28. TRAFFIC AND TRANSPORT

This chapter describes the existing transport environment of the Gladstone region pertinent to the Arrow LNG Plant, and the potential issues the project presents for road, rail, air and shipping modes of transport and transport infrastructure during construction and operation. Measures to address significant issues are also described in this chapter.

The chapter is based on the findings of the road, rail and air impact assessment undertaken by GTA Consultants (Appendix 23, Traffic and Transport Impact Assessment) and on various Arrow Energy studies on shipping including hazard identification studies and scenario modelling undertaken in conjunction with Gladstone Ports Corporation and the proponents of the Gladstone LNG (GLNG), Queensland Curtis LNG (QCLNG), and Australia Pacific LNG (APLNG) projects. Consultation with transport stakeholders carried out by Arrow Energy and GTA Consultants is also described.

A detailed logistics strategy has yet to be developed for the project as options for moving plant and materials to Curtis Island are not sufficiently well developed to carry out detailed modelling and assessment. A decision on the temporary workers accommodation facility (TWAF) site and mainland launch site is also required to progress this strategy. Consequently, the Traffic and Transport Impact Assessment (Appendix 23) has not considered in detail the impacts of heavy vehicle and shipping movements required to transport LNG plant components, equipment and other materials to the LNG plant site on Curtis Island. These impacts will be identified as the logistics strategy is developed and will be assessed in the supplementary report to the EIS.

The objectives for traffic and transport are set out in Box 28.1.

Box 28.1 Objectives: Traffic and transport

- To assess the impacts of the Arrow LNG Plant on road and rail network infrastructure and air services.
- To assess the impacts of the Arrow LNG Plant on shipping within and outside the Port of Gladstone.
- To identify avoidance, mitigation and transport management strategies that will be implemented for the project.

Major hazards and risks associated with the construction, operation and decommissioning of the Arrow LNG Plant, including shipping activities are discussed in detail in Chapter 29, Hazard and Risk.

28.1 Legislative Context and Standards

This section discusses Commonwealth and state legislation, plans and guidelines relevant to the project. Legislation applicable to all transport modes and infrastructure are introduced first, followed by those that set out specific requirements for each mode.

28.1.1 All Transport Modes

The following Queensland legislation is relevant to all transport modes and infrastructure:

- *State Development and Public Works Organisation Act 1971*. This act establishes the office of the Coordinator-General and grants the Coordinator-General powers to direct programs of works, declare significant projects and coordinate environmental impact assessments on a whole of government basis. The Port of Gladstone Western Basin Master Plan (DIP, 2010a) and the development scheme for the Gladstone State Development Area (DIP, 2010c) have

been developed under the act. Both documents consider the orderly development of a range of transport infrastructure in the region.

- *Transport Infrastructure Act 1994* (Qld). This act provides a framework to advance the integrated planning and management of transport infrastructure, including road and rail networks and port facilities. Approval is required under this act for any works that interfere with a railway or state controlled road. The act also grants port authorities powers to establish, manage and operate port facilities and services.
- *Sustainable Planning Act 2009* (Qld). As Queensland's principal planning legislation, this act coordinates planning at local, regional and state levels. The act provides a common assessment framework in the form of the Integrated Development Assessment System for regional councils and state government agencies to assess development applications against specific regional planning schemes or other plans as applicable. Under the system:
  - The Department of Transport and Main Roads (DTMR) acts as a referral agency for development applications that have potential to impact on public passenger transport services or state controlled roads.
  - Gladstone Ports Corporation is the port authority for the Port of Gladstone and the assessment manager for assessable development on strategic port land and within strategic port land tidal areas.

Plans that take an integrated approach to transport requirements include:

- Port of Gladstone Western Basin Master Plan (DIP, 2010a). This plan has been prepared under the State Development and Public Works Organisation Act. The master plan gives direction to current and planned land and marine uses, infrastructure development (including road and rail transport infrastructure requirements), port activities, common user channels, and dredging and disposal options in the Western Basin to 2039.
- Gladstone Integrated Regional Transport Plan 2001–2030 (DoT, 2001). This plan addresses all modes of transport including road, rail, port and air. The plan considers the region's transport system as a whole so as to balance general motor traffic, freight movements, public transport and non-motorised transport (i.e., cycling and walking). The plan sets out the vision for the Gladstone region, provides guiding principles, explains planning assumptions, and details a number of action plans for each transport mode.
- Planning schemes for the Gladstone Regional Council. On 15 March 2008, the Calliope Shire Council, Gladstone City Council and Miriam Vale Shire Council amalgamated to form the Gladstone Regional Council. The planning schemes of the former local governments continue to apply to their respective areas until such time as a regional planning scheme is finalised. The study area is covered by two local government planning schemes:
  - Calliope Shire Planning Scheme (CCC, 2007b).
  - The Gladstone Plan (SKM, 2006).

  The schemes include engineering standards for roads and road transport infrastructure policies.
- Development scheme for the Gladstone State Development Area (DIP, 2010c). This scheme replaces provisions of the Calliope Shire Planning Scheme (CCC, 2007b) and the Gladstone Plan (SKM, 2006) to regulate development within the Gladstone State Development Area. The area is divided into precincts and sub precincts considered suitable for industrial development

of national, state and regional significance, as well as complementary industrial, infrastructure and services uses. The scheme provides for the development of transport linkages within the Gladstone State Development Area and connection to surrounding transport networks.

28.1.2 Road Network

Road related legislation, plans and guidelines relevant to the project include:

- *Transport Operations (Road Use Management) Act 1995* (Qld). This act facilitates the granting of permits for transport of dangerous goods, mass dimensions and loads.
- Road implementation plan (DTMR, 2009a). This plan describes the Fitzroy region and details the DTMR key deliverables including road upgrade works planned for 2010/11.
- Road and transport standard (CCC & GCC, 2005). This standard provides guidance as to acceptable practices for roads and transport within the former Gladstone City Council and Calliope Shire Council areas.
- Guide to road safety in rural and remote areas (Austroads, 2006). This guide identifies the nature and causes of crashes in rural areas, and identifies measures to reduce road trauma.
- Guide to traffic management (Austroads, 2009). This guide sets out methods of traffic data analysis for effective traffic management, design and control.
- Guidelines for assessing the impacts on roads from development (DMR, 2006a). These guidelines detail the steps that should be followed to identify road impacts arising from proposed developments.
- Manual for road planning and design (DMR, 2006b). This manual sets the framework for the design of new and upgraded roads in Queensland.

28.1.3 Rail Network

The manual of uniform traffic control devices for railway crossings (DTMR, 2009b) is the guideline most relevant to the project and it specifies traffic control devices to control and manage traffic in advance of railway crossings.

28.1.4 Air Services

Plans and policies relevant to the project include:

- State Planning Policy (SPP) 1/02: Development in the vicinity of certain airports and aviation facilities. This policy comes under the *Integrated Planning Act 1997* and seeks to ensure developments do not adversely affect the safety and operational efficiency of aviation facilities.
- Gladstone Airport development plan (Sullivan, 2008). The plan describes airspace protection requirements associated with the upgrade of facilities at Gladstone Airport and also forecasts airport passenger movements to 2026/27.

28.1.5 Shipping

Legislation and guidelines of most relevance to the shipping aspects of the project include:

- *Great Barrier Reef Marine Park Act 1975* (Cwlth). This act provides for the protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef region. The act requires LNG shipping and other project related maritime transport activities to use designated shipping channels when passaging through the Great Barrier Reef region.

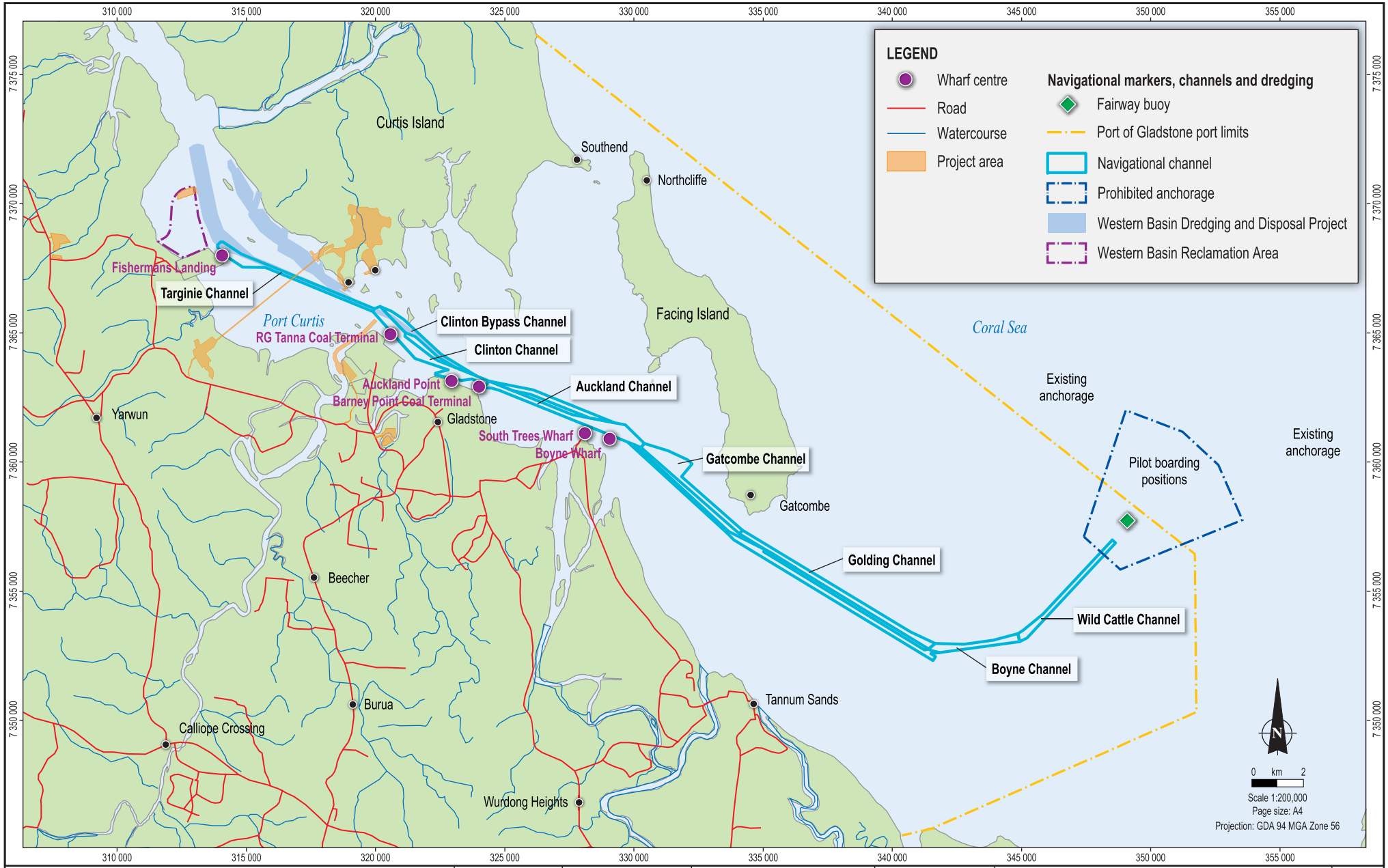
- *Maritime Transport and Offshore Facilities Security Act 2003* (Cwlth). This act safeguards against unlawful interference with maritime transport and offshore facilities. Should the Port of Gladstone be declared a security regulated port and Arrow Energy a port facility operator, the company would be required to prepare a maritime security plan in accordance with the act. Requirements aim to reduce the vulnerability of ships to terrorist attacks and other unlawful activity.
- *Navigation Act 1912* (Cwlth). This act addresses a range of matters including qualifications of ship crews, pilotage requirements and safety requirements related to dangerous goods, vessels carrying bulk noxious liquid substances, and unseaworthy and substandard ships. The act is undergoing Commonwealth Government review.
- *Maritime Safety Act 2002* (Qld). This act establishes Maritime Safety Queensland, a state government agency attached to DTMR. Maritime Safety Queensland administers shipping legislation in Queensland.
- *Transport Operations (Marine Safety) Act 1994* (Qld). This act regulates the maritime industry to ensure marine safety. The act provides for the orderly control of ships and provides statutory powers to regional harbour masters.
- *Transport Operations (Marine Pollution) Act 1995* (Qld). This act gives effect to the International Convention for the Prevention of Pollution from Ships 1973 (MARPOL) by providing for the protection of the marine coastal environment by minimising deliberate and negligent discharges of ship sourced pollutants into coastal waters.
- Port procedures and information for shipping – Port of Gladstone, (MSQ, 2010). This document sets out the standard procedures to be followed in the pilotage area of the Port of Gladstone. The procedures incorporate the requirements set out in the Transport Operations (Marine Safety) Act, the Transport Operations (Marine Pollution) Act, and the Maritime Transport and Offshore Facilities Act, in so far as these acts relate to ship movements within the jurisdiction of the Regional Harbour Master (Gladstone). Section 16 of the procedures document relates specifically to LNG carrier operating parameters, including vessel separation distances, arrival and departure restrictions, tug escorts and vessel scheduling.
- Standard for marine construction activities – Gladstone Harbour (MSQ, 2011b). This standard sets out requirements for vessels engaged in construction activities within Gladstone Harbour. Coverage includes vessel and crew information, and operating procedures and emergency response.

28.2 Assessment Method

This section describes the traffic and transport impact assessment methods for road, rail, air and shipping modes of transport for project construction and operation. Decommissioning impacts were not assessed and these activities are expected to be similar in nature to construction activities, albeit with less impact. Such matters will be addressed in the decommissioning plan for the project.

The study area for the road, rail, alternative local transport and air services assessment broadly includes the major transport routes in the Gladstone region, and focuses on road linkages and intersections likely to be used to transport personnel and goods associated with the project.

