) associated with outflows from creeks draining from the hilly region immediately to the east of the flats.

### 3.2.4 Surface Water Runoff

Based on the field observations of the relatively low relief and the extensive coverage of the site by colluvium, the potential for extensive erosion and runoff across the site is not considered as significant. However, runoff and erosion may be accelerated during periods of heavy rainfall, which are more common between December and February. Further detail on surface and groundwater in the area is provided in *Volume 5, Chapter 9* and *Chapter 10*.

## 3.3 GEOMORPHOLOGY

### 3.3.1 Field Observations

The main factors controlling the geomorphological development on Curtis Island are water (as runoff and tidal movements), vegetation, soils and geology. Two main watercourses (ephemeral flow only) have been observed on the LNG Facility site[2], flowing through the site from the north-east to the south-west. There are several smaller first and second order perennial watercourses which flow into the main creeks from the elevated areas on the south and north of the site.

2 Environmental Resources Management Australia (2009) *Queensland Curtis LNG Plant: Geology and Soils Report*.

The creeks observed across the site generally range in width between 2 m and 5 m and typical depth of 0.5 m-1.5 m, but ranging up to more than 5 m in one watercourse in the upper slopes of the site towards the eastern site boundary. The watercourses exhibit variable degrees of erosion, with the upper reaches showing higher erosion than the lower reaches (*Plate 5.3.1*).

***Plate 5.3.1 Evidence of Erosion in the Upper Part of Watercourse (Flowing to the South)***

The major factor influencing the development of landform characteristics across the site is water, with erosion of soils from runoff occurring as rills across the relatively flat sections of the site, and as water-driven erosion. The site contains a number of small watercourses, which occur between hills across the site and drain west to south-westwards towards the tidal flats on the western margin of the site. The watercourses are first and second order and exhibit variable degrees of bank erosion.

Based on the evidence of erosion in several of the streams, it appears that erosion potential for the site exists, particularly during high rainfall events (*Plate 5.3.2*). Further detail on soil erosion potential is provided in *Volume 5, Chapter 4.*

***Plate 5.3.2 Erosion Along Creek Bank, Exposing Overlying Soil Profile Consisting of Overbank Alluvial Deposits***

Other factors impacting on the geomorphological development of the land include vegetation and weathering. Soil disturbance from falling trees was observed in a limited number of locations across the site. The falling trees caused limited disturbance to the underlying soil and exposed the weathered substrate section of the underlying bedrock to penetration by roots. Along the coastline on the western side of the site, geomorphology is affected by tidal and other coastal processes. These are described in Volume 5, *Chapter 11*.

Environmentally sensitive areas or areas of high conservation value are discussed in *Volume 5, Chapter 7.*

### *3.3.2 Landslide*

No evidence of seismic activity or landslides has been observed within the LNG Facility boundary or immediate surrounds. Based on information from the region's Local Disaster Management Plan, Gladstone lies within an active earthquake area and has a 10 per cent chance of experiencing an earthquake with a velocity of 90 mm/s every 100 years. More detail on seismic assessment for the LNG Facility site is provided in *Volume 5, Chapter 4*.

The site was assessed, based on visual observation of surface conditions and incorporating the geology, soils and landform types, against the criteria

detailed in State Planning Policy (SPP) 1/03[3], specifically as:

- an area identified by a local government in its planning scheme consistent with the conclusions of a landslide hazard assessment prepared in accordance with Appendix 4 of the SPP 1/03 Guideline, or
- where such a study has not been undertaken, an area identified by a local government in its planning scheme and including all land of 15 per cent and greater slope and other land known or suspected by the local government as being geologically unstable, together with other areas that the local government considers may be adversely affected by a landslide event, or
- where an area has not been identified by a local government, all land with a slope of 15 per cent or greater.

The initial limited assessment considered that the risk of landslide, as defined in SPP 1/03, is acceptable for the proposed Curtis Island LNG Facility site and associated pipeline and other infrastructure[4]. The overall acceptability of the site in terms of SPP1/03 (landslide component) will be reassessed subject to ongoing geotechnical investigations.

The exposed outcrop across the site was generally less than 5 per cent of the total area, with exposed bedrock limited to creeks and less commonly on higher ground on the top of hills. The majority of the site was covered with colluvium, which ranged in size from approximately 10 mm to 1 m. The distribution of clast sizes varied across the site, with most clasts ranging in size from 20 mm to 100 mm (refer *Plate 5.3.3*).

3 Queensland Government (2003) *State Planning Policy (SPP) 1/03: Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*

4 Environmental Resources Management Australia (2009) *Queensland Curtis LNG Plant: Geology and Soils Report*.

***Plate 5.3.3 Outcrop of Dark Grey Blocky Indurated Mudstone of the Wandilla Formation, Curtis Island***

### *3.3.3 Vegetation*

Site is described in detail in *Volume 5, Chapter 7*. In summary, vegetation range from open woodland, with individual eucalypts and iron bark trees up to approximately 30 m in height, to closed medium density undergrowth of eucalypt saplings ranging in height from 1 m to 3 m. Open woodlands occupied approximately 65 per cent of the site, with medium density saplings occupying the remaining 35 per cent. The sapling understory occupied areas approximately 50 m to 200 m wide, where present, with larger trees distributed relatively evenly throughout.

The dominant vegetation types consisted of *Eucalyptus citriodora* woodland (Lemon-scented Gum), *Eucalyptus tereticornis* woodland (Red Gum) with *Eucalyptus crebra* (Narrow-leaved Ironbark). *Xanthorrea* spp. occurred in limited distribution across the site, and occupied approximately 5 per cent of the total area. Tree heights of the open woodland ranged up to approximately 25 m. Open woodlands and medium density understory of saplings are shown in *Plate 5.3.4* and *Plate 5.3.5*.

Additional information on the appropriate use of native plant species during landscaping and re-vegetation is described in *Volume 5, Chapter 7*. A discussion of bushfire risk is provided in *Volume 5, Chapter 18*.

*Plate 5.3.4 Typical Open Woodland, Dominated by E. citriodora and E. tereticornis*

*Plate 5.3.5 Typical Understory of Saplings of E. crebra, E. citriodora and E. tereticornis*

## 3.4 CONCLUSION

An assessment of geomorphology and topography in the area of the LNG Facility site indicates there are no significant issues with the potential to impact construction and operation of the LNG Facility and associated infrastructure sites. Ridgelines to the south and east of the site provide effective, natural visual and acoustic buffers between the site and residences in Gladstone and South End. These buffers are discussed further in *Volume 5, Chapters 13 and 16*. A summary of the impacts outlined in this chapter is provided in *Table 5.3.1*.

### Table 5.3.1 Summary of Topography and Geomorphology impacts

| Impact assessment criteria | Assessment outcome |
|---|---|
| Impact assessment | Positive for screening effect on LNG Facility and Curtis Island Road.<br><br>Negligible for the impact of the LNG Facility based on scale.<br><br>Negligible for risks posed by topography and geomorphology to construction and operation. |
| Impact type | Direct |
| Impact duration | Long-term |
| Impact extent | Local |
| Impact likelihood | High |

Overall assessment of impact significance: Negligible to minor positive, due to ridges and valleys on Curtis Island providing natural visual and acoustic buffers between the LNG Facility and sensitive receptors at South End and Gladstone.