The study area for maritime components broadly includes Port Curtis and the shipping channels leading into Port Curtis from the Fairway Buoy (Figure 28.1).



Source:
Place names, roads and watercourses from DME. Great Barrier Reef Marine Park from GBRMPA.
Project area and wharf centres from Coffey Environments.
Western Basin Dredging Master Plan from Gladstone Ports Corporation.
Port of Gladstone navigation markers, channels and port limits digitised by Coffey from GPC figure (accuracy may be compromised).

coffey environments

Date: 05.12.2011
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File Name: 7033_07_F28.01_GIS_GL

Arrow Energy

Arrow LNG Plant

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Port of Gladstone wharf centres and navigational channels

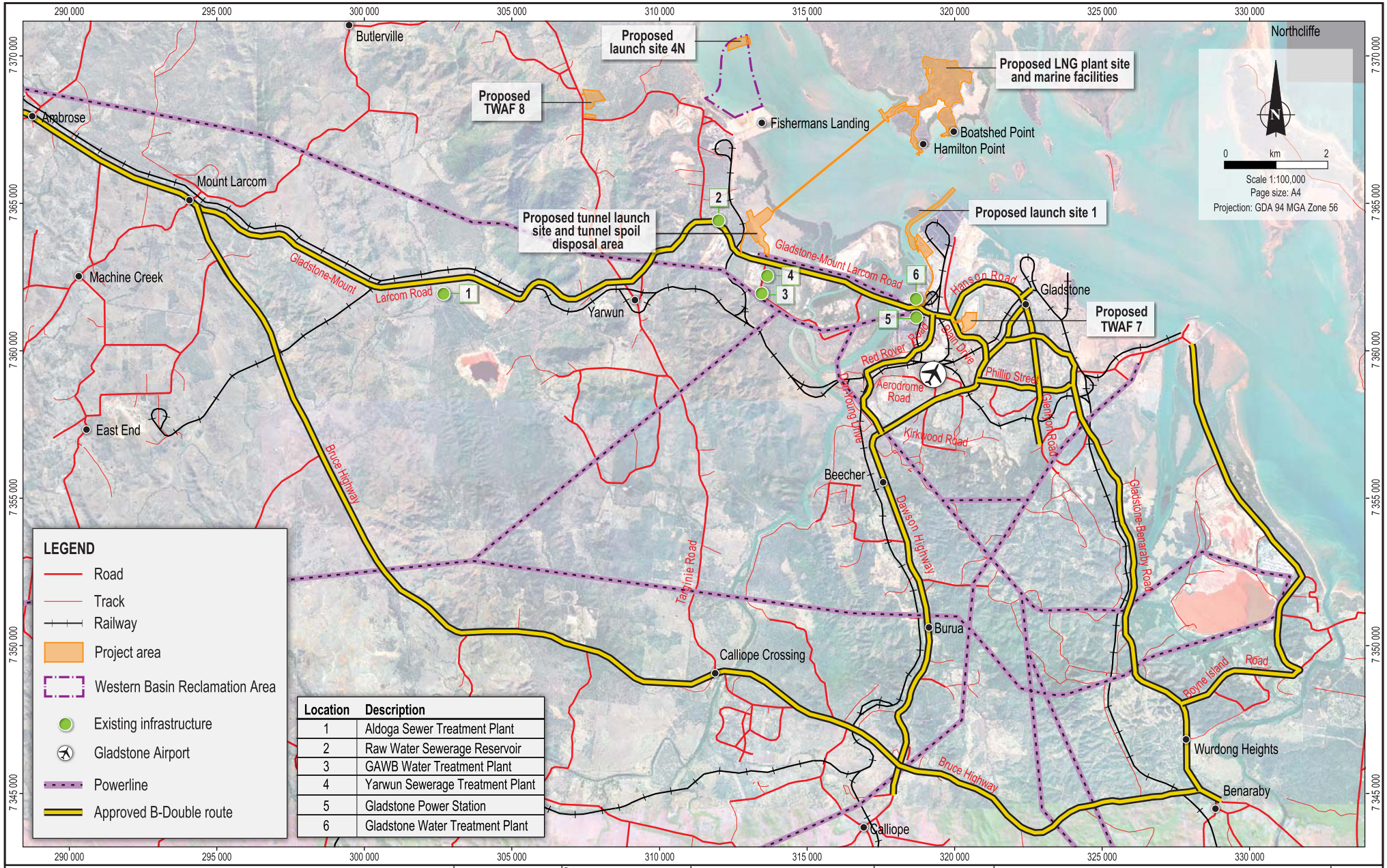
Figure No: 28.1

28.2.1 Road Network

The assessment of the suitability of the road network to cater for project transport requirements involved:

- Developing project transport scenarios, including impact assessment design years, modes of transport, expected traffic generation, key roads and intersections likely to be used and times of travel. Design years were chosen to represent key periods and conditions of the construction and operation schedule of the project and include:
  - Design year 2014 – early construction phase.
  - Design year 2016 – peak construction phase (i), first two LNG trains.
  - Design year 2024 – peak construction phase (ii), two LNG trains operating and two LNG trains under construction.
  - Design year 2026 – post construction/operation phase, all four trains operating.
- Identifying the existing condition of key roads and intersections likely to be used by the project and preparing background traffic growth rate projections for the design years (i.e., the growth of traffic likely to occur regardless of the project proceeding). Data was sourced from the DTMR and the Gladstone Regional Council. Traffic growth rates for major roads (Figure 28.2) were endorsed by DTMR and applied to obtain an estimate of traffic volumes for the relevant design years as follows:
  - Five percent per annum (pa) – Dawson Highway (between Bruce Highway and Aerodrome Road).
  - Three percent pa – Dawson Highway (between Aerodrome Road and Hanson Road).
  - Five percent pa – Gladstone–Mount Larcom Road.
  - Four percent pa – Bruce Highway.
- Assessing the potential of the project to impact roadway link capacities and intersection performance. The significance of impacts was identified considering the sensitivity of existing road network operation and the magnitude of the impact prior to the application of mitigation measures. In accordance with the guidelines for assessing road impacts of developments (DMR, 2006a), roads and intersections assessed were those likely to experience a greater than 5% increase in annual average daily traffic during the various design years. Worst case operation of intersections was considered, i.e., during ‘network peak period’, which typically occurs in the morning (AM network peak) and late afternoon (PM network peak).

  As the project seeks to use the road network primarily outside the network peak period, four assessment times were considered:
  - AM site peak: project generated peak traffic in the morning period (6.00 a.m. to 7.00 a.m.)
  - AM network peak: the intersection or network morning peak (8.00 a.m. to 9.00 a.m.)
  - PM site peak: project generated peak traffic in the afternoon period (2.00 p.m. to 3.00 p.m.)
  - PM network peak: the intersection or network morning peak (5.00 p.m. to 6.00 p.m.)
- Proposing avoidance and mitigation measures to manage the impact of project traffic.
- Assessing the significance of residual impacts to the road network assuming mitigation measures are applied.



Source:
Place names, roads, powerlines and airports from DME.
Approved B-Double routes from GTA.
Pipelines from Arrow Energy.
Project area and existing infrastructure (indicative only) from Coffey Environments.
Imagery from SPOT (2004-2007).

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Arrow LNG Plant

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Roads of relevance to the project and existing infrastructure

Figure No: 28.2

- Assessing the cumulative effect of the Arrow LNG Plant and other development projects proposed for the region including the GLNG Project, QCLNG Project, and APLNG Project. The LNG proponents shared data for the purpose of assessing the combined impacts of the LNG projects with other developments planned or yet to be planned (and which are accounted for in the growth rates) to determine how the cost of works may be proportioned. Unlike other cumulative impact assessments carried out for this EIS, APLNG Project data was available at this time and was therefore included in the cumulative traffic assessment (also see Chapter 32, Cumulative Impacts.)

28.2.2 Rail Network

Impacts on the rail network were determined by:

- Identifying the existing rail network infrastructure in the Gladstone region.
- Identifying project activities related to the use and interaction with rail network resources.
- Considering project activities and their likelihood to impact rail network resources.

28.2.3 Air Services

Impacts on air services were determined by:

- Identifying existing air services and infrastructure for the Gladstone region, including recent upgrades at Gladstone Airport and expansion of passenger services.
- Estimating the extent to which the project workforce is likely to use air services during design years 2014, 2016, 2024 and 2026 (consistent with road network modelling scenarios).
- Reviewing the Gladstone Airport development plan (Sullivan, 2008) to understand forecast passenger growth and aircraft movements for the upgraded airport through to 2027. The plan provided low, mid and high growth scenarios.
- Considering the airport's capacity to accommodate project air service requirements, particularly during peak construction years.

28.2.4 Alternative Local Transport

The assessment of the impact of the project on alternative local transport (i.e., Buslink services, taxis and pedestrian walkways and cycling paths) involved:

- Identifying the existing bus and taxi services and pedestrian and cycling infrastructure.
- Identifying likely project use and/or interaction with services and infrastructure, including the likelihood of project personnel to use services and infrastructure.
- Considering the likely impact of project activities (including demand by project personnel) on services and infrastructure.

28.2.5 Assessment of Significance

The significance assessment method was used to assess project impacts on roads, rail, air services and alternative local transport. This approach considers existing environmental values, the magnitude of the potential impact and the sensitivity of these values to change. Environmental values include:

- Roads, intersections and parking facilities.
- Rail crossings.
- Airport facilities.

- Public transport routes.
- Pedestrian/cyclist routes and crossings.

Sensitivity Criteria

The sensitivity of road, rail, air and alternative local transport values depends on the following:

- Hierarchy of road.
- Composition of traffic and road users.
- Locations of intersections.
- Existing level of congestion and operation.

In the case of the road link assessment, level of service (LOS) was used to determine level of road congestion. LOS is the operational conditions within a traffic stream and their perception by motorists and passengers (i.e., how 'free flowing' the traffic is). There are six levels of service, designated from A to F. LOS A represents the best operating condition and LOS F the worst. LOS D was chosen to represent the level of service at which road link upgrades are required. LOS D is close to the level of stable flow but approaching unstable flow. Drivers under LOS D are severely restricted in their freedom to select their desired speed and manoeuvre in the traffic system.

For the intersection assessment, degree of saturation (DOS) was calculated using intersection software SIDRA and used to determine levels of congestion. DOS is used to express the volume/capacity ratio of an intersection. In accordance with the DTMR (2006a) guidelines, the operation of an intersection is considered acceptable where the DOS is less than or equal to:

- 0.90 for signalled intersections.
- 0.85 for roundabouts.
- 0.80 for un-signalled or priority controlled intersections.

The sensitivity of the environmental values was determined according to the criteria set out in Table 28.1.

Magnitude Criteria

Criteria used to determine magnitude of impacts are identified in Table 28.2 and consider the scale of the impact (e.g., a physical change to the environment or traffic or passenger volume increases) and the duration of the impact (i.e., short, medium, long term, or permanent).

Table 28.1 Criteria for evaluating the sensitivity of environmental values

Sensitivity Factor	Sensitivity of Environmental Value		
	High	**Moderate**	**Low**
Hierarchy	Lower order roads such as access streets and collector roads (reduced capacity to carry large volumes of traffic).	Local transport routes and networks. Sub arterial routes and connectors.	Strategic road and rail transport routes and networks assigned by state government. Higher order roads are designed to be capable of carrying larger volumes.
Traffic composition and road user	Large vehicles, e.g., used for freight (with slower manoeuvring and visibility). Areas with on-road bicycle use and high pedestrian areas.	Public transport routes, roads that connect to areas with on-road bicycle paths.	Passenger cars only. Low presence of pedestrian or public transport use.

Table 28.1 Criteria for evaluating the sensitivity of environmental values (cont'd)

Sensitivity Factor	Sensitivity of Environmental Value		
	High	Moderate	Low
Location within network	Located on key freight access (e.g., port). Major access to central business district (CBD), shopping precincts or schools.	Secondary access to CBD or freight access. Access to major residential or commercial areas and suburban zones not within CBD.	Rural zoning areas. Location out of CBD and major freight access.
Existing level of congestion	Highly congested roads or intersections (intersection above or close to DTMR (2006a) acceptable limits of operation).	Moderately congested roads or intersections (intersection below acceptable limits of operation but above 70% of capacity).	Free flow (or close to) roads or intersections (intersection below 70% capacity).

Table 28.2 Criteria for determining the magnitude of the impact

Magnitude Factor	Magnitude of Impact		
	High	Moderate	Low
Scale of impact	Intersection operates worse than for background traffic only (network peak). Increased use of services outstrips existing forecast capacity.	Intersection operates the same as background traffic (network peak) or within DOS +/- 0.05. Increased use of services is borderline in terms of existing forecast capacity.	Despite project traffic increasing DOS, the intersection still operates better than the forecast background traffic (network peak). Increased use of services lies well within existing forecast capacity.
Duration of impact	Greater than two consecutive years	Greater than one year but less than two years.	Less than one year.

The overall magnitude of impact was then determined using the criteria set out in Table 28.3, which combines the scale and duration of impact.

Table 28.3 Criteria for determining the magnitude of scale and duration of impact

	Duration of Impact		
Scale of Impact	**High**	**Moderate**	**Low**
High	High	High	Moderate
Moderate	Moderate	Moderate	Low
Low	Low	Low	Low

Assessment of Significance of Impacts

The significance of impacts was determined using the matrix shown in Table 28.4 together with the sensitivity and magnitude criteria in Tables 28.1 and 28.2 above.

Table 28.4 Significance of impacts matrix

	Sensitivity of Environmental Value		
Magnitude of Impact	**High**	**Moderate**	**Low**
High	**Major**	**High**	**Moderate**
Moderate	**High**	**Moderate**	**Low**
Low	**Moderate**	**Low**	**Negligible**

The impact of significance ranges are defined as follows:

- Major. The impact on the project is such that it cannot be tolerated due to safety, economic or social impact. Mitigation in the form of infrastructure upgrades is likely required.
- High. The impact on the network cannot be tolerated due to safety, economic or social impact. Mitigation may be required, but not necessarily in the form of infrastructure upgrades.
- Moderate. The impact to the network could be tolerated; however, traffic management or other mitigation may be required.
- Low. The impact to the network may be perceptible but can be tolerated.
- Negligible. The significance of the impact is considered negligible.

28.2.6 Shipping

During the course of project design, Arrow Energy has considered potential shipping issues and impacts through hazard identification studies and modelling undertaken in conjunction with Maritime Safety Queensland, Gladstone Ports Corporation and GLNG, QCLNG, and APLNG project proponents. Studies and modelling undertaken include:

- Gladstone LNG projects navigation simulations (HRW, 2010) The four LNG proponents, Gladstone Ports Corporation and Maritime Safety Queensland prepared simulations of LNG carriers coming into and out of the port. Individual simulations were undertaken for each proponent's LNG jetty, considering all failure types.
- Gladstone LNG navigation risk assessment (ELP, 2010a). This marine hazard identification study considered the hazards arising from the transit of LNG carriers to and from the LNG jetty and for their duration alongside. Shell Australia LNG risk tolerability criteria were used to assess the severity of risk.
- Gladstone marine qualitative risk assessment (ELP, 2010b). This qualitative risk assessment examines the frequency of release of LNG following collision or grounding of LNG carriers at two locations within the Port of Gladstone. The impacts of the project were assessed against the maximum acceptable risk levels and published injury level risk criteria published by the Queensland Safety Regulator.
- Voyage risk assessment: Gladstone to Shanghai (Arrow Energy, 2010). This risk assessment considered an indicative passage from Gladstone to Asia for LNG carrier transit.
- LNG trade scenarios: configuration details and performance results for forecast LNG scenarios, prepared by AECOM for Gladstone Ports Corporation (AECOM, 2010). This report examined the potential for LNG operation to impact on other operational activities in the Port of Gladstone.

Where applicable, the findings of the above reports and modelling have been summarised in the shipping sections of this chapter.

28.2.7 Consultation

The consultation undertaken to inform the land and maritime components of the impact assessment is described below.

Road and Rail Network and Air Services

GTA Consultants liaised with representatives of the DTMR, Gladstone Regional Council and Gladstone Airport during the early stages of preparing the traffic and transport impact assessment. Feedback from consultation was considered when undertaking the assessment and included the following requests and comments by DTMR and the council:

- Avoid where possible increasing traffic flows on Port Access Road, Phillip Street and the section of Dawson Highway between Phillip Street and Port Access Road.
- Avoid taking routes through the CBD and local streets.
- Utilise ring roads such as Red Rover Road or Don Young Drive, Kirkwood Road and Blain Drive (see Figure 28.2).
- Where possible, utilise Calliope River Road and Gladstone–Mount Larcom Road for transport of freight rather than Dawson Highway (Gladstone CBD end).
- Metering on the north, west and southern legs of the Dawson Highway/Phillip Street roundabout is activated during peak periods (queue trigger).
- Project impacts on Gladstone Regional Council roads must be assessed.

Transport workshops were also held with other LNG proponents and their transport consultants. Traffic data was shared between LNG proponents for the purpose of assessing the combined impacts of LNG projects over and above other developments.

Arrow Energy has been participating in the State Controlled Road Cumulative Impact Forum facilitated by DEEDI and including representatives of DTMR, GLNG, QCLNG and APLNG. This forum was set up to address the cumulative impact assessment on state road infrastructure and the apportionment of impacts by the respective projects. Arrow Energy will continue to work with forum members to further understand the apportionment of the cumulative road impacts from Arrow Energy's road use, once the detailed logistics strategy and associated traffic management plans have been developed.

Shipping

During the course of project design, Arrow Energy has undertaken extensive consultation with the Gladstone Regional Harbour Master, Maritime Safety Queensland, Gladstone Ports Corporation and proponents of the GLNG, QCLNG and APLNG projects. This consultation has focused on identifying ways to minimise issues and impacts arising from LNG shipping. Outcomes of consultation have included:

- Establishing a new anchorage and a LNG pilot station near the Fairway Buoy.
- Developing LNG protocols which have been included in the Gladstone port procedures (MSQ, 2010).
- Developing LNG carrier pilot training programs, including the establishment of a training facility in Brisbane.

Consultation is ongoing and LNG protocols will continue to be refined.

28.3 Existing Environment and Environmental Values

The following sections describe the existing transport system of the Gladstone region with particular focus on elements relevant to the project.

28.3.1 Road Network

The Gladstone region has an extensive road network that services major industry and allows heavy materials transport in a manner that seeks to minimise impacts to densely populated areas (see Figure 28.2). Table 28.5 describes the state controlled roads and council controlled roads of particular relevance to the project, and summarises works planned for those roads set out in the DTMR (2009a) roads implementation program and the Gladstone integrated regional transport plan (DoT, 2001).

Approved B-Double (lengths of 23 m and 25 m) freight routes servicing Gladstone are also shown on Figure 28.2. Intersections addressed in the impact assessment are shown on Figure 28.3 and listed in Table 28.6. Intersections of relevance to the project were determined through the following criteria:

- The location of intersections in relation to anticipated project transport routes.
- Major intersections in close proximity to key transport nodes.
- Major intersections other LNG proponents assessed in their EISs.
- Project traffic is expected to generate a 5% or greater increase to annual average daily traffic.

Table 28.5 Roads of relevance to the project

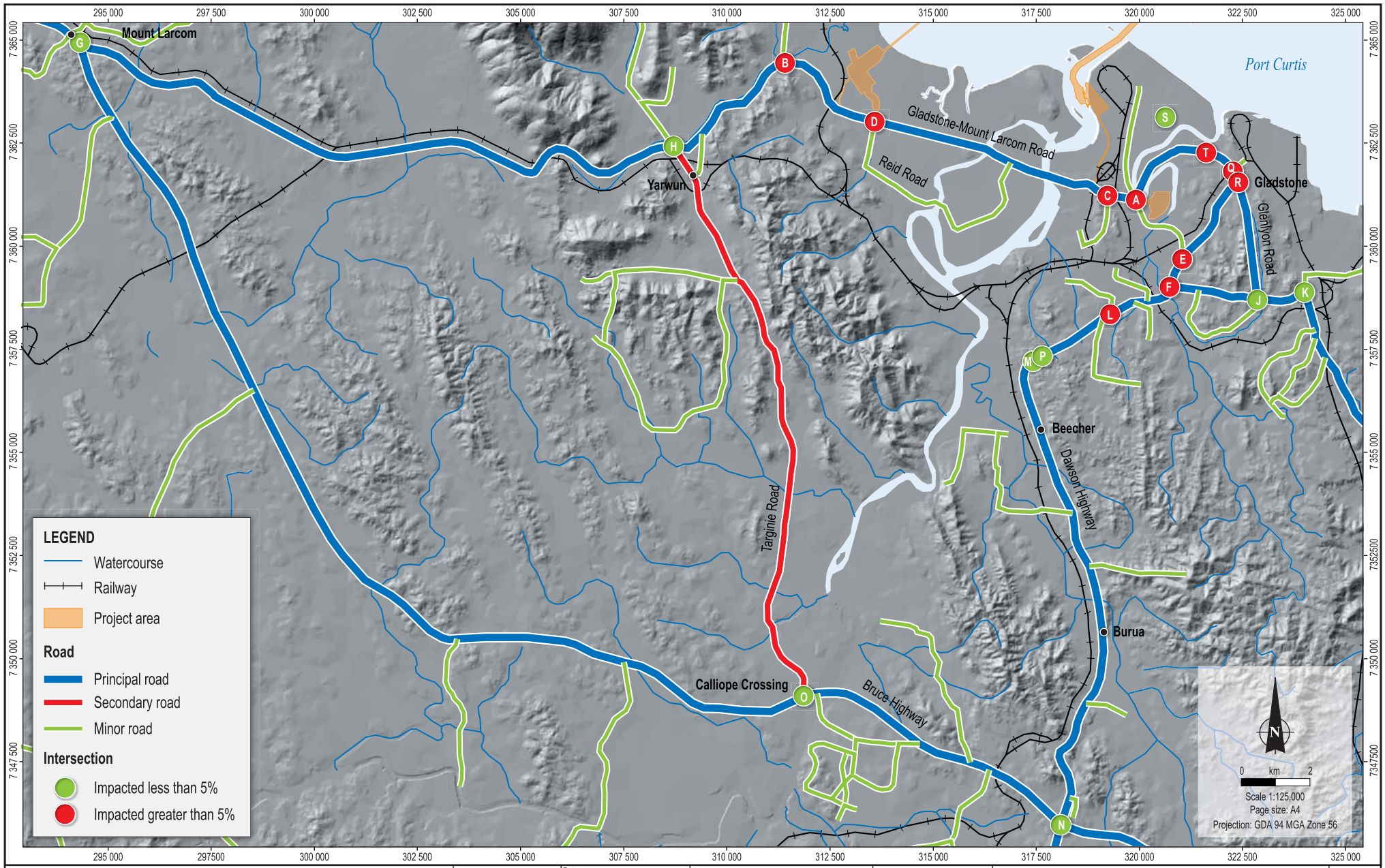
Road Name	Description	DTMR Roads Implementation Program (DTMR, 2009a)	Gladstone Integrated Regional Transport Plan (DoT, 2001)
State controlled Road Network			
Bruce Highway	High standard, high speed rural highway extending north from Brisbane to Cairns. Between Brisbane and Rockhampton, the highway has a 100 km/h speed limit varying to 110 km/h in some sections. Near Gladstone, the highway has a two lane, two way cross section.	Project 27/10E/910: concept planning for Benaraby to Rockhampton road section.	n/a
Dawson Highway	Two lane undivided road with some overtaking lanes and varying speed limits of 80 to 100 km/h between the Bruce Highway and Chapman Drive in Gladstone. North of Chapman Drive the highway takes an urban form with a four lane, two way, median divided cross section. The link provides kerbside parking with a 60 km/h speed limit through central Gladstone.	Project 26/46A/22: construct deviation, sealed standard, Gladstone to Biloela.	• Four lane upgrade, stage one: Brelin Street to Blain Drive, Britney roundabout to Chapman Drive. This will allow for future freight movement between the Bruce Highway and the port/Gladstone city area. • Four lane upgrade, stage two: Chapman Drive to Kirkwood Road. This will allow for future freight movement between the Bruce Highway and the port/Gladstone city area.
Gladstone –Benaraby Road	Two way, two lane undivided road with overtaking lanes and sealed shoulders between the Bruce Highway and Toolooa Street. North of Phillip Street, the road becomes a four lane, two way road with a number of roundabout intersections. The speed limit is 100 km/h from the Bruce Highway to Glen Eden Drive, where it becomes 80 km/h.	n/a	• Upgrade between Kirkwood Road to Ten Mile Creek to four lanes. • Upgrade to four lanes between the Glenlyon Road extension and Boyne Island Road intersection (2.5 km). • Shoulder widening and overtaking lanes to improve safe overtaking opportunities.
Gladstone –Mount Larcom Road	Sealed two way, two lane, undivided road with narrow sealed shoulders and some overtaking lanes. As the road extends eastward from Landing Road, it becomes Hanson Road, a sealed two way single lane formation with 1 m sealed shoulders.	• Project 161/181/14: delineate/line marking section 5.00 to 32.10 km. • Project 161/181/15: intersection improvements for Glenlyon Street/Dawson Highway/Bramston Street. • Project 161/181/803: rehabilitate pavement for Wiggins Island intersection/Reid Road.	• Gladstone–Mount Larcom Road/Landing Road intersection upgrade. • Gladstone–Mount Larcom Road overtaking lanes. This will allow for future freight movement between Bruce Highway and Gladstone.

Table 28.5 Roads of relevance to the project (cont'd)

Road Name	Description	DTMR Roads Implementation Program (DTMR, 2009a)	Gladstone Integrated Regional Transport Plan (DoT, 2001)
State controlled Road Network (cont'd)			
Gladstone –Port Access Road	60 km/h separated two way, two lane road providing access to Barney Point port facilities. There is an underpass with 4.7 m clearance on the southern section of the road (western end of Gladstone Port Access Road).	n/a	n/a
Council Controlled Road Network			
Blain Drive	60 km/h two lane undivided road that performs a through traffic function from Dawson Highway to Hanson Road/Gladstone–Mount Larcom Road.	n/a	n/a
Forest Road	Unsealed road with a 40 m road reserve connecting Targinie Road to Landing Road.	n/a	n/a
Glenlyon Road	60 to 80 km/h varying speed that begins as a two lane formation south of Kirkwood Road and runs north to Gladstone as a two lane, undivided road with wide sealed shoulder on the west side of the road. The road has grade separation over the rail tracks and includes a bicycle lane to the north of the rail tracks.	• Project 161/LGSA/013: asphalt resurfacing (less than 75 mm). • Project 229/LGSG/001: bicycle lane construction. • Project 229/LGSG/002: construct bicycle lane /footpath over rail crossing. • Project 161/LGSA/013: asphalt resurfacing (less than 175 mm) between Ferris Street and Derby Street.	• Two lane extension of Glenlyon Road from Dalrymple Drive to the southern intersection with the Gladstone–Benaraby Road (Glenlyon Road Extension – 8 km). • Glenlyon Road to Gladstone–Benaraby Road Link (Kirkwood Road extension). • Upgrade to four lanes between Bramston Street and Derby Street (1 km).
Hanson Road/ Glenlyon Road	60 km/h varying to 70 km/h road becomes Glenlyon Road in the Gladstone urban area, with a four lane, two way form. To the south of Gladstone–Mount Larcom Road, the road is fully sealed with a two lane, undivided cross section.	n/a	• Hanson Road duplication stage one: Gibson Street – Blain Drive, Blain Drive – Red Rover Road, Red Rover – Power Station access. • Hanson Road duplication stage two: Power Station access – Gladston–Mount Larcom Road intersection, Gladstone–Mount Larcom Road/Landing Road intersection – Aldoga precinct. Planning allows for increased access to the Gladstone State Development Area.

Table 28.5 Roads of relevance to the project (cont'd)

Road Name	Description	DTMR Roads Implementation Program (DTMR, 2009a)	Gladstone Integrated Regional Transport Plan (DoT, 2001)
Council controlled Road Network (cont'd)			
Kirkwood Road	80 km/h two lane, two way road linking the Dawson Highway to Glenlyon Road. Kirkwood Road is intended to act as a ring road directing traffic south of the central city area.	n/a	• New two lane section of Kirkwood Road from Dawson Highway to the Glenlyon Road extension, stage one: middle part of new road. • New two lane section of Kirkwood Road from Dawson Highway to the Glenlyon Road extension and associated intersection works, stage two: balance of new road.
Landing Road	100 km/h two lane, two way road with sealed shoulders between Gladstone–Mount Larcom Road and Fisherman's Landing.	n/a	• Landing Road upgrade, stage one: widen and strengthen Gladstone–Mount Larcom Road to the Queensland Cement site. • Landing Road upgrade, stage two: widen and strengthen Queensland Cement Ltd to Forest Road.
Phillip Street	60 km/h two lane, two way, divided road linking the Dawson Highway to Gladstone–Benaraby Road.	n/a	• Upgrade last two lane section of Phillip Street to four lanes.
Red Rover Road/Don Young Drive	Red Rover Road, to the north, is a 60-km/h road providing access to abutting industrial uses. Don Young Drive, to the south, is 80 km/h road (for 4 km) providing access to higher density residential development in the suburb of Clinton.	• Project 161/LGSA/016: asphalt resurfacing (less than 175 mm).	n/a
Reid Road	60 to 70 km/h sealed, two lane, two way, undivided road providing access to rail yards, a water treatment plant and the Orica Australia Ltd chemical manufacturing facility at Yarwun.	n/a	n/a



Source:
Place names, roads, railways and watercourses from DME.
Intersection impact percentages from GTA.
Project area and digital elevation model from Coffey Environments.

coffey environments

Date: 25.11.2011
MXD: 7033CA_07_GIS205_v1_2
File Name: 7033_07_F28.03_GIS_GL

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Intersections of relevance to the project

Figure No: **28.3**

Table 28.6 Intersections of relevance to the project

ID	Intersection Name	Type of Intersection	DTMR/GRC Upgrade Planned
A	Hanson Road/Blain Drive/Alf O'Rouke Drive	Roundabout	Yes
B	Landing Road/Gladstone–Mount Larcom Road	Priority controlled – give way	No
C	Hanson Road/Red Rover Road	Roundabout	Yes
D	Gladstone–Mount Larcom Road/Reid Road	Priority controlled – give way	No
E	Dawson Highway/Blain Drive/Herbertson Street	Roundabout	No*
F	Dawson Highway/Phillip Street	Roundabout	No*
G	Bruce Highway/Gladstone–Mount Larcom Road	Priority controlled – stop	No
H	Targine Road/Gladstone–Mount Larcom Road	Priority controlled – give way	No
J	Phillip Street/Glenlyon Road	Roundabout	No
K	Phillip Street/Gladstone–Benaraby Road	Roundabout	No
L	Dawson Highway/Aerodrome Road	Signalled	No*
M	Dawson Highway/Don Young Drive	Priority controlled – give way	No
N	Dawson Highway/Bruce Highway	Priority controlled – give way	No
O	Bruce Highway/Calliope River Road	Priority controlled – give way	No
P	Dawson Highway/Kirkwood Road	Priority controlled – give way	No
Q	Gladstone Port Access Road/Glenlyon Road/ Railway Street	Signalled	No
R	Glenlyon Road/Bramston Road	Signalled	Yes
S	Alf O'Rourke Drive / Bryan Jordan Drive	Roundabout	No
T	Hanson Road/Lord Street	Signalled	No

*Additional intersections will require upgrades as a result of natural growth in the region; at present, these have not been planned.

28.3.2 Rail Network

Queensland Rail manages the freight and passenger rail network services to the Gladstone region that are described below.

Freight Services

The Gladstone rail network moves significant freight, including freight to and from the Port of Gladstone (see Figure 28.2). There are two routes from Gladstone that link to the North Coast Line, which provides north–south rail linkage between Brisbane and Cairns. The routes include:

- Blackwater system. A service link for Rockhampton, Blackwater, Gladstone and intermediary towns. The link services Stanwell Power Station, Gladstone Power Station, Fishermans Landing and the RG Tanna, Barney Point and Wiggins Island coal terminals.
- Moura system. A connection between the southern Bowen Basin and Gladstone that services the industrial and rural communities of the Dawson and Callide valleys. Coal is transported via this system to the Gladstone Power Station, Queensland Alumina Ltd alumina refinery and the Port of Gladstone.

In addition to the two main rail lines, the system services the Auckland Point area (Barney Point coal export facility), Clinton Wharf and the Gladstone Cement Plant at Fishermans Landing via a rail balloon loop and Queensland Alumina Ltd alumina refinery via a spur line.

Passenger Services

Two passenger services pass through Gladstone enroute from Brisbane to Cairns. These include:

- Tilt Train. The Tilt Train travels daily between Brisbane and Rockhampton (616 km) and twice weekly between Brisbane and Cairns (1,681 km). The Tilt Train has one service in each direction passing through Gladstone each day.
- The Sunlander. The Sunlander passes through Gladstone three times a week in each direction travelling between Brisbane and Cairns.

28.3.3 Air Services

The Gladstone Airport is located on Aerodrome Road, close to the Dawson Highway, approximately 7 km southwest of the Gladstone CBD (see Figure 28.2). The airport is bounded by industrial developments to the north and west, and residential developments to the south and east. The runway was extended from 1,635 m to 1,965 m in length during 2010. The largest aircraft catered for by the airport include the B737-800 (162 passengers) and A320-200 (150 passengers). QantasLink operates most scheduled services, utilising Dash-8 Q400 aircraft (74 passengers). Virgin Australia commenced services to Gladstone in October 2011.

The majority of QantasLink services operate direct flights between Gladstone and Brisbane. A small number of services operate northward to Rockhampton, Mackay, Townsville and Cairns. QantasLink offers approximately 50 return flights from Brisbane to Gladstone per week. Virgin Australia operates 11 weekly return services from Brisbane and Gladstone.

Redevelopment of the airport terminal building was completed in April 2011 and includes new security screening facilities, improved baggage areas and car parking. During September 2011, LNG proponents for the APLNG, GLNG and QCLNG projects, and the Arrow LNG Plant committed to provide $10.5 million in funding to upgrade the airport's instrument landing system. The upgrade will improve the ability of aircraft to land at the airport during adverse weather conditions and reduce the diversion of flights to Rockhampton (GRC, 2011b). Arrow Energy has committed to provide its share of this funding at project final investment decision (FID).

28.3.4 Alternative Local Transport

Local transport options providing alternatives to travel by private passenger vehicles include:

- Bus passenger services. Buslink Queensland operates a 10-route urban passenger service in Gladstone and surrounds. Most services operate between 7.00 a.m. and 3.30 p.m. weekdays with some extended services to 6.00 p.m. General services and school services are catered for using the same routes. Current services operate in Gladstone city and between Gladstone and Boyne Island, Tannum Sands, Awoonga Dam, Calliope and Benaraby (see Figure 28.2).
- Taxis. Blue & White Taxis services the Gladstone region with a fleet of 23 taxis, including three maxi taxis and an additional four taxis that are wheel chair accessible. Blue & White Taxis also operate a 25 seat bus during peak demand times to service Gladstone's hotels and clubs and shuttle sailors from the port to Gladstone city during port calls.
- Pedestrian and cycle networks. Gladstone has approximately 38 km of footpaths and cycleway both on and off road, shared and exclusive paths. The existing cycle network provides relatively direct links to a number of major community and shopping facilities.

28.3.5 Shipping

The Port of Gladstone is Queensland's largest multi-commodity port and comprises six wharf centres: Boyne Wharf, South Trees Wharves, Barney Point Coal Terminal, Auckland Point, RG Tanna Coal Terminal, and Fishermans Landing. Gladstone Ports Corporation owns all wharves. Other companies operate Boyne, South Trees and Fishermans Landing. Together, wharf centres provide 15 wharfs along the coastline. Of all products, coal accounted for around 72% of the port's total throughput of 83,365,671 t during the 2009/10 financial year (GPC, 2010a).

The Port of Gladstone wharves are accessed via shipping channels described in Table 28.7 and shown in Figure 28.1.

Table 28.7 Port of Gladstone shipping channels

Shipping Channels	Length (km)	Depth LWOST[1] (m)	Width (m)
Outer harbour channels	22.45	16.3	183
Inner harbour channel – Auckland	8.7	15.8	180
Inner harbour channel – Clinton	2.2	16.0	180
Inner harbour channel – Clinton Bypass	n/a[2]	10.6	160
Inner harbour channel – Targinie	6.1	10.6	120

Source: GPC (2011c).

[1] Low water of ordinary spring tides (LWOST).

[2] Not specified in source material.

The harbour entrance is marked with a red and white fairway beacon approximately 33 km northwest of Bustard Head. The existing channels are well marked with navigational buoys, sector lights and leading marks. Outer harbour anchorage lies in the vicinity of Fairway Buoy (GPC, 2011c). Four anchorages will be designated for use by LNG carriers and monitored by an upgraded Vessel Traffic Services station.

Existing pilot boarding areas are located approximately 2 nautical miles from the Fairway Buoy. Arrival and departure, movement and traffic, port navigation and pilotage procedures are set out in DTMR's port procedure manual (MSQ, 2010).

The Port of Gladstone can accommodate vessels up to 220,000 dead weight tonnes. The port receives bulk carriers, liquefied petroleum gas (LPG) tankers, chemical and oil products tankers, and general cargo ships. During the 2009/10 financial year, 1,430 shipping vessels entered the port. Of these, largest vessel counts were associated with the following commodities/products:

- Coal exports (758 vessels using Auckland Point 1, Barney Point and RG Tanna Coal Terminal 1, 2, 3, and 4 wharves).
- Alumina exports (122 vessels using Fishermans Landing 1 and 2 and South Trees East wharves).
- Bauxite imports (185 vessels using Fishermans Landing 2 and South Trees West wharves).

Gladstone marina and Southend on Curtis Island are commonly used by the public as ports for access to a range of onshore and offshore recreational and commercial fishing activities. Recreational boat drivers require a personal watercraft licence to operate a boat powered by a motor greater than 4.5 kW. Maritime Safety Queensland has instigated a program of educating users of smaller craft in following correct rules and procedures when within the port limits.

28.4 Issues and Potential Impacts

Issues and potential impacts have been described based on findings in the Traffic and Transport Impact Assessment (see Appendix 23, Traffic and Transport Impact Assessment). The detailed logistic strategy will be developed and finalised by Arrow Energy, and these impacts (and associated mitigation measures) will be updated as necessary and documented in the supplementary EIS.

The following sections describe the issues and potential impacts of the project on the transport system of Gladstone.

28.4.1 Road Network

The following sections describe the workforce transport scenarios for the four design years (i.e., 2014, 2016, 2024 and 2026). Impacts are discussed in terms of a road link assessment, intersection assessment, and road management and safety. For the purposes of the road network analysis, those roads and intersections likely to be affected by project traffic were identified. Principal routes investigated are those likely to be used for workforce transport between the alternative TWAF sites (TWAF 7 and TWAF 8), the alternative mainland launch sites (launch site 1 and 4N) and Gladstone Airport. Launch site 4N will be accessed via a road and services corridor to be established on the Western Basin Reclamation Area engineered containment wall from either Landing Road or Forest Road.

Arrow Energy is currently evaluating the site access options for launch site 1 including the Gladstone–Mount Larcom Road and Blain Road access track. Access options for launch site 1 will be further evaluated as part of developing the detailed logistics strategy for the project.

Once the final TWAF and mainland launch site locations are confirmed, transport routes and detailed traffic data will be available, including goods and materials transport. At this time, it would be appropriate to complete a bridge capacity analysis and pavement impact assessment on the proposed routes. The results of these assessments will be presented in the supplementary EIS for the project.

Design Year 2014 – Early Construction Phase Workforce Transport Scenarios

Information on the construction workforce and associated vehicle movements have been updated and defined further following the production of the traffic and transport technical study (Appendix 23). Further information regarding this phase will be available following the development of the project's logistics strategy and will be outlined and assessed in the supplementary report to the EIS.

Key workforces and activities during this phase will include:

- A steady ramp up during 2014 to a construction workforce peak of 1,040 persons (approximately 80% local content) to construct the mainland launch site, undertake civil works and establish a 250 bed pioneer camp at Boatshed Point on Curtis Island.
- 100 person peak workforce to construct the Port Curtis feed gas pipeline tunnel.
- 20 to 40 person dredging workforce.

Prior to the construction camp becoming operational, a construction workforce of between 200 and 300 will need to be accommodated on the mainland. Options that will be considered for the accommodation of these workers will include residential properties, third party provided

construction camp facilities, or another form of accommodation facilitated by the project, depending on accommodation availability.

The tunnel workforce is anticipated to be accommodated on the mainland. Options that will be considered for the accommodation of these workers include residential properties, third party provided construction camp facilities, another form of accommodation facilitated by the project, or a TWAF, depending on accommodation availability. The dredging workforce will be housed on board the dredge vessel.

The Curtis Island civil construction workforce will commute from accommodation in Gladstone, to a centralised parking area either in private cars or buses, where the workforce will be transported via buses to a temporary launch site and ferried to Curtis Island. Gladstone Marina and Auckland Point wharf are being considered as temporary launch site locations until construction of the mainland launch site is complete at the end of quarter five after FID.

Based on average vehicle occupancy of 1.5 persons for private cars and 50 seater buses for transport to the temporary launch site, expected vehicle movements include:

- Up to 1,380 daily, one way private vehicle movements to/from the centralised parking area for the Curtis Island workforce.
- Up to 42 one way bus movements to/from the centralised parking area to the temporary launch site for the Curtis Island workforce.
- One day per week, 10 movements each way per day, bus transportation to the Gladstone Airport during a construction shift change (less than one bus movement each way is anticipated during peak hour).

The tunnel workforce has not been included in vehicle movement estimates as their numbers were not considered significant comparative to the Curtis Island construction workforce.

The intersections likely to be impacted during the early construction phase are the same as those affected during the peak construction period. Consequently, specific upgrades have not been identified for this phase.

Design Year 2016 and 2024 – Peak Construction Workforce Transport Scenarios

The 2016 peak workforce is estimated to include 3,500 personnel, comprising 3,000 construction workers, 350 engineering, procurement and construction (EPC) workers and 150 Arrow Energy employees. The 2024 peak construction workforce will have fewer construction workers. However, with the operational workforce also taken into account, the total workforce for 2024 is only slightly less than in 2016.

Two workforce scenarios for peak construction were considered. Between 5% and 20% of the workforce is estimated to be local workers. Each scenario assumed an upper local workforce limit of 20% as project worst case scenario for private passenger car trips. If the local workforce is less than 20%, bus trips between the TWAF and the mainland launch site carrying fly-in, fly-out workers are expected to increase and private vehicle travel of local workers will decrease.

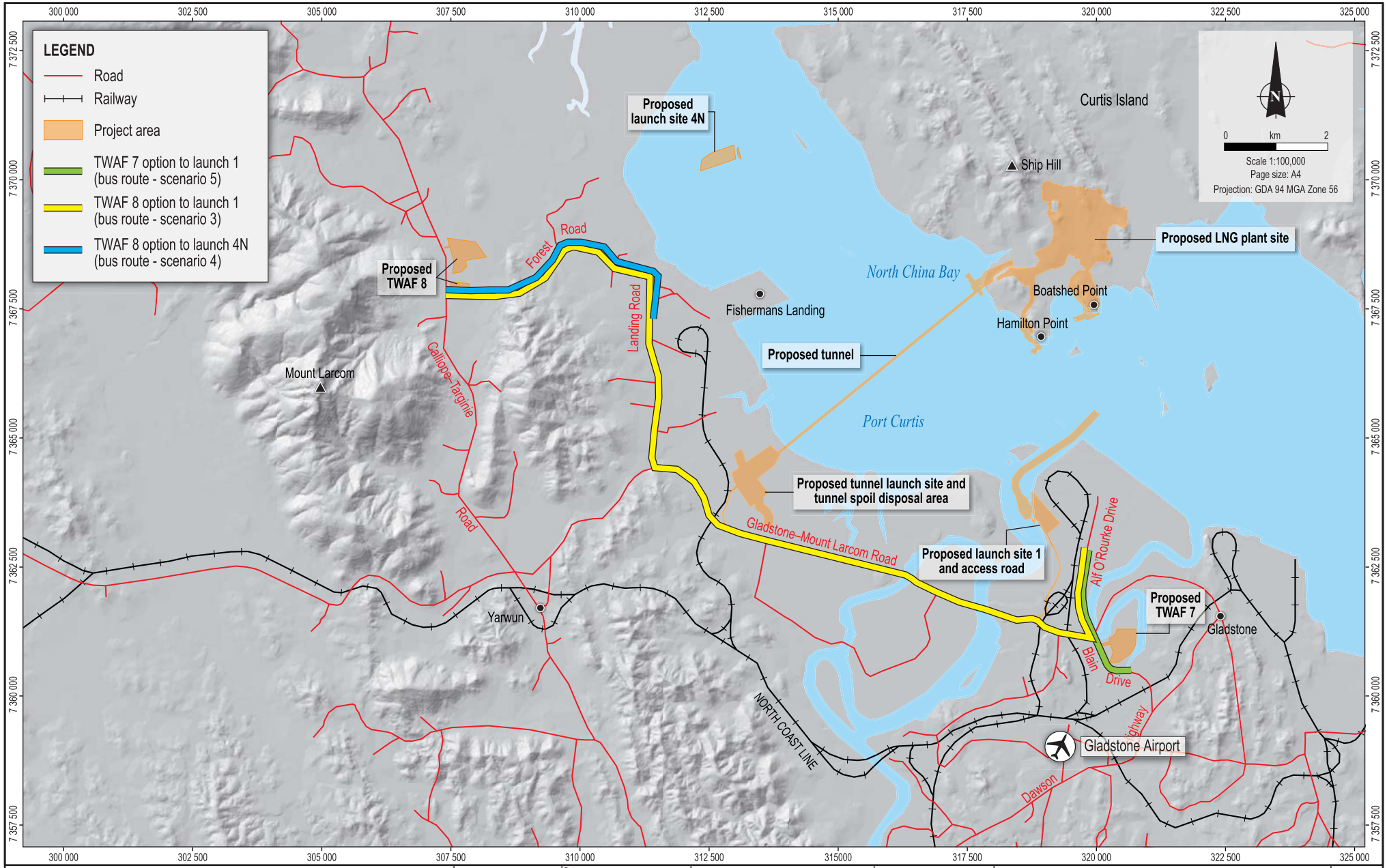
The main workforce breakdown scenario assumes no TWAF. The sensitivity scenario assumes that both a construction camp and a TWAF operating at full capacity will be required (Table 28.8). Different transport scenarios were modelled to account for the different routes between TWAF and mainland launch site options (Figure 28.4). Transport scenarios are described in Table 28.9.

Table 28.8 Peak construction workforce breakdown for main and sensitivity scenarios

Main Scenario (No TWAF)	Sensitivity Scenario (With TWAF)
Local Gladstone Accommodation	
• 350 local EPC personnel. • 150 Arrow Energy employees. • 600 local construction personnel.	• 350 local EPC personnel. • 150 Arrow Energy employees. • 600 local construction personnel.
Construction Accommodation	
• 2,400 external personnel at construction camp.	• 1,400 external personnel at construction camp. • 1,000 external personnel at the TWAF.
Transport Requirements	
• 1,100 local personnel commute daily to mainland launch site via private vehicle.	• 1,100 local personnel commute daily to the mainland launch site via private vehicle. • 1,000 external personnel commute daily to the mainland launch site via bus.

Table 28.9 Transport scenarios modelled

Workforce Main Scenario – Curtis Island Construction Camp Only	
Transport scenario 1: launch site 1: • Local workers travelling to and from ferry daily to their residences. • Regional workers travelling to and from ferry and airport weekly.	Transport scenario 2: launch site 4N: • Local workers travelling to and from ferry daily to their residences. • Regional workers travelling to and from ferry and airport weekly. Transport Scenario 2 was not specifically assessed as it was found to have the same transport implications as Scenario 4.
Workforce sensitivity scenario - Curtis Island construction camp with TWAF 8 (Fishermans Landing)	
Transport scenario 3: launch site 1: • Local workers travelling to and from ferry daily to their residences. • Regional workers travelling to and from ferry and airport weekly. • Workers travelling to and from mainland camp and ferry daily.	Transport scenario 4: launch site 4N: • Local workers travelling to and from ferry daily to their residences. • Regional workers travelling to and from ferry and airport weekly. • Workers travelling to and from mainland camp and ferry daily.
Workforce sensitivity scenario – Curtis Island construction camp with TWAF 7 (ash pond site)	
Transport scenario 5: launch site 1: • Local workers travelling to and from ferry daily to their residences. • Regional workers travelling to and from ferry and airport weekly. • Workers travelling to and from mainland camp and ferry daily.	Transport scenario 6: launch site 4N: As travel distance and travel time has significant bearing on project construction cost, workers would not be accommodated at TWAF 7 if launch site 4N were selected. Transport scenario 6 was not assessed.



Source:
Place names, roads and watercourses from DME.
Launch 4N and launch 1 travel options to airport from GTA.
Project area and digital elevation model from Coffey Environments.

coffey environments

Date: 05.12.2011
MXD: 7033CA_07_GIS212_v1_2
File Name: 7033_07_F28.04_GIS_GL

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Peak construction workforce travel routes

Figure No: 28.4

The following assumptions were used regarding travel movements:

- Private vehicle travel to mainland launch site. Private vehicles will have average vehicle occupancy of 1.5 persons. This equates to 735 one way private vehicle movements per day (main scenario and sensitivity scenario).
- Bus travel from TWAF to mainland launch site. Buses will have a 20 person capacity. Assuming buses carry between 10 and 15 workers, 80 one way bus movements per day have been assumed for the sensitivity scenario.
- Weekly shift rotations. The construction workforce would consist of three shifts each comprising 800 personnel. One shift will end and one shift will begin each week. Buses will transport workers directly to/from the airport to either the TWAF or mainland launch site for transfer via ferry to the Boatshed Point construction camp. The majority of these trips will occur outside site peak hours. Eighty-one way bus trips have been conservatively assumed based on the assumption that a maximum of 120 persons will be able to depart on flights from Gladstone each hour (ten of which are assumed to occur in the AM and PM site peak periods).
- Heavy vehicles. Twenty heavy vehicle movements (10 return trips) will be generated daily for delivery of food, water and other supplies. These movements will be confirmed in the traffic management plan that will be developed in consultation with Gladstone Regional Council and DTMR during the detailed design phase.
- Feed gas pipeline movement. Transport associated with the feed gas pipeline will likely be completed within a couple of weeks. Pipe will most likely be imported with pipeline for the approved Arrow Surat Pipeline. Once offloaded from cargo vessels, pipe will be either transported directly to Curtis Island or to a pipe laydown area near the tunnel launch shaft (see Figure 1.2).

The following assumptions were used for ferry movements between the mainland and Curtis Island to determine likely traffic generated by the project during AM and PM site peak periods:

- Two fast passenger ferries with up to 250 person capacity each (total 500 person capacity).
- One RoPax ferry with capacity for 200 persons and 80 vehicles.

Travel time is assumed to take 20 minutes for loading, 20 minutes transit to Curtis Island, 20 minutes for unloading, and 20 minutes to return to the mainland. Indicative daily site peak hour traffic generation is shown in Table 28.10 for the main scenario and Table 28.11 for the sensitivity scenario.

Table 28.10 Daily site peak hour traffic generation to mainland launch site (main scenario)

Arrival/Departure Time	Vehicle	Number of Persons	Trips Generated
Fast passenger ferries 1, 2 5.30 a.m.	Car	400	267 vehicle movements
RoPax ferry 5.45 a.m.	Car	160	107 vehicle movements
Fast passenger ferries 1, 2 6.30 a.m.	Car	400	267 vehicle movements
RoPax ferry 7.15 a.m.	Car	140	95 vehicle movements
	Total	**1,100**	**736 vehicle movements**
1 hour flow (60% of 2 hour flow)*			**440 vehicle movements per peak hour***

*Note that only AM site peak is presented. The PM site peak will be the same as the AM site peak as the PM travel will be the same as AM travel, only in reverse.

Table 28.11 Daily site peak hour traffic generation to mainland launch site (sensitivity scenario)

Arrival/Departure Time	Vehicle	Number of Persons	Trips Generated
Fast passenger ferries 1, 2: 5.30 a.m.	Car	400	267 vehicle movements
RoPax ferry: 5.45 a.m.	Car	160	107 vehicle movements
	Bus	500	40 bus movements*
Fast passenger ferries 1, 2: 6.30 a.m.	Car	400	267 vehicle movements
RoPax ferry: 7.15 a.m.	Car	140	95 vehicle movements
	Bus	500	40 bus movements*
Total		**1,100**	**736 vehicle movements**
		1,000	**80 bus movements**
1 hour flow (60% of 2 hour flow)			**440 vehicle movements per peak hour**
			48 bus movements per peak hour*

*Buses may not be full and could have between 10 and 15 persons per bus. Buses will travel on the RoPax and take all their passengers from the mainland launch site to Curtis Island and not return until the end of the shift.

Additional ferry trips will operate outside the site peak period. Additional trips may transport workers to site at the commencement or end of their shifts. Site peak hour trips to all destinations are shown in Table 28.12.

Table 28.12 AM and PM site peak hour traffic – all destinations (sensitivity scenario)

Scenario Options	AM Site Peak Hour Trips				PM Site Peak Hour Trips			
	Car Trips		Bus Trips		Car Trips		Bus Trips	
	In	Out	In	Out	In	Out	In	Out
Local workers to mainland launch site	440	-	-	-	-	440	-	-
TWAF to mainland launch site	-	-	48	-	-	-	-	48
Mainland launch site/TWAF to airport	-	-	10	10	-	-	10	10

Note: blanks indicate 'not applicable'.

Projected daily, weekly and annual trips for all transport types are summarised in Table 28.13.

Table 28.13 Transport scenario – peak construction phase 2016 and 2024

Transport Type	Daily	Weekly	Annually
Private car (local workers)	1,468	7,340	367,000
Bus (TWAF)	160	1,120	56,000
Bus (shift changes to airport)	80	160	8,000
Heavy vehicles to mainland launch site	20	140	7,000
Total	**1,728**	**8,760**	**438,000**

Tunnel construction personnel (100 person peak) will be accommodated in the mainland TWAF, construction camp facilities provided by third parties or, if unavailable, in other forms of temporary accommodation. Tunnel construction trips have not been specifically calculated in the assessment although the need for intersection upgrades as a result of construction traffic is addressed.

Commutes for workers on the dredgers are not included in the assessment. The 20 to 40 personnel required will be accommodated on each dredge vessel and the number of trips to and from the vessels boarding location is not significant.

Design Year 2026 – Operation Phase Workforce Transport Scenarios

The following assumptions regarding the operational workforce were used for the impact assessment:

- Five hundred eighty-five operational, security and maintenance personnel will be employed at the LNG plant site on Curtis Island. This will involve three eight-hour shifts comprising 195 personnel to cover 24 hours per day, 7 days per week operation. Shift times will include: 6.00 a.m. to 2.00p.m., 2.00 p.m. to 10.00 p.m. and 10.00 p.m. to 6.00 a.m. Twelve-hour shifts will also be considered.
- Ten personnel will be employed in the Gladstone central office (e.g., community relations personnel) working Monday to Friday from 9.00 a.m. to 5.00 p.m.
- Forty-six personnel will be employed at the mainland launch site and Curtis Island from Monday to Friday 9.00 a.m. to 5.00 p.m. Shift personnel will cover the operation of mainland launch site outside these hours.

Indicative personnel movements are set out in Table 28.14. Personnel numbers, shift times and shift make-up are indicative only and likely to be refined closer to the operation phase of the project.

Table 28.14 Operation phase – personnel movement

Road Network Time	To Mainland Launch Site		From Mainland Launch Site	
	Personnel	Trips	Personnel	Trips
5.00 a.m. to 6.00 a.m.	195 (shift 1)	130 (shift 1)	-	-
6.00 a.m. to 7.00 a.m.	-	-	195 (shift 3)	130 (shift 3)
8.00 a.m. to 9.00 a.m.	46 (9.00 a.m. to 5.00 p.m.)	31 (9.00 a.m. to 5.00 p.m.)	-	-
1.00 p.m. to 2.00 p.m.	195 (shift 2)	130 (shift 2)	-	-
2.00 p.m. to 3.00 p.m.	-	-	195 (shift 1)	130 (shift 1)
5.00 p.m. to 6.00 p.m.	-	-	46 (9.00 a.m. to 5.00 p.m.)	31 (9.00 a.m. to 5.00 p.m.)
9.00 p.m. to 10.00 p.m.	195 (shift 3)	130 (shift 3)	-	-
10.00 p.m. to 11.00 p.m.	-	-	195 (shift 2)	130 (shift 2)

Issues and Potential Impacts

Project impacts are discussed in terms of road management and safety, the road link assessment and intersection assessment.

Road Management and Safety

Potential road management and safety management issues for the project include:

- Disruption to the Gladstone road network while pipe is transported from wharves to construction laydown areas. Although pipe transportation will be completed over a short period, avoiding disruption by these heavy vehicle loads during network peak hour is of particular concern.
- Gladstone road network congestion arising from increased private vehicle traffic (local project personnel transiting to/from the mainland launch site) during site and network peak hours.

- Project traffic (particularly freight) avoidance of the Dawson Highway/Phillip Street intersection, and the Dawson Highway/Blain Drive/Herbertson Street intersection at Gladstone Regional Council request. An alternative route choice endorsed by Gladstone Regional Council utilises ring roads such as Red Rover Road, Don Young Drive and Kirkwood Drive.
- Safe access to work sites to prevent entering/exiting vehicles endangering pedestrians.
- Seasonal conditions impacting on the operation and efficiency of various modes of transport, for example, wet weather can increase both road traffic volumes (often otherwise reduced by pedestrian and cycling transport modes) and travel times due to perceived/actual safety conditions including traction and visibility.
- Bridges and unsealed roads are considered potentially vulnerable infrastructure in relation to large volumes of heavy vehicle traffic. A number of bridges along Gladstone–Mount Larcom Road have speed and load limits. Works are currently underway on a number of these bridges, which may improve load limits. Dust generation arising from any project use of unsealed roads may impact surrounding areas.
- Provision of a safe driving culture (applicable to maritime construction vessels also), including reduction of driver fatigue and zero drug and alcohol tolerance.

The project is not expected to impact on areas of natural environment within the jurisdiction of DTMR. If road or rail reserves are used for project construction activities (e.g., temporary stockpile areas) these will be rehabilitated and returned to their prior state in agreement with DTMR.

Road Link Assessment

Arrow Energy is currently evaluating the site access options for launch site 1, including the Gladstone–Mount Larcom Road and Blain Road access track. Access options for launch site 1 will be further evaluated as part of developing the detailed logistics strategy for the project.

Further, launch site 4N will be accessed via a road and services corridor to be established on the Western Basin Reclamation Area engineered containment wall from either Landing Road or Forest Road. For the purposes of the road network analysis, those roads and intersections likely to be affected by project traffic were identified. For this launch site, Forest Road and Landing Road to the Cement Australia entrance were considered relevant.

Table 28.15 summarises the outcome of the road link assessment for the Dawson Highway, Gladstone–Mount Larcom Road and Blain Road. The latter two roads provide the main travel route between TWAF 8 and launch site 1 (transport scenario 3) and launch site 4N and the airport. LOS D has been chosen to represent the level of service at which road upgrades are required. This road link has been assessed in Appendix 23, Traffic and Transport Impact Assessment and is the current preferred access option. Other road alignment options may be considered and assessed as appropriate in the future.

Table 28.15 Road link assessment

Road Section	Road Type	Design Capacity (Passenger Car Units Per Day)	2 Way Volume (Vehicles per day) – All Design Year Scenarios								Issues and Potential Impacts
			Without the project				With the project				
			2014	2016	2024	2026	2014	2016	2024	2026	
Dawson Highway											
Overall significance of impact to existing road formation			-	-	-	-	Not assessed	Low	Low	Low	
Aerodrome Road to Phillip Street	Uninterrupted, divided, 4-lane, 2-way (existing)	58,620	36,420	38,100	44,810	46,490	36,560	38,390	45,100	46,780	Dawson Highway road linkages are expected to operate within capacity for all design years.
Phillip Street to Blain Drive	Interrupted, divided, 4-lane, 2-way arterial (existing)	46,900	24,410	25,550	29,150	30,100	24,650	26,090	29,740	30,690	
Blain Drive to Hanson Road	Interrupted, divided, 4-lane, 2-way arterial (existing)	43,640	26,210	27,470	30,740	31,640	26,470	27,910	31,380	32,080	
Gladstone–Mount Larcom Road											
Overall significance of impact to existing road formation							Not assessed			High	
Red Rover Road to Blain Drive	Uninterrupted 2-lane, 2-way (existing)	12,240	**13,210**	**14,170**	**18,020**	18,990	13,270	15,640	19,490	20,460	The Reid Road to Red Rover Road section of the Gladstone–Mount Larcom Road may require upgrade to an uninterrupted, divided, 4-lane, 2-way road in 2016 as a result of
	Uninterrupted divided 4-lane, 2-way (proposed DTMR upgrade)	49,140									

Table 28.15 Road link assessment (cont'd)

Road Section	Road Type	Design Capacity (Passenger Car Units Per Day)	2-Way Volume (Vehicles per day) – All Design Year Scenarios								Issues and Potential Impacts
			Without the project				With the project				
			2014	2016	2024	2026	2014	2016	2024	2026	
Gladstone–Mount Larcom Road (cont'd)											
Reid Road to Red Rover Road	Uninterrupted 2-lane, 2-way (existing)	11,240	10,190	10,790	**13,750**	14,470	10,250	**12,260**	**15,220**	15,970	project traffic. With background only traffic, upgrades are not required until 2024. The Landing Road to Reid Road section of the Gladstone–Mount Larcom Road may require upgrade to an uninterrupted, divided, 4 lane, 2 way road in 2024 as a result of project traffic.
	Uninterrupted, divided, 4-lane, 2-way (proposed DTMR upgrade)	43,130									
Reid Road to Red Rover Road	Uninterrupted, divided, 4-lane, 2-way (existing)	10.970	7,200	7,720	9,800	10,320	7,260	9,910	**11,270**	11,790	
	Uninterrupted, divided, 4-lane, 2-way (existing)	42,340									
Blain Drive											
Overall significance of impact to existing road formation							Not assessed	Negligible	Negligible	Negligible	
Hanson Road to Dawson Highway	Uninterrupted, 2-lane, 2-way (existing)	12,620	7,150	7,540	9,179	9,570	7,610	8,640	10,270	10,670	Blain Drive is expected to operate satisfactorily for all design years.

Note: **Bold type** indicates where road capacity has been calculated above acceptable limits.

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Intersection Assessment

Table 28.16 summarises the potential impacts of intersections for which project traffic will generate a greater than 5% increase on annual average daily traffic. Where applicable, DTMR future planned upgrades are identified and their suitability to accommodate project traffic assessed. DTMR intersection upgrade plans are included in Appendix 23, Traffic and Transport Impact Assessment (Appendix E).

The DMR (2006a) assessment guidelines state that the operation of an intersection is acceptable where the DOS is less than or equal to:

- 0.90 for signalled intersections.
- 0.85 for roundabouts.
- 0.80 for unsignalled or priority controlled intersections.

The following approach has been taken when assessing impacts to intersections:

- Where the intersection operates better in the site peak period with project traffic included comparative to the background network peak period when project traffic is excluded, the impact of the project is considered manageable.
- Where the intersection does not meet levels of service for background traffic growth regardless of the project proceeding, background upgrades will be required. Where upgrades can also accommodate project traffic, the project does not propose to contribute to upgrade works.
- Where the intersection operates for background traffic, but does not operate when project traffic is included, mitigation measures (contribution to road upgrade) are proposed by the project.

For the 2026 assessment, 'early' refers to site peak periods (6.00 a.m. to 7.00 a.m. and 2.00 p.m. to 3.00 p.m.) and 'late' refers to network peak periods (8.00 a.m. to 9.00 a.m. and 5.00 p.m. to 6.00 p.m.).

Table 28.16 Intersection assessment – design years 2016, 2024 and 2026

Intersection	Design Year	Scenario	Significance of Impact	Description of Impact
A: Hanson Road/Blain Drive/Alf O'Rourke Drive	2016	All scenarios	High	The intersection exceeds capacity during the road network peak period at 2016 and 2024 when the project is considered. DTMR have identified works to this intersection; however, the project may necessitate additional works. Timing of works may need to be brought forward due to the project.
	2024	All scenarios	Moderate	
	2026	Launch site 1/4N	Low	The existing intersection layout is not expected to accommodate background traffic at design year 2026. A new intersection layout is required irrespective of the project.
B: Landing Road/ Gladstone–Mount Larcom Road	2016	Scenario 3/4	Low	The operation of the intersection is acceptable at 2016.
	2024	Scenario 3	High	The existing intersection layout is not expected to accommodate project related traffic. DTMR has identified works at this intersection (four lanes required between 2020 and 2030). Timing of DTMR works may need to be brought forward to early in the 2020 to 2030 period to accommodate project traffic.
	2026	Launch site 4N	High	

Table 28.16 Intersection assessment – design years 2016, 2024 and 2026 (cont'd)

Intersection	Design Year	Scenario	Significance of Impact	Description of Impact
C: Gladstone–Mount Larcom/ Red Rover Road	2016	Scenario 3/4	Moderate	The existing layout cannot support project traffic. DTMR have identified works to this intersection however, the project may necessitate additional works. Timing of works may need to be brought forward due to the project.
	2024	Scenario 3	High	
	2026	Launch site 4N	Low	
D: Gladstone–Mount Larcom Road/Reid Road	2016	Scenario 3/4	Negligible	The intersection is capable of accommodating project traffic during all design years.
	2024	Scenario 3	Negligible	
	2026	Launch site 4N	Negligible	
E: Dawson Highway/ Blain Drive/ Herbertson Street	2016	All scenarios	Low	Upgrade works are proposed by DTMR/Gladstone Regional Council for the network peak period. The existing intersection form is anticipated to accommodate project traffic.
	2024	All scenarios	Low	
	2026	Launch site 1/4N	Low	The existing intersection is not expected to accommodate background traffic at design year 2026, irrespective of the project.
L: Dawson Highway/ Aerodrome Road	2016	All scenarios	Moderate	The existing intersection layout is expected to accommodate project traffic, as traffic will mostly operate outside network peak times. Intersection works for background traffic are required irrespective of the project.
	2024	All scenarios	Moderate	
Q: Gladstone Port Access Road/ Glenlyon Road/ Railway Street	2016	All scenarios	Low	The intersection is capable of accommodating project traffic during all design years.
	2024	All scenarios	Low	
	2026	Launch site 1/4N	Low	
R: Glenlyon Road/ Bramston Road	2016	All scenarios	Moderate	Upgrades are being undertaken irrespective of the project. While the existing intersection is not sufficient to accommodate network peak volumes, lower project traffic at site peak times means the intersection is sufficient for project purposes.
	2024	All scenarios	Moderate	
	2026	Launch 1/4N	Moderate	
T: Hanson Road/Lord Street	2016	All scenarios	Low	The intersection is capable of accommodating project traffic during all design years.
	2024	All scenarios	Low	
	2026	Launch site 1/4N	Low	

A new intersection will also be required accessing the proposed tunnel entry site from Mount Larcom–Gladstone Road. The intersection will be designed to meet relevant safety standards.

28.4.2 Rail Network

Arrow Energy is investigating opportunities to utilise rail infrastructure for the transport of project personnel and goods. At this stage, no specific use of rail has been identified and is consequently not assessed in this EIS. The potential for use of rail by the project will be confirmed in the logistics strategy.

Rail transport has currently not been proposed for use in the construction and operation of the Arrow LNG Plant either for the transport of materials or the workforce and consequently, no impacts are expected to rail transport and services. The project is not expected to generate impacts related to safety, dust, noise or vibration along rail corridors.

Project traffic is not expected to cause any interruptions to rail operations. The presence of signalled level crossings means rail traffic will take precedence over road traffic. Vehicle movements associated with the project will be interrupted, rather than rail operations.

No alterations to rail infrastructure are proposed by the project. The sensitivity of the rail network in this context is low and magnitude of impacts is also low. Overall, the significance of impact of the project on the rail network is negligible.

28.4.3 Air Services

Table 28.17 shows projected air travel requirements associated with the project for each project phase. Due to recent upgrades, the Gladstone Airport runway and terminal now has a projected life of 10 to 12 years and no additional infrastructure upgrades are required.

The peak construction phase produces the greatest demand for air services. Assuming 800 persons are flying in and 800 persons are flying out each week, this would equate to an additional 22 QantasLink Q400 flights per week (11 arriving and 11 departing, each carrying 74 passengers) or 1,144 QantasLink Q400 flights per year. If a larger aircraft were used, i.e., Boeing 737, this would half the number of flights required for the project. The potential for charter flights to maintain crew change rosters may be considered, if required.

Table 28.17 Projected project air traffic requirements

Project Phase	Air Travel Requirements
Design year 2014: early construction	• 157 Curtis Island construction personnel arriving per week.[1] • 157 Curtis Island construction personnel departing per week. • 40 additional return flights a week (average) of various project personnel (Brisbane based Arrow Energy/EPC managers and staff, specialist consultants, environmental specialists, etc.).
Design year 2016/2024: peak construction phase	• 800 Curtis Island construction personnel arriving per week.[2] • 800 Curtis Island construction personnel departing per week. • 30 additional return flights per week (average) of various project personnel (Brisbane based Arrow/EPC managers and staff, specialist consultants, environmental specialists, etc.).
Design year 2026: post construction and operation phase	• 30 additional return flights a week (average) various project personnel (Brisbane based Arrow staff, specialist consultants). • Short periods of high influx of staff for major and minor maintenance activities. Maintenance of gas turbines will require 200 to 300 personnel every two to three years. Maintenance of LNG trains will require 300 to 500 personnel every five to six years.

[1] This assumes the 470 external workers comprise three shifts of 157 persons with one shift change per week.

[2] This assumes the workforce comprises three shifts each comprising 800 personnel with one shift change per week.

Note that the projected construction workforce for 2024 (construction of trains 3 and 4) is lower than that required for construction of trains 1 and 2 (i.e., design year 2016), therefore 2016 is taken to be the more conservative estimate.

In 2010/11, Gladstone Airport accommodated 5,717 aircraft movements or 240,275 passenger movements. The Gladstone Airport Development Plan currently forecasts a median growth scenario of 19,260 aircraft movements by 2027/28 or 872,300 passenger movements. At 2023/24, the plan indicates 736,500 passenger movements. This suggests the airport will have capacity at 2024 to accommodate an additional 135,800 personnel movements, which is

approximately 1,950 QantasLink Q400 flights. Market forces will drive the provision of additional flights. If required, demand will be met either by the use of larger planes or more frequent flights.

Overall air services for Gladstone will improve with the acquisition of a new instrument landing system (contributed to by LNG proponents). The improvements will reduce the likelihood that the arrival and departure of the construction workforce will be disrupted by adverse weather conditions.

The sensitivity of air services is low given Gladstone Airport's capacity to accommodate additional flights. The magnitude of the impact is also low. Overall, the significance of impacts on air services arising from project transportation requirements is negligible.

28.4.4 Alternative Local Transport

This section describes potential impacts from project activities to bus passenger services, taxi services and local pedestrian and cycle networks.

Bus Passenger Services

The specific impacts of project traffic on bus routes are yet to be determined. The potential for congestion will be investigated when a detailed traffic management plan is prepared following the selection of the final TWAF and mainland launch site location.

Arrow Energy will provide buses to cater for all project related transport needs of construction personnel. There may be a small increase in demand for Buslink passenger services associated with families of personnel, who relocate to Gladstone to work on the project.

Taxis

Work transport needs for construction personnel will be provided by Arrow Energy. Construction staff will occasionally utilise taxi services for recreational purposes. Similarly, the dependants of project personnel, who relocate to Gladstone, may also call upon the use of taxis. A rise in the demand of services may create a commercial opportunity for taxi service providers.

Pedestrian and Cycling Network

Traffic from the project is not expected to have a direct impact on the operation of pedestrian or cycling networks. Increased road traffic can reduce safety. Measures to maximise safety will be included in the detailed traffic management plan.

The overall sensitivity of alternative local transport services in the Gladstone region is moderate. The magnitude of impacts on these services is low. Overall, the significance of impacts from the project on alternative local transport requirements is low.

28.4.5 Shipping

The following section describes the types of marine vessels that will be used during design years 2016 (peak construction) and 2026 (post construction/operation), the navigational procedures that will be put in place around these vessels, and the potential impacts of vessel operation on other harbour users.

Design year 2024 has not been described as vessel numbers are expected to fall somewhere between the peak construction estimate at 2016 and that of the operation of all four LNG trains at 2026.

Design Year 2016: Peak Construction

Marine Vessels

Table 28.18 sets out the estimated type, number and frequency of marine vessels required for the construction of the first two LNG trains. Vessels will typically perform one of three functions: (i) transport the construction workforce and goods to the LNG plant site on Curtis Island, (ii) deliver imported construction materials and/or prefabricated LNG plant components direct from overseas ports, (iii) undertake dredging activities associated with shipping access to LNG jetty, MOF and passenger jetty and the mainland launch site.

Table 28.18 Estimated type, number and frequency of marine vessels – peak construction

Type	Indicative Description	Indicative Frequency
Fast Cat ferry	High speed people movers with a capacity of up to 200 to 250 people; up to four fast passenger ferries will be required during construction.	38 trips per day[a]
RoPax ferry	Roll-on, roll-off ferry approximately 80 m long with a capacity of 200 people and 80 cars.	18 trips per day[a]
Barges[b]	Typically 80 m long and 20 m wide with a capacity of 5,000 to 6,000 m^3. Require tugs to manoeuvre. Will be used to transport bulk materials.	60 to 70 trips per year
Heavy purpose cargo vessels[c]	Capable of transporting modules and major components (gas turbines, cryogenic heater exchanger, acid gas removal absorption column and refrigerant storage spheres) to the MOF on Curtis Island.	30 to 40 deliveries in total
Cutter suction dredging vessel	Size and specifications will not be determined until closer to construction.	To be confirmed[d]
Support vessel	Medium sized support vessel.	To be confirmed[d]
Backhoe dredging barge	Size and specifications will not be determined until closer to construction.	To be confirmed[d]
Backhoe dredger support tugs	Standard tugs.	To be confirmed[d]

[a]Indicative ferry movement assuming worst-case scenario for transferring 2,100 personnel on a daily basis, based on a staggered shift arrangement.

[b]Barges and heavy purpose vessels may be engaged on an ad-hoc basis or chartered.

[c]Alternatively, ships might be roll-on, roll-off vessels.

[d]Frequency of dredge vessels (including tugs and support vessels) will be specified in the dredge management plan.

Construction Management

An LNG Maritime Movement Scheduling Committee has been established to manage the movement of marine construction traffic within the harbour. Membership of the committee comprises the Regional Harbour Master, Maritime Safety Queensland, LNG proponents and other authorities as the Regional Harbour Master deems necessary. Marine construction traffic must also have regard to the Maritime Queensland's standard for marine construction activities in Gladstone Harbour (MSQ, 2011b).

Design Year 2026 – Post Construction/Operation Marine Vessels

Marine Vessels

The number of LNG carriers required to export LNG will vary depending on the type and size of the vessel, which is still to be determined. Table 28.19 details the number of LNG carriers required for two and four LNG trains. Table 28.20 sets out the estimated type, number and frequency of other marine support vessels required to service LNG plant operation on Curtis Island.

Table 28.19 LNG carrier movements

LNG Carrier Type and Nominal Capacity	Two LNG Trains		Four LNG Trains	
	LNG Carriers per Week	LNG Carriers per Year	LNG Carriers per Week	LNG Carriers per Year
Membrane design 145,000 m^3	2 to 3	120	4 to 5	240
Membrane design 215,000 m^3	1 to 2	88	3 to 4	176

Table 28.20 Estimated type, number and frequency of marine vessels – operation

Type	Indicative Description	Frequency
Fast passenger ferry	High-speed people movers with a capacity of 200 to 250 people.	Up to 6 return trips per day.
RoPax ferry	Roll-on, roll-off ferry approximately 80 m long with a capacity of 200 people and 80 cars.	Up to 6 return trips per day.
LPG vessel	Unknown.	1 return trip in the first year of operation.
Barge/cargo vessels	Unknown.	Occasional deliveries of fuel, lubricants, equipment and plant required for maintenance activities direct to MOF.
LNG escort tug	70 to 80 t bollard pull tugs.	960 per year (based on 240 LNG carriers per year).

LNG Carrier Protocols

LNG carriers transiting to and from the Arrow LNG jetty will be required to comply with LNG protocols developed by MSQ, which currently consider:

- LNG carrier transits will be programmed through the Clinton Bypass Channel. LNG carriers will approach the Clinton Bypass Channel via the Wild Cattle, Boyne, Golding, Gatcombe and Auckland channels. LNG carriers must advise their estimated time of arrival and departure as soon as possible and confirm 48 hours prior to arrival.
- Pilots will undertake LNG simulation training prior to the arrival of the first LNG carrier. Pilots will embark the LNG carriers to the seaward of the Fairway Buoy. Two pilots will be on board the LNG carrier during the first six months, after which this practice will be reviewed. LNG carriers will also be restricted to daylight movement during the first six months, extended to night-time once a safety review has been completed.
- Tug masters will undertake LNG simulation training prior to the arrival of the first LNG carrier. Two escort tugs will join the inbound LNG carrier or be released from an outbound LNG carrier in the vicinity of the Fairway Buoy. An additional two tugs will join the inbound carrier or be released from the outbound carrier near the G4 buoy/Boynes Wharf. Speeds may range up to 10 knots.
- The LNG jetty is expected to be orientated parallel to the channel on a 135°/315° berthing line. A safety exclusion zone of 250 m out from the centre of the jetty will be in place around docked LNG carriers. Gas detectors on the LNG jetty compliment the safety exclusion zone.
- The operation of LNG carriers within the Port of Gladstone will comply with industry recommendations as agreed by Maritime Safety Queensland and the requirements of the port procedure manual.

- No passing will take place between LNG carriers and vessels carrying dangerous goods or deep-draught vessels transiting channel areas.
- LNG carriers use escort tugs and transit at 10 knots water speed. A set minimum 30-minute separation distance, based on the stopping distance of a typical LNG ship travelling at 12 knots, will be enforced for ships entering or leaving the port.
- Separation between LNG carrier and non-LNG carriers will be in accordance with the port procedures manual. LNG carriers will be classified similar to Panamax Class vessels in that the draught of the vessel and escort tug assistance allows for the option of safely aborting the transit at a number of locations.
- A minimum under-keel clearance of 1.2 m shall be retained throughout vessel arrivals and departures (minimum deemed satisfactory for swinging on arrival and departure for vessels with draughts up to 12.0 m).
- LNG carriers will not transit in or out of the harbour in wind speed conditions in excess of 25 knots, wave heights in excess of 2.5 m, or minimal visibility of 0.5 nautical miles.
- A tug with full fire fighting capability will be on standby while an LNG carrier is at berth at the Arrow LNG jetty.
- Loading of stores (e.g., food supplies) onto LNG carriers will be permitted at the LNG jetty, but only before or after loading. Bunkering (i.e., refuelling) of LNG carriers will not be permitted.

These LNG protocols will be reviewed periodically. Operational performance and experience may lead to the refinement of rules or the introduction of further rules as required.

Shipping Route

The indicative route for LNG carriers travelling from Gladstone to Asia uses the recommended outer shipping channel within the Great Barrier Reef Marine Park. The initial track from the Gladstone pilot station is 47 nautical miles southeasterly 100°T following through south of the Bunker Group islands. Keeping clear of Lady Elliot reef, the course is altered passing the light abeam to ExN 074°T for 7 nautical miles to clear the reef. Once clear, the track leads in northeasterly 036°T for 150 nautical miles toward Lady Musgrave light. The coastal passage to the outer channel can be executed in all weather and visibility.

Issues and Potential Impacts

Issues and impacts are discussed in relation to shipping and foreshore accidents, impacts on existing shipping activity, potential risk of spills and impacts on recreational activities.

Shipping Accidents

The principal scenarios that could arise include:

- Collision with another vessel in transit.
- Allision (i.e., collision with a static object) of a vessel with a carrier at berth.
- Grounding.

To result in a major gas release, a collision, allision or grounding would have to occur with sufficient force to perforate the outer hull, inner hull and membrane containment tank would be perforated. This is only possible by a large ship impacting at a speed with a significant collision angle or grounding on rock at speed. Findings of the Gladstone marine hazard identification study (ELP, 2010b) concluded:

- A collision between two LNG carriers in the channel is a non-credible event due to strict passing rules. Sufficient tug escort will not be available to enable two LNG carriers to transit within the harbour at any one time.
- A collision between an LNG and LPG vessel is a non-credible event as the presence of both an LNG and LPG vessel in port at the same time could only result from major human error on behalf of numerous people.
- Groundings of an LNG carrier in the vicinity of the LNG jetty (and therefore gas release) are extremely unlikely. The vessel will be travelling slowly under escort of four tugs on its final manoeuvring.
- Allision between an LPG carrier and an LNG carrier at the LNG jetty has a low probability due to the significant distance between the channel and the berth.

The Gladstone marine hazard identification study also noted that no other deep-draught vessels, e.g., coal carriers, will be in the channel at the same time as an LNG carrier.

The risk of a shipping accident involving an LNG carrier is low. Simulations indicate low risk of foreshore damage arising from berthing activities at the LNG jetty due to the low speed of approach of LNG carriers and their tug escort.

Further discussion of the hazards and risks of shipping incidents is included in Chapter 29, Hazard and Risk.

Existing Shipping Activities

The standard for marine construction activities (MSQ, 2011b) sets out safety requirements for marine construction traffic operating within the harbour. The LNG Maritime Movement Scheduling Committee has been established to manage marine construction traffic movements. The risk of construction vessel movements impacting the port is low.

The risk of LNG shipping activities affecting other operational activities of the port is low. Since 2004, a simulation model of the shipping operations at the Port of Gladstone has been used to analyse the performance of the port under various trade, channel and berth configurations (AECOM, 2010). Gladstone Ports Corporation has examined LNG trading scenarios for the four LNG proponents (GLNG, QCLNG and APLNG projects and the Arrow LNG Plant) using this model, and the proponents have jointly commissioned a due diligence report on the model and findings. Results indicate channel infrastructure is likely to be sufficient to maintain existing port performance subject to management of port movements via scheduling.

LNG carriers transiting to Arrow Energy's LNG jetty will give advance notice of arrival dates and will time vessel arrivals for allotted time slots for entry into the port. LNG carrier arrival times are very accurate. LNG vessels have the advantage of being able to enter the port on all tide conditions, which also aids overall port scheduling. Coal carriers (which, in 2009/10 financial year accounted for around 53% of vessel movements in the port) typically only depart the port on high tide. Gladstone Ports Corporation will continue to refine the simulation model with input from the LNG proponents.

Potential Spills

The main risk of a potential spill occurring is at the LNG jetty, as the risk of an LNG carrier collision or grounding during harbour transit it low.

The risk of LNG spills during loading/unloading of LNG carriers is low. Equipment monitoring systems and automatic shutdown functions at the LNG jetty will see the system shut down rapidly in the event of a spill. Any residual spill will evaporate by the time it reaches the edge of the 250 m safety exclusion zone.

There is no risk of fuel spill as bunkering (refuelling) will not be permitted at the LNG Jetty.

Further discussion of the risks of spills at the LNG jetty is included in Chapter 29, Hazard and Risk.

Recreational Activities

Safety exclusion zones around the LNG jetty will not impede the passage of recreational boats in adjacent shipping channels while LNG carriers are at berth. Users of recreational boats may occasionally experience delays of up to 30 minutes when LNG vessels are swinging as the swing basin extends across the shipping channel. The overall impact to recreational vessels in Port Curtis is low.

28.5 Avoidance, Mitigation and Management Measures

Avoidance, mitigation and management measures for each mode of transport are described below. These measures will be reassessed upon completion of the detailed logistics strategy for the project.

28.5.1 Road Network

The following mitigation measures will be adopted:

- Develop a traffic management plan for the project in consultation with DTMR and Gladstone Regional Council. Methods to ensure public safety at project sites, avoid obstruction to other road users, address seasonal weather influences on transport arrangements and manage any issues including driver fatigue will be detailed in the plan. The traffic management plan will address the movement of oversized loads. [C28.01]
- Undertake a pavement intersection assessment and bridge capacity assessment when preferred transport routes are identified. [C28.02]
- Implement a formal local workforce car-pooling or busing strategy to minimise the number of local project personnel using the roads during peak hour and maximise usage of accommodation on Curtis Island. A busing strategy may comprise a number of small buses travelling from areas central to where personnel live. A staff-matching or car-pooling strategy will also be considered [C28.03]
- Use DTMR/Gladstone Regional Council preferred freight routes where practical. [C28.04]
- Separate pedestrian access from vehicle access, in access to construction and operational work sites (where practical). [C28.05]
- Consult DTMR and Gladstone Regional Council on the scope and timing of already identified upgrades and project-specific upgrades (including potential contributions) that may be required when final routes for freight and workforce bus routes are confirmed. This process will take place during the preparation of the Traffic Management Plan and may include, subject to final TWAF/mainland launch site selection, and completion of the detailed logistics strategy:
  - Timing of Gladstone–Mount Larcom Road upgrades and whether upgrades need to be brought forward.

– Design of a new intersection accessing the proposed tunnel entry site from Gladstone–Mount Larcom Road.

– Intersection A: Hanson Road/Blain Drive/Alf O'Rourke Drive (all transport scenarios). DTMR have identified works to this intersection; however, the project may necessitate additional works. Timing of DTMR works may need to be brought forward.

– Intersection B: Gladstone–Mount Larcom Road/Landing Road (transport scenario 3). The existing intersection layout is not expected to accommodate project related traffic at 2024 and 2026. DTMR has identified works at this intersection (four lanes required between 2020 and 2030). Timing of DTMR works may need to be brought forward to early in the 2020 to 2030 period to accommodate project traffic.

– Intersection C: Gladstone–Mount Larcom/Red Rover Road (transport scenario 3). DTMR have identified works to this intersection; however, the project may necessitate additional works. Timing of works may need to be brought forward due to the project. [C28.06]

28.5.2 Rail Network

The use of rail has not been considered in this EIS and currently the project is not expected to generate rail related impacts. However, the option to use rail may be identified in the logistics strategy and will be assessed as appropriate at that time.

28.5.3 Air Services

The following actions will be implemented:

- Consult with providers of air services to Gladstone on the timing of construction and operation weekly shifts to aid commercial decision making by service providers on the frequency of services and capacity of aircraft. [C28.07]
- Provide a share of funding toward the new instrument landing system at Gladstone Airport upon project FID. [C28.08]

28.5.4 Alternative Local Transport

No specific mitigation measures for alternative local transport have been included as project impacts have been assessed as low. Mitigation measures to address increasing demands on social infrastructure arising from movement of personnel and families to Gladstone are set out in Chapter 26, Social, and Attachment 7, Social Impact Management Plan.

28.5.5 Shipping

Health, safety and environmental requirements for marine vessels and crews during construction and operation will be developed during the front-end engineering design (FEED) phase in consultation with GPC and MSQ. The following actions will be implemented to minimise impacts associated with marine construction traffic and LNG shipping operations:

- Develop a shipping activity management plan in consultation with Gladstone Regional Council, Gladstone Ports Corporation, Maritime Safety Queensland and all contractors operating within the Gladstone Port. [C28.09]
- Operators of project vessels, Arrow Energy staff and contractors to comply with the port procedures manual (MSQ, 2010), which details LNG operating parameters. [C28.10]
- Ensure that operators of project vessels, Arrow Energy staff and contractors comply with the LNG marine operations maritime safety management plan if/when this plan is agreed between

Maritime Safety Queensland, Gladstone Ports Corporation and the other LNG proponents. [C28.11]

- Ensure that operators of project vessels, Arrow Energy staff and contractors comply with Arrow Energy rules for marine vessels and LNG shipping operations in addition to following the Oil Companies International Marine Forum (OCIMF) and Society of International Gas Tanker and Terminal Operators guidelines (SIGTTO). Rules will address crew competencies, a three stage approvals process for each LNG vessel (i.e., vetting of ships and operators prior to engagement to transport LNG), scheduling and other requirements and quality assurance. For the construction period, additional rules will address safety and competency requirements of smaller marine vessels and vessel operators involved with the project. [C28.12]
- Provide support for tug and LNG carrier pilot training organised by all proponents, the Gladstone Ports Corporation, Maritime Safety Queensland and SMIT tugs. [C28.13]

28.6 Residual Impacts

The following section describes the residual impacts of the project assuming traffic and transport mitigation measures are applied.

The residual impacts of shipping, and of project activities on air and alternative transport services, are of low or negligible significance prior to mitigation and have therefore not been assessed further. The significance of these impacts will be reviewed upon completion of the detailed logistics strategy for the project. Consequently, only the residual impacts on roads are presented in Table 28.21.

The implementation of planned and project related road and intersection upgrades will reduce the significance of project impacts to low in most cases and have the benefit of improving road network capacity in the Gladstone region. The Dawson Highway/Aerodrome Road intersection is an exception. Project traffic does not warrant the upgrade of this intersection, although it remains a moderate impact on the basis that there are presently no planned DTMR upgrades to this intersection.

Table 28.21 Traffic and transport residual risk assessment

Road/Intersection	Design Year	Scenario	Significance of Impact	Mitigation	Residual Significance of Impact
Gladstone–Mount Larcom Road link	2016	Reid Road to Red Rover Road section	Major	Bring forward intended DTMR upgrade	Low
	2024		Major		Low
	2036		High		Low
Intersection A: Hanson Road/ Blain Drive/Alf O'Rourke Drive	2016	All scenarios	High	Bring forward DTMR upgrade with a revised layout to accommodate project traffic	Low
	2024	All scenarios	Moderate		Low
Intersection B: Landing Road/ Gladstone–Mount Larcom Road	2024	Scenario 3	High	Bring forward DTMR works to early in the planned period 2020 to 2030.	Low
	2026	Launch 4N	High		Low

Table 28.21 Traffic and transport residual risk assessment (cont'd)

Road/Intersection	Design Year	Scenario	Significance of Impact	Mitigation	Residual Significance of Impact
Intersection C: Gladstone–Mount Larcom/ Red Rover Road	2016	Scenario 3/4	Moderate	Bring forward DTMR works/undertake temporary works with a layout consistent with ultimate intersection layout	Low
	2024	Scenario 3	High		Low
Intersection L: Dawson Highway/ Aerodrome Road	2016	All scenarios	Moderate	Seek where possible to transport personnel to the airport outside peak hour.	Moderate
	2024	All scenarios	Moderate (all scenarios)		Moderate
Intersection R: Glenlyon Road/ Bramston Road intersection	2016	All scenarios	Moderate	Bring forward DTMR upgrade with a revised layout to accommodate project traffic.	Low
	2024	All scenarios	Moderate		Low
	2026	All scenarios	Moderate		Low

28.7 Inspection and Monitoring

Inspection activities will focus on staff and contractor compliance with relevant procedures in various plans and documents including:

- Traffic management plan for the project.
- Port procedures manual (MSQ, 2010).
- LNG marine operations maritime safety management plan (if agreed).
- Arrow Energy rules for marine vessels and LNG shipping operations.

28.8 Commitments

The measures (commitments) that Arrow Energy will implement to manage impacts on traffic and transport are set out in Table 28.22.

Table 28.22 Commitments: Traffic and transport

No.	Commitment
C28.01	Develop a traffic management plan for the project in consultation with DTMR and Gladstone Regional Council. Methods to ensure public safety at project sites, avoid obstruction to other road users, address seasonal weather influences on transport arrangements and manage any issues including driver fatigue will be detailed in the plan. The traffic management plan will address the movement of oversized loads. Common with Chapter 29, Hazard and Risk.
C28.02	Undertake a pavement intersection assessment and bridge capacity assessment when preferred transport routes are identified.
C28.03	Implement a formal local workforce car-pooling or busing strategy to minimise the number of local project personnel using the roads during peak hour and to maximise usage of accommodation on Curtis Island. A busing strategy may comprise a number of small buses travelling from areas central to where personnel live. A staff matching or car pooling strategy will also be considered.
C28.04	Use DTMR/Gladstone Regional Council preferred freight routes where practical.
C28.05	Separate pedestrian access from vehicle access in access to construction and operational work sites (where practical).

Table 28.22 Commitments: Traffic and transport (cont'd)

No.	Commitment
C28.06	Consult DTMR and Gladstone Regional Council on the scope and timing of already identified upgrades and project specific upgrades (including potential contributions) that may be required when final routes for freight and workforce bus routes are confirmed. This process will take place during the preparation of the detailed traffic management plan for the project and may include, subject to final TWAF/mainland launch site selection and completion of the detailed logistics strategy: • Timing of Gladstone–Mount Larcom Road upgrades and whether upgrades need to be brought forward. • Design of a new intersection accessing the proposed tunnel entry site from Gladstone–Mount Larcom Road. • Intersection A: Hanson Road/Blain Drive/Alf O'Rourke Drive (all transport scenarios). DTMR have identified works to this intersection; however, the project may necessitate additional works. Timing of DTMR works may need to be brought forward. • Intersection B: Gladstone–Mount Larcom Road/Landing Road (transport scenario 3). The existing intersection layout is not expected to accommodate project related traffic at 2024 and 2026. DTMR has identified works at this intersection (four lanes required between 2020 and 2030). Timing of DTMR works may need to be brought forward to early in the 2020 to 2030 period to accommodate project traffic. • Intersection C: Gladstone–Mount Larcom/Red Rover Road (transport scenario 3). DTMR have identified works to this intersection; however, the project may necessitate additional works. Timing of works may need to be brought forward due to the project.
C28.07	Consult with providers of air services to Gladstone on the timing of construction and operations weekly shifts to aid commercial decision making by service providers on the frequency of services and capacity of aircraft.
C28.08	Provide a share of funding toward the new instrument landing system at Gladstone Airport upon project FID.
C28.09	Develop a shipping activity management plan in consultation with Gladstone Regional Council, Gladstone Ports Corporation, Maritime Safety Queensland and all contractors operating within the Gladstone Port. Common with Chapter 29, Hazard and Risk.
C28.10	Operators of project vessels, Arrow Energy staff and contractors, to comply with the Gladstone port procedures manual, which details LNG operating parameters.
C28.11	Ensure that operators of project vessels, Arrow Energy staff and contractors comply with the LNG marine operations maritime safety management plan if/when this plan is agreed between Maritime Safety Queensland, Gladstone Ports Corporation and the other LNG proponents. Common with Chapter 29, Hazard and Risk.
C28.12	Ensure that operators of project vessels, Arrow Energy staff and contractors comply with Arrow Energy rules for marine vessels and LNG shipping operations in addition to following the Oil Companies International Marine Forum (OCIMF) and Society of International Gas Tanker and Terminal Operators guidelines (SIGTTO). Rules will address crew competencies, a three stage approvals process for each LNG vessel (i.e., vetting of ships and operators prior to engagement to transport LNG), scheduling and other requirements and quality assurance. For the construction period, additional rules will address safety and competency requirements of smaller marine vessels and vessel operators involved with the project.
C28.13	Provide support for tug and LNG carrier pilot training organised by all proponents, the Gladstone Ports Corporation, Maritime Safety Queensland and SMIT tugs